OPENING THE PATENT SYSTEM: DIFFUSIONARY LEVERS IN PATENT LAW

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ABSTRACT

The patent system uses exclusion to stimulate innovation. But a mounting body of evidence calls into question the assumption that innovation based on excluding others is the only, or even primary, way that the patent system supports innovation today. Nearly 50 percent of manufacturers got the idea for their most important new product from an outside source that shared it with them, 45–59 percent of patentees acquire patents in order to access the technology of others, and over 2,100 companies, including five of the top ten holders of patents, have committed to sharing their patents with others.[1] But because the essence of a patent is the right to exclude, policymakers have paid relatively less attention to ways in which patents can be used to include and to diffuse technology. This paper focuses on the ways that innovators are modifying the patent system's exclusionary defaults, employing open source approaches, licenses, pledges, contracts, defensive publication and patenting, and

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1. *See infra* notes 34, 38, 210 and accompanying text.

related mechanisms to share innovation—including with their rivals. This Article advocates supporting and encouraging, rather than just tolerating these uses of the patent system, for several reasons. First, as innovation takes place in open and closed modes, the patent system can increase its relevance to all types of innovation. Second, weaknesses in voluntary diffusionary arrangements—for example, the lack of enforceability of patent pledges or open source commitments, the use of patents subject to licensing commitments to seek injunctions, and the use of once-defensive patents for patent assertion —suggest that the policy environment for innovation could be improved. Finally, providing ways for patent holders to take voluntary steps to curtail or limit their rights can offer a more flexible and predictable framework for rebalancing the patent system than measures like imposing limits on patentable subject matter or compulsory licensing.

This Article recommends reorienting the patent system to better support open innovation models. Making it easier to waive and rely on waivers of patent rights, for example in support of open source strategies, by making it easier to record pledges, creating an "open" or "defensive-only" patent option that allows patentees to pay discounted maintenance fees in exchange for giving up offensive rights, or allowing patentees to give up certain rights while retaining others, akin to "license of right" schemes in the United Kingdom and Germany, could improve sharing and the freedom to operate. Making it easier to place inventions in the public domain through effective defensive publication and a change in the default regarding patent publication would encourage earlier dissemination of information. So would setting defaults so that provisional applications are open rather than closed to the public and utility applications publish upon filing rather than after an eighteen-month delay. Improving reporting and discovery of patent information, including ownership, availability for licensing, patent licenses, and standards commitments, could boost markets for technology transfers.

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INTRODUCTION

On June 12, 2014, Elon Musk, CEO of Tesla, published a blog post, "All Our Patent Are Belong to You."[2] In it, he announced that Tesla would, "in the spirit of the open source movement," make its patents freely

2. Elon Musk, *All Our Patent Are Belong to You*, TESLA: BLOG (June 12, 2014), https://www.teslamotors.com/blog/all-our-patent-are-belong-you.

available.[3] The real competition was not the "small trickle of non-Tesla electric cars," but the "enormous flood of gasoline cars pouring out of the world's factories every day."[4] By making its technology available, the company hoped to advance electric vehicle technology to benefit all.[5]

Like the meme that inspired the post's title,[6] the announcement engendered admiration, imitation, and confusion. Was Musk's move altruistic, about saving the planet, or shrewd, about driving adoption of Tesla's technology to achieve market dominance?[7] Was it a marketing gimmick or a naïve and self-destructive act, "damag[ing] the value of the embedded option" central to Tesla's valuation?[8]

Why the strong response? It is because people are used to thinking that excluding—rather than including—rivals in the practice of one's technology leads to innovation.[9] The Constitution enshrines this idea, authorizing Congress "[t]o promote the Progress of Science and useful Arts, by securing . . . to . . . Inventors the *exclusive Right* to their . . . Discoveries."[10] As the Supreme Court has added, "[T]he essence of a patent grant is the right to *exclude others*."[11] The importance of exclusion is deeply ingrained in property theory, providing owners with the

3. *Id.*

4. *Id.*

5. *Id.*

6. "All your base are belong to us" is a poor "Engrish" translation of a Japanese phrase meaning "all of your bases are now under our control" that was featured in the introduction to a Japanese video game called Zero Wing. *All Your Base Are Belong to Us*, KNOW YOUR MEME, http://knowyourmeme.com/memes/all-your-base-are-belong-to-us (last updated Apr. 16, 2015).

7. Serguei Netessine & Karan Girotra, *Tesla Goes Big, Not Home*, HARV. BUS. REV. (June 17, 2014), https://hbr.org/2014/06/tesla-goes-big-not-home.

8. Tech Equity Strategies, *Did Tesla's Actions in Detroit Put Its Patents in the Public Domain? Why Investors Should Worry*, SEEKING ALPHA (Feb. 15, 2015, 5:40 AM), http://seekingalpha.com/article/2918086-did-teslas-actions-in-detroit-put-its-patents-in-the-public-domain-whyinvestors-should-worry.

9. The role of exclusion in the patent system has been the subject of a number of recent scholarly articles. *See, e.g.*, Amy Kapczynski & Talha Syed, *The Continuum of Excludability and the Limits of Patents*, 122 YALE L.J. 1900 (2013) (articulating the concept of an excludability continuum); Oskar Liivak, *Rethinking the Concept of Exclusion in Patent Law*, 98 GEO. L.J. 1643 (2010) (examining the benefits of limiting patent law's broad exclusion to actual copying, as in copyright law); Adam Mossoff, *Exclusion and Exclusive Use in Patent Law*, 22 HARV. J.L. & TECH. 321 (2009) (using a historical lens to examine the "exclusion concept" in patent law as distinct from the larger set of "exclusive rights" traditionally associated with property that also include the positive rights of use and possession).

10. U.S. CONST., art. I, § 8, cl. 8 (emphasis added).

11. Dawson Chem. Co. v. Rohm & Haas Co., 448 U.S. 176, 215 (1980) (emphasis added). *Accord* Bloomer v. McQuewan, 55 U.S. (14 How.) 539, 548 (1852) ("[T]he patent . . . consists altogether in the right to exclude . . . . ").

incentive to preserve and utilize property more efficiently.[12]

Tesla's move turned this logic on its head. Instead of discouraging imitation, it encouraged it. Instead of excluding its rivals, Tesla found that diffusing its technology to them was in its self-interest, potentially paving the way for its use of rival's patents. Following the announcement, BMW, Nissan, and Tesla, who together make the majority of the world's electric-car batteries, expressed desires to collaborate on global vehicle-charging standards.[13] Later, Toyota announced that it would open its hydrogen-car patents.[14] Sharing has not been limited to electric cars. Following Toyota's announcement, LG Corporation announced that it would share 29,000 patents with small- and medium-sized companies and make another 3058 patents freely available to start-ups.[15] Panasonic moved to open its source code, technology, and patents in order to expedite research and development ("R&D") of the "Internet of Things."[16] A branch of the conglomerate Daewoo announced that it would share "patents and knowhow relating to liquefied natural gas (LNG) engine technology with local businesses," and a number of other Korean firms, including Samsung, Hyundai Motor, and Lotte have announced plans to launch open-innovation hubs.[17] Companies like Google, Facebook and Blockstream have announced that they are developing technology in the open in areas like three-dimensional printing, bitcoin, drones,[18] and artificial intelligence,[19]

12. *See, e.g.*, Harold Demsetz, *Toward a Theory of Property Rights*, 57 AM. ECON. REV. 347, 356 (1967) ("[A]n owner, by virtue of his power to exclude others . . . [has] incentives to utilize resources more efficiently."). *See infra* Part I.

13. Netessine & Girotra, *supra* note 7.

14. Sebastian Blanco, *Toyota Follows Tesla, Makes Hydrogen Patents Open Source*, AUTOBLOG (Jan. 5, 2015, 5:30 PM), http://www.autoblog.com/2015/01/05/toyota-follows-tesla-makes-hydrogen-patents-open-source.

15. Jack Ellis, *LG Has as Much to Gain from Its Open Innovation Drive as Korea's SMEs*, IAM: BLOG (Feb. 13, 2015), http://www.iam-media.com/Blog/Detail.aspx?g=c4010b69-e529-48ce-b83f-dc2bce3d763c.

16. Jack Ellis, *Asian Companies Lead the Way in Royalty-Free Patent Licence Strategies*, IAM: BLOG (Mar. 31, 2015), http://www.iam-media.com/Blog/Detail.aspx?g=0a884580-e30f-4d5a-a827-786dd0b10316.

17. *Id*.

18. *E.g.*, Quentin Hardy, *For Hardware Makers, Sharing Their Secrets Is Now Part of the Business Plan*, N.Y. TIMES: BITS (Mar. 29, 2015, 5:30 AM), http://bits.blogs.nytimes.com/2015/03/29/open-sourcing-cars-and-computers; Stan Higgins, *Blockstream to Release First Open Source Code for Sidechains*, COINDESK (June 9, 2015, 1:00 AM), http://www.coindesk.com/blockstream-open-source-code-sidechains.

19. *Frankenstein's Paperclips*, ECONOMIST: SPECIAL REPORT (June 25, 2016), http://www.economist.com/news/ special-report/21700762-techies-do-not-believe-artificial-intelligence-will-run-out-control-there-are (describing Google and Facebook's policies of making AI code open source).

engaging in massive sharing of what otherwise would be proprietary technology—not because of altruism, but because of the benefits of open innovation, including recruitment, culture, and speed. Facebook credits its commitment to open source with enabling the company to "innovate faster, it allows us to recruit and retain talented engineers who want to work on these kinds of problems, and it helps accelerate the industry as a whole."[20] As one prominent venture capitalist said about artificial intelligence researchers, "If you won't let them publish, they won't work for you."[21]

While notable, using patents for inclusion rather than exclusion is not new. Patent licensing is an old and well-known way for permitting others—exclusively and nonexclusively—to practice one's technology, usually for money.[22] Since the 1850s, patent holders have pooled and collectively licensed their rights.[23] Defensive patenting—that is, holding patents not to assert them, but to support patentees' freedom to operate[24]—is practiced by an estimated half or more of patent holders.[25] Some have opened up their technology without strings. When Tim Berners-Lee and his collaborators invented the Internet, they deliberately provided it to the world on a royalty-free and patent-free basis.[26] When a Volvo engineer invented the three-point seatbelt in 1959, the company dedicated the invention to the public for the safety of all.[27] At the turn of the eighteenth century,

20. Tess Townsend, *How We'll Communicate in the Future, According to Mark Zuckerberg*, INC. (Apr. 12, 2016), http://www.inc.com/tess-townsend/mark-zuckerberg-lays-out-10-year-plan.html.

21. *From Not Working to Neural Networking*, ECONOMIST: SPECIAL REPORT (June 25, 2016), http://www.economist.com/news/special-report/21700756-artificial-intelligence-boom-based-old-idea-modern-twist-not.

22. *See* Naomi R. Lamoreaux et al., *Patent Alchemy: The Market for Technology in US History*, 87 BUS. HIST. REV. 3, 4 (2013).

23. *See, e.g.*, Ryan Lampe & Petra Moser, *Do Patent Pools Encourage Innovation? Evidence from the Nineteenth-Century Sewing Machine Industry*, 70 J. ECON. HIST. 898, 898–903 (2010) (describing the first patent pool, the Sewing Machine Combination of 1856–1877).

24. Freedom to operate, in turn, is the freedom to develop and sell technology unencumbered by intellectual property constraints or demands. *See* Colleen V. Chien, *From Arms Race to Marketplace: The Complex Patent Ecosystem and Its Implications for the Patent System*, 62 HASTINGS L.J. 297, 308 & n.60 (2010); Jason Schultz & Jennifer M. Urban, *Protecting Open Innovation: The Defensive Patent License as a New Approach to Patent Threats, Transaction Costs, and Tactical Disarmament*, 26 HARV. J.L. & TECH. 1, 21 (2012) (defining freedom to operate as "a general freedom from intellectual property limitations to make, use, sell, import, or offer for sale a particular device or service").

25. *See infra* Figure 1 and note 94.

26. *Tim Berners-Lee Biography*, BIOGRAPHY ONLINE, http://www.biographyonline.net/business/tim-berners-lee.html (last visited Apr. 15, 2016). *See also* WALTER ISAACSON, THE INNOVATORS 413 (2014). The earliest architectural principles of the Internet indicated a preference for unpatented technology in order to ensure the widest dissemination and adaptability. Brian E. Carpenter, *Architectural Principles of the Internet*, INTERNET ENGINEERING TASK FORCE (June 1996), https://tools.ietf.org/html/rfc1958.

27. Tony Borroz, *Strapping Success: The 3-Point Seatbelt Turns 50*, WIRED (Aug. 13, 2009,

Benjamin Franklin refused to patent what is now known as the Franklin stove, writing, "[A]s we enjoy great advantages from the inventions of others, we should be glad of an opportunity to serve others by any invention of ours . . . ."[28] By design, the patent system supports the diffusion of technology through the public disclosure of patented inventions[29] and the transfer of patent rights from one innovator to another.[30]

However, several developments suggest that policymakers should pay more attention to a wider variety of mechanisms for supporting the diffusion of technology through the patent system. First, innovation has become increasingly collaborative, spurred by the growth of open-innovation and commons-based policies and platforms,[31] a reduction in the cost of communication, computing, and replication,[32] and a rise in multidisciplinary approaches and inventions.[33] For example, nearly 50 percent of manufacturers report that their most important new product originated from an outside source and that patented inventions were among the most valuable inputs.[34] Biopharmaceutical companies signed nearly $32 billion worth of licenses in 2014,[35] 76 percent of biotechnology

2:23 PM), http://www.wired.com/2009/08/strapping-success-the-3-point-seatbelt-turns-50.

28. BENJAMIN FRANKLIN, THE AUTOBIOGRAPHY OF BENJAMIN FRANKLIN 215 (Frank Woodworth Pine ed., Henry Holt & Co. 1916) (1791).

29. *See* Janusz A. Ordover, *A Patent System for Both Diffusion and Exclusion*, 5 J. ECON. PERSP. 43, 45 (1991).

30. Naomi R. Lamoreaux & Kenneth L. Sokoloff, *Inventors, Firms, and the Market for Technology in the Late Nineteenth and Early Twentieth Centuries*, *in* LEARNING BY DOING IN MARKETS, FIRMS, AND COUNTRIES 19, 20 (Naomi R. Lamoreaux et al. eds., 1999).

31. *See* HENRY W. CHESBROUGH, OPEN INNOVATION: THE NEW IMPERATIVE FOR CREATING AND PROFITING FROM TECHNOLOGY 43 (2003); JEREMY DE BEER, "OPEN" INNOVATION POLICY FRAMEWORKS: INTELLECTUAL PROPERTY, COMPETITION, INVESTMENT & OTHER MARKET GOVERNANCE ISSUES 3 (2015); Brett M. Frischmann et al., *Governing Knowledge Commons*, *in* GOVERNING KNOWLEDGE COMMONS 1, 2–3 (Brett M. Frischmann et al. eds., 2014) (describing "knowledge commons" as arrangements for overcoming challenges related to sharing and producing information, innovation, and creative works).

32. *See* Mark A. Lemley, *IP in a World Without Scarcity*, 90 N.Y.U. L. REV. 460, 468–81 (2015) (discussing technologies that have reduced the cost of creating, distributing, and reproducing, such as the Internet, three-dimensional printing, synthetic biology, and robotics).

33. *See, e.g.*, Hyejin Youn et al., *Invention as a Combinatorial Process: Evidence from US Patents*, J. ROYAL SOC'Y INTERFACE, May 2015, at 2, http://rsif.royalsocietypublishing.org /content/12/106/20150272 (documenting the rise in combinatorial invention codes used by the United States Patent and Trademark Office as evidence of the growth in combinatorial inventions).

34. Ashish Arora et al., *The Acquisition and Commercialization of Invention in American Manufacturing: Incidence and Impact* 4 (Nat'l Bureau of Econ. Research, Working Paper No. 20264, 2014).

35. *See* The Bos. Consulting Grp., *2014 Biopharmaceutical Partnering Survey*, SLIDESHARE 5–6 (Jan. 9, 2015), http://www.slideshare.net/TheBostonConsultingGroup/2014-biopharmaceutical-

companies license university technology,[36] and the majority of revenues from the best-performing drug companies are from products that were not developed in-house,[37] according to recent studies. Between 45 and 59 percent of companies say that accessing the technology of others motivates them to acquire patents.[38] Open source projects dominate the supercomputer, browser, and smartphone operating systems. It would be worthwhile to consider how the patent system can best support the widespread embrace of open innovation.

Second, the recent growth of diffusive mechanisms within the patent system has drawn attention to its limitations. In the technology sector, defensive patenting, in which companies hold but do not assert their patents, has provided freedom of action in a number of technology sectors, but it has broken down in the sale of once-defensive patents to patent-assertion entities ("PAEs").[39] Commitments to license essential patents on reasonable and nondiscriminatory ("RAND") bases have enabled the widespread dissemination of standardized technology, but those commitments have been subject to acrimonious disputes about the relative rights of patent holders and implementers.[40] Unilateral public patent pledges like the ones described earlier can be implemented flexibly—by announcement, blog post, or other informal mechanism[41]—but are subject to legal uncertainty.[42] Does Musk's blog post represent his personal commitment? Does it bind the company if he departs? What if Tesla changes its position, is bought, or goes bankrupt? There exist no easy ways for innovators either to put their technologies in the public domain while ensuring that they will not be patented by others, or otherwise to let the

partnering-survey (reporting 559 deals and a $57 million average upfront deal value in 2014).

36. Vicki Loise & Ashley J. Stevens, *The Bayh-Dole Act Turns 30*, 45 LES NOUVELLES 185, 189 (2010). *But see* Stuart J.H. Graham et al., *High Technology Entrepreneurs and the Patent System: Results of the 2008 Berkeley Patent Survey*, 24 BERKELEY TECH. L.J. 1255, 1316 (2009) (reporting that 37 percent of surveyed biotechnology companies licensed-in patents).

37. Nils Behnke et al., *New Paths to Value Creation in Pharma*, BAIN & CO. 3 (Sept. 24, 2014), http://www.bain.com/Images/BAIN_BRIEF_New_paths_to_value_creation_in_pharma.pdf ("Between 1992 and 2012, the eight core pharma companies on our list [of high-performing pharmaceutical companies] (excluding Teva and Cipla) generated 70% of their cumulative revenue inorganically.").

38. *See infra* Figure 1 and note 94.

39. *See infra* Part I.

40. *Id.*

41. See Part III.D.3 for examples of each type.

42. For discussions of the challenges of enforcing patent promises, see Jorge L. Contreras, *A Market Reliance Theory for FRAND Commitments and Other Patent Pledges*, 2015 UTAH L. REV 479 (2015), and Robert P. Merges & Jeffery M. Kuhn, *An Estoppel Doctrine for Patented Standards*, 97 CALIF. L. REV. 1 (2009).

world know that their technologies are available for licensing.[43]

As such, there is a risk that innovation by diffusion—innovation in which the invention or other key input to the innovation process is spread from one source to another—is happening less than would be socially optimal. This Article advocates a number of ways to reorient the patent system to better support open innovation—for example, through early publication, selective waiver of patent rights and terms, disclosure of product information, defensive publication, and defensive patents. Giving patent holders the opportunity to select into or out of the open-innovation options described here has several advantages. First, providing open-innovation options enables the flexible use of the patent system, rather than merely substituting existing hardcoded presets with others. Second, it allows for fine-grained owner tailoring at the individual invention level, rather than at the industry level, or by a court or other policymaking entity. Third, implementing these options need not be costly. Finally, to the extent that open-innovation options build on current, actual uses of the patent system, they are more likely to be adopted as voluntary measures by patent holders and are preferable to regulatory measures like compulsory licensing.[44]

It is widely recognized that different industries use patents differently[45] and that patents support a diversity of business models.[46] Allowing innovators to individually tailor patent rights—and, in some cases, to change these options over the lifetime of the patent—would provide precise controls to those in the best position to know the optimal balance between exclusion and diffusion with respect to a particular invention. My analysis suggests that adoption of these ideas could enlarge the innovation-inducing role of the patent system, creating positive social consequences without imposing significant administrative costs.[47]

43. *See infra* Part III.D. *See generally* Michael Risch, *Licensing Acquired Patents*, 21 GEO. MASON L. REV. 979 (2014) (emphasizing the importance of timing to the disclosure of such information).

44. *See, e.g.*, Robert P. Merges, *Contracting into Liability Rules: Intellectual Property Rights and Collective Rights Organizations*, 84 CALIF. L. REV. 1293, 1300 (1996) (advocating voluntary over compulsory licensing for new media). *But see* Colleen V. Chien, *Cheap Drugs at What Price to Innovation: Does the Compulsory Licensing of Pharmaceuticals Hurt Innovation?*, 18 BERKELEY TECH. L.J. 853, 862–63 (2003) (finding "no measurable decline in innovation" in five of the six cases of compulsory licensing studied).

45. The seminal work in this regard is Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575 (2003).

46. *See, e.g.*, CHESBROUGH, *supra* note 31, at 155–56.

47. *See infra* Part II.D.

Part I explores the ways the patent system currently promotes innovation through exclusionary and nonexclusionary mechanisms and, drawing upon examples in copyright and real property, examines the case for greater flexibility in the use and design of patent rights. Part II explores open modes of innovation and "innovation by diffusion," focusing on the development of ideas generated externally. Case studies, of open innovation in manufacturing, markets for technology, and defensive patenting—illustrate the growing significance of innovation by diffusion and the patent system's important role in its growth. Part III articulates a novel diffusion framework and applies it to three diffusive mechanisms of the patent system—disclosure, transfer, and sharing.

Building upon Parts II and III, Part IV discusses thus-far overlooked ways that the patent system could be reformed to lend even greater support to open forms of innovation. Examples of open-innovation reforms that could enhance patent disclosure include removing legal barriers to reading patents, facilitating the placement of inventions in the public domain through effective defensive publication, changing the default for provisional patent applications from closed to open, and publishing utility applications upon filing by default rather than after an eighteen-month delay (but granting inventors the right to opt out of these defaults). Improving reporting and discovery of patent information—including ownership status, availability for licensing, and extant patent licenses and standards commitments—could boost markets for technology. Creating a government registry of patent rights, making it easier to waive patent rights and rely on waivers of patent rights, and implementing a "freedom to operate" option akin to "license of right" schemes in the United Kingdom and Germany, which would allow patentees to pay discounted maintenance fees in exchange for promising to use their patents only defensively, would improve innovators' freedom to operate and share their patents. This Article concludes by reviewing proposed measures to open the patent system.

I. EXCLUSION AND DIFFUSION IN THE U.S. PATENT SYSTEM

A patent is a legal instrument that bestows a set of exclusive rights to its owner.[48] It is also a social bargain.[49] Society gets the innovation and, in

48. *General Information Concerning Patents*, U.S. PAT. & TRADEMARK OFF. (Oct. 2014), http://www.uspto.gov/patents-getting-started/general-information-concerning-patents.

49. *E.g.*, Pfaff v. Wells Elecs., Inc., 525 U.S. 55, 63 (1998) ("[T]he patent system represents a carefully crafted bargain that encourages both the creation and the public disclosure of new and useful advances in technology, in return for an exclusive monopoly for a limited period of time.").

the patent document, a complete description of the invention from which others can learn.[50] This is all in exchange for one thing—a set of rights to exclude others.[51] Supported by this basic legal framework, the patent system has created opportunities to foster innovation through exclusion and diffusion. This Part discusses the current balance of exclusion and diffusion in the patent system and makes the case that patent holders should be given more options for adjusting this balance with respect to their individual inventions.

Patent law's exclusionary bent follows from patents' historical role as a form of property. According to John Locke's oft-cited labor theory of property, one has a natural property right over one's own person and, by extension, the fruits of one's labor.[52] When man takes from nature and mixes his labor with it, he removes it from the common state and "excludes the common right of other men" from it.[53] Natural rights justifications have been extended to intellectual property,[54] though not without criticism.[55] Securing exclusive rights to inventors who serve society through their creations is also fair and just,[56] preventing others from free-riding off the work of inventors.[57]

Granting patents has always been associated with taking away the rights of others. A Venetian patent statute passed in 1474, the first of its kind,[58] promised patentees that it would be "forbidden to every other person in any of our territories and towns to make any further device

50. *See* Fritz Machlup & Edith Penrose, *The Patent Controversy in the Nineteenth Century*, 10 J. ECON. HIST. 1, 10–11 (1950) (justifying granting patent rights in exchange for public disclosure as necessary to prevent "the loss of inventions through secrecy").

51. *Id.*

52. JOHN LOCKE, THE SECOND TREATISE OF GOVERNMENT 17 (Thomas P. Peardon ed., The Liberal Arts Press 1952) (1690).

53. *Id.*

54. *See* ROBERT P. MERGES, JUSTIFYING INTELLECTUAL PROPERTY 156 (2011).

55. For example, the tendency of ideas to be cumulative makes it difficult to delineate the fruits that are directly attributable to one's labor, and to give independent inventors the ability to practice their own inventions. *See* WILLIAM M. LANDES & RICHARD A. POSNER, THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW 4–5 (2003).

56. *E.g.*, Machlup & Penrose, *supra* note 50, at 10 ("The most appropriate way to secure to inventors rewards commensurate with their services [to society] is by means of exclusive patent rights in their inventions.").

57. *E.g.*, Sigrid Sterckx, *The Moral Justifiability of Patents*, 13 ETHICAL PERSP. 249, 255 (2006) ("The establishment of a patent system is justified because it would be unfair to allow people a 'free ride' at the expense of others who apply themselves to the act of inventing.").

58. SUBCOMM. ON PATENTS, TRADEMARKS, & COPYRIGHTS OF THE S. COMM. ON THE JUDICIARY, 85TH CONG., AN ECONOMIC REVIEW OF THE PATENT SYSTEM 2 (Comm. Print 1958) [hereinafter PATENT SYSTEM REVIEW].

conforming with [the patented device]."[59] The first American patent law gave patentees "the sole and exclusive right and liberty of making, constructing, using and vending to others to be used, the said invention or discovery."[60] The statute conferred the full suite of property rights—to use and possess as well as to exclude.[61]

But just as exclusion has always been the means, the diffusion of innovation has always been the desired end. The purpose of the first patent law was to attract artisans and printers from other territories to Venice.[62] The early novelty requirement had a distinctly nationalistic flavor—a patent would be justified only if the skill was new to the country,[63] and British patents, which were just one type of privilege routinely granted throughout Western Europe,[64] extended only to actually produced "manufactures."[65] A number of studies have documented the positive link between intellectual property and the geographical diffusion of technology.[66]

The early American patent system featured a number of mechanisms to ensure that information about "patented knowledge was readily available and diffused rapidly."[67] In the early nineteenth century, Congress required the publication of "an annual list of patents granted the preceding year, and after 1832 also required the publication in newspapers of notices regarding

59. Giulio Mandich, *Venetian Patents (1450–1550)*, 30 J. PAT. OFF. SOC'Y 166, 177 (1948).

60. Act of Apr. 10, 1790, ch. 7, § 1, 1 Stat. 109, 110 (repealed 1793).

61. *See* 1 WILLIAM BLACKSTONE, COMMENTARIES *138 (defining property as that which "consists in the free use, enjoyment, and disposal of all his acquisitions"). *See* Mossoff, *supra* note 9, at 349–60 (tracing the history of such conceptions of property).

62. *See* Mandich, *supra* note 59, at 168–71, 181.

63. Douglass North & Robert Paul Thomas, *Patents, Property Rights, and Economic History: The "Statute of Monopolies" Era in Great Britain*, *in* FOUNDATIONS OF INTELLECTUAL PROPERTY 13, 14 (Robert P. Merges & Jane C. Ginsburg eds., 2004).

64. *See* PATENT SYSTEM REVIEW, *supra* note 58, at 2.

65. Michael Risch, *America's First Patents*, 64 FLA. L. REV. 1279, 1297, 1299 (2012) (describing the English Statute of Monopolies).

66. *See, e.g.*, Lee G. Branstetter et al., *Do Stronger Intellectual Property Rights Increase International Technology Transfer? Empirical Evidence from U.S. Firm-Level Panel Data*, 12 Q.J. ECON. 321, 347 (2006) (documenting increases in royalty payments and R&D expenditures by multinational firms after intellectual property reforms were adopted and concluding that "U.S. multinationals respond to changes in [intellectual property rights] regimes abroad by 'significantly increasing technology transfer to reforming countries'"); Mercedes Delgaldo et al., *Intellectual Property Protection and the Geography of Trade*, 61 J. INDUS. ECON. 733, 756 (2013) (identifying increased trade flows in intellectual-property-intensive sectors following the implementation of an international intellectual property agreement).

67. B. Zorina Khan, *Intellectual Property and Economic Development: Lessons from American and European History* 22 (Comm'n on Intellectual Prop. Rights, Study Paper No. 1a, 2002), http://www.iprcommission.org/papers/pdfs/study_papers/sp1a_khan_study.pdf.

expired patents."[68] Patent models were kept not only at the central patent office, but also at its repositories around the country,[69] and patent descriptions were regularly published in trade journals like *Scientific American*.[70] These and related aspects of the U.S. patent system differentiated it from its European peers, which were less effective at disseminating information.[71]

According to conventional accounts, the patent system diffuses inventions in at least two ways. First, by requiring inventors to provide complete descriptions of their inventions—including instructions on how to make and use them—as a condition of getting patents, the system induces the disclosure of technical details that otherwise would be kept secret.[72] Indeed, the word "patent" comes from the Latin word *patere*, which means "to be open."[73] Like in academic and public science, user and open-source innovation result in dissemination, though disclosure does not necessarily come with the permission to use the innovation.[74] Through the promise of exclusion, patents encourage initial investments in knowledge goods, which, because of their public good properties, cannot exclusively benefit their producers and therefore risk underproduction.[75] Once granted, patents encourage investments in commercialization, including through their creation of prospects that make it easier to coordinate investments.[76] In this

68. *Id.*

69. *Id.*

70. Lamoreaux et al., *supra* note 22, at 12–13.

71. Khan, *supra* note 67, at 52.

72. *See* Jeanne C. Fromer, *Patent Disclosure*, 94 IOWA L. REV. 539, 541 (2009) (describing the role of patent disclosures in stimulating innovation during and after the patent term).

73. Ove Granstrand, *Innovation and Intellectual Property Rights*, *in* THE OXFORD HANDBOOK OF INNOVATION 266, 285 n.3 (Jan Fagerberg et al. eds., 2005). *Accord* PATENT SYSTEM REVIEW, *supra* note 58, at 1.

74. *See* Kevin J. Boudreau & Karim R. Lakhani, *"Open" Disclosure of Innovations, Incentives and Follow-On Reuse: Theory on Processes of Cumulative Innovation and a Field Experiment in Computational Biology*, 44 RES. POL'Y 4, 6 (2015) (using the patent system as an example of "upstream knowledge and technology [being] disclosed in order for downstream innovators to reuse and build upon this work").

75. Joseph E. Stiglitz, *Knowledge as a Global Public Good*, *in* GLOBAL PUBLIC GOODS 308 , 308 (Inge Kaul et al. eds., 1999). Knowledge has characteristics that distinguish it from tangible property. First, it is nonrival; as Thomas Jefferson explained in a famous letter, "He who receives an idea from me, receives instruction himself without lessening mine . . . ." Letter from Thomas Jefferson to Isaac McPherson (Aug. 13, 1813), *in* 6 THE WRITINGS OF THOMAS JEFFERSON 175, 180 (H.A. Washington ed., 1855). Second, knowledge is nonexcludable, or in Jefferson's words, made by nature "expansible over all space, . . . and like the air . . . incapable of confinement or exclusive appropriation." *Id.* at 180–81.

76. *See* Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 265, 276 (1977) ("No one is likely to make significant investments searching for ways to increase the commercial value of a patent unless he has made previous arrangements with the owner of the patent. This puts the patent owner in a position to coordinate the search for technological and market

pattern of exclusion followed by diffusion, patents mediate the "tradeoff between static and dynamic efficiency."[77] The patentee is incented to make investments due to its ability to exclude others from using the invention.[78] While this leads to less competition and higher prices during the patent's term,[79] when the patent expires, the invention falls into the public domain, facilitating the widest possible dissemination of the inventor's knowledge.[80]

While by default, then, the patent system provides the patentee with a period of exclusion followed by diffusion, parties can adjust these parameters. Through licensing or selling their technology and accompanying patent rights during a patent's term, patentees can transfer their rights exclusively or nonexclusively to others who are in a better position to commercialize their inventions.[81] Through standard-setting bodies, patentees encourage investment in their invention by others.[82] Through patent pools, patent holders get together to share patents over a technology.[83] Rather than using patents to exclude rivals, standards and

enhancement of the patent's value . . . .").

77. Ordover, *supra* note 29, at 43.

78. Although U.S. patent law does not require practice of the patent, it continues to reward patent practice in several ways. For example, the nonobviousness doctrine prevents routine or marginal technological developments from getting patents. *See* KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 417 (2007). Commercial success, licensing, copying of the invention by others, and public recognition of the patentee are relevant to obviousness determinations, almost always favoring the patentee. *See* Daralyn J. Durie & Mark A. Lemley, *A Realistic Approach to the Obviousness of Inventions*, 50 WM. & MARY L. REV. 989, 995, 1004 (2008). But a patentee can demonstrate these factors only if a patent has been practiced. Similarly, the written-description doctrine requires that the patent specification convey to a person of skill in the art that the inventor was in "possession" of the invention. Ariad Pharm., Inc. v. Eli Lilly & Co., 598 F.3d 1336, 1351 (Fed. Cir. 2010) (en banc). Details from practice make this requirement easier to satisfy. Remedies are more readily available when the patentee practices the invention. In order to get the legal remedy of lost profits, the patentee must demonstrate foreseeable loss. Rite-Hite Corp. v. Kelley Co., 56 F.3d 1538, 1548–49 (Fed. Cir. 1995) (en banc). Lost sales due to the infringement can suffice, but such damages are only available if the patentee is selling the product; otherwise, the floor for damages is set to but a royalty from the infringer. *See* 35 U.S.C. § 284 (2012). In the past years, requests for injunctions by nonpracticing entities have been routinely denied, not granted. Colleen V. Chien & Mark A. Lemley, *Patent Holdup, the ITC, and the Public Interest*, 98 CORNELL L. REV. 1, 10 fig.1 (2012) (showing a 7 percent grant rate to PAEs on contested requests for injunctions). However, it should be noted that the federal government can use patented inventions without permission under 28 U.S.C. § 1498 (2012), a compulsory license provision the government has relied upon hundreds of times. Chien, *supra* note 44. The federal government also has the right to compel the licensing of federally funded patents in certain cases. 35 U.S.C. § 203(a) (2012).

79. *See* Granstrand, *supra* note 73, at 279 ("[I]ncreased protection means less competition, higher prices, and slower diffusion[].").

80. Benjamin Roin, Note, *The Disclosure Function of the Patent System (or Lack Thereof)*, 118 HARV. L. REV. 2007, 2011–13 (2005) (reviewing "the disclosure rationale" as a judicial justification for the existence of patents).

81. *See* CHESBROUGH, *supra* note 31, at 64.

82. *See infra* Part III.

83. Lampe & Moser, *supra* note 23, at 898. Though patent pools have been around since the

pools enable the efficient and widespread sharing of technologies like Bluetooth, wireless and wireline communication, and video compression.[84] Why would a patent holder agree to give up rights to such valuable technology and to subject their technology to the royalty-free or RAND licensing commitments most standard bodies require?[85] Because becoming part of a popular standard means that a technology will be used widely and generally rather than exclusively and specifically, driving higher adoption rates for technology developers, reduced litigation risks for implementers, and reduced transaction costs for all.[86]

Defensive patenting and publication are two other ways patent holders can relinquish certain exclusive rights in pursuit of other objectives.[87] In contrast with patent standards, where technology providers opt out of exclusion in order to achieve widespread adoption, those who engage in defensive patenting seek patents not in order to exclude others, but to include themselves.[88] Defensive patents are generally not enforced, but they arm their owners with assets that can be traded for access to the technology of others.[89] Defensive publication, the publication of an invention in order to create prior art so that others do not patent the invention later, thus rescuing inventions by bringing them into the public domain,[90] functions like open-source software development and other commons-promoting actions, which clear the path for innovation despite the potential presence of patent thickets.[91]

mid-1800s, they were disfavored by antitrust regulators in the 1940s and 1950s. Anne Layne-Farrar & Josh Lerner, *To Join or Not to Join: Examining Patent Pool Participation and Rent Sharing Rules*, 29 INT'L J. INDUS. ORG. 294, 295–96 (2011) (describing the long history of patent pools in the United States). They regained popularity in 1995 when the Department of Justice and the Federal Trade Commission began issuing guidelines to support pools. *Id.* at 295.

84. Layne-Farrar & Lerner, *supra* note 83, at 296–98.

85. Colleen Chien et al., *RAND Patents and Exclusion Orders: Submission of 19 Economics and Law Professors to the International Trade Commission*, SANTA CLARA L. DIGITAL COMMONS 1, 3 n.11 (2012), http://digitalcommons.law.scu.edu/facpubs/435 (describing the licensing policies of the "American National Standards Institute (ANSI), which administers and coordinates U.S. private sector standards among 100,000 companies, and the European Telecommunication Standards Institute (ETSI), which sponsors the development of European telecommunications standards among more than 700 members," and citing studies that document the prevalence of RAND and royalty-free terms).

86. Lampe & Moser, *supra* note 23, at 898–99.

87. *See infra* Part II.

88. Chien, *supra* note 24, at 321–22.

89. *See id.*

90. *See infra* Part III.B.3.

91. *See* Maria Alessandra Rossi, *Decoding the Free/Open Source Software Puzzle: A Survey of Theoretical and Empirical Contributions*, *in* THE ECONOMICS OF OPEN SOURCE SOFTWARE DEVELOPMENT 15, 40–44 (Jürgen Bitzer & Philipp J.H. Schröder eds., 2006) (describing the use of free and open-source software licenses, which obligate code adopters to refrain from asserting patent rights

Previous explorations of such private actions have tended to describe them as special solutions to special problems, such as transactional bottlenecks among repeat players[92] and the development of patent thickets in high-tech industries.[93] However, there is evidence that, rather than being on the periphery of the patent system, the acquisition and use of patents to include instead of exclude have become widespread.

The use of patents for diffusionary as well as exclusionary purposes is documented in surveys about motives for patenting, for example. When asked why they patent, companies have consistently expressed motivations to prevent copying and block patenting by others, as shown in Figure 1.[94] However, diffusionary motives also ranked highly, right after exclusionary ones. Of the R&D managers surveyed by Cohen and his colleagues, 59 percent said they patent product innovations to prevent suits, and 47 percent said they patent in order to negotiate.[95] Likewise, Nagaoka and Walsh's survey of inventors found pure defense to be the third most important reason for patenting after exclusive commercial exploitation and blocking.[96] Fifty percent of the respondents to a European Patent Office study agreed with the statement, "I patent mainly to preserve my freedom of operation"—just 16 percent fewer respondents than those who agreed with the statement, "I patent mainly to prevent imitation by competitors."[97] Patenting by young firms is motivated by the desire to "[i]mprove

against subsequent adopters and limit the shortcomings associated with patent-based innovation).

92. *See* Merges, *supra* note 44, at 1295.

93. Chien, *supra* note 44, at 862.

94. *E.g.*, Wesley M. Cohen et al., *Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not)* 17 (Nat'l Bureau of Econ. Research, Working Paper No. 7552, 2000) (showing that 96 percent of the 1478 R&D managers surveyed indicated that preventing copying motivated the acquisition of their last product innovation patent); Sadao Nagaoka & John P. Walsh, *Commercialization and Other Uses of Patents in Japan and the U.S.: Major Findings from the RIETI-Georgia Tech Investor Survey*, RES. INSTITUTE OF ECON., TRADE & INDUSTRY 3, 31 fig.13 (Mar. 2009) (describing the results of a survey of inventors of "triadic patents"—"those for which a patent was granted by the US patent office and applied for at both the Japanese and European Patent offices"—and finding that 82 percent of the 7933 American inventors surveyed selected enhancing exclusive commercial exploitation, followed by blocking, as the top answers to the question of what motivated their patenting). 82 percent of respondents in Cohen's survey selected the next highest ranked answer, the prevention of patenting by others, or "blocking," which can be motivated by a desire to exclude competitors from a particular area or to facilitate cross-licensing and improve freedom to operate. Cohen et al., *supra*, at 17, 21–22. Preventing copying and blocking were the top answers in Cohen's survey regarding process innovation patents too. *Id.* at fig.8.

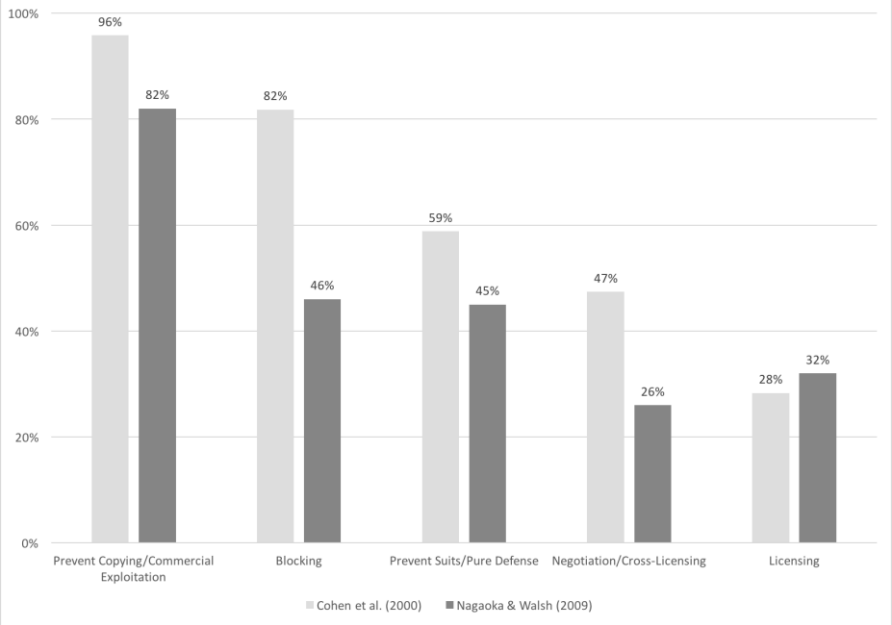
95. Cohen et al., *supra* note 94, at 18 fig.7.

96. Nagaoka & Walsh, *supra* note 94, at 20 fig.13.

97. Gaétan de Rassenfosse et al., *Motivations to Patent: Empirical Evidence from an International Survey*, *in* PROCEEDINGS OF PRESENTATION PAPERS: THE 5TH INTERNATIONAL CONFERENCE ON INNOVATION & MANAGEMENT 98 tbl.1 (2008).

negotiating position[s] with other companies (e.g., cross-licenses)," though less so than preventing copying, obtaining financing, and enhancing their image.[98] Other motives for patenting include the ability to exclusively or nonexclusively license and the desire to use patents to advance technology adoption, as in the case of the patent pledges of Tesla and others described in the Introduction.[99]

FIGURE 1. Exclusionary and Diffusionary Motives for Patenting[100]



While a single innovator may embrace both exclusionary and diffusionary purposes for patents, it is generally the case that within patent portfolios, the bulk is not intended to be asserted.[101] In the words of one software entrepreneur interviewed by Jessica Silbey about his firm's patenting strategy:

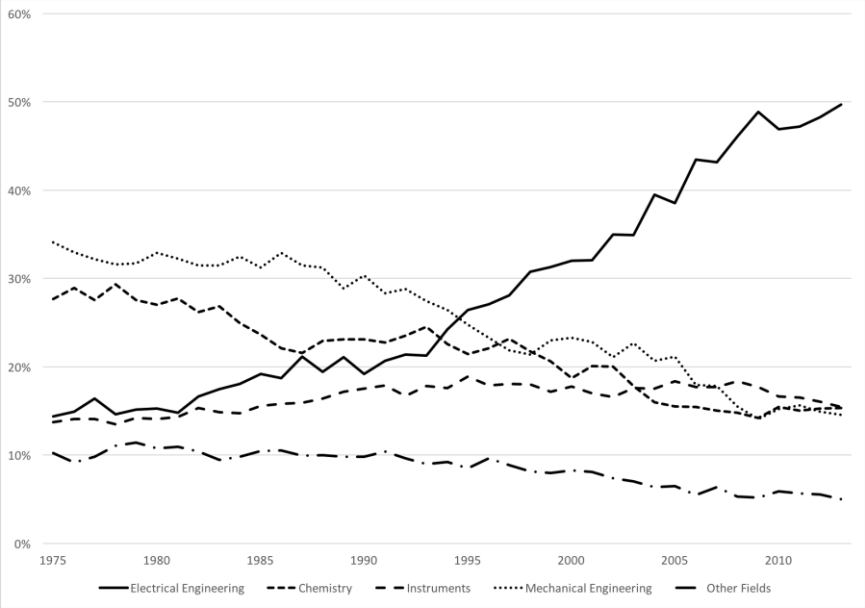
> [T]here is typically one or two ideas that are really valuable . . . . And then the company ends up getting a dozen or two dozen patents. The rest of them are just the blocking stuff—or not even that: they're just

98. Graham et al., *supra* note 36, at 1301 fig.3.
99. *See supra* notes 2–8 and accompanying text.
100. Cohen et al., *supra* note 94, at 18 fig.7; Nagaoka & Walsh, *supra* note 94, at 20 fig.13.
101. *See, e.g.*, JESSICA SILBEY, THE EUREKA MYTH 207–11 (2015).

> something you build to look very attractive to a potential buyer. But they're not real . . . .[102]

Thus, while the share of patent holders seeking patents for defensive purposes may be 45–59 percent,[103] if the bulk of their patents are held for defensive reasons, the proportion of overall patents held defensively could be much higher. The shift in the U.S. economy toward silicon-based technologies, where defensive patenting is pervasive, has been accompanied by a growth in the proportion of the electrical engineering patents from less than 15 percent of patents in 1975 to around 50 percent in 2014.[104]

FIGURE 2. Shares of U.S. Patents by Technology Field[105]



102. *Id.* at 208–09.

103. *See supra* Figure 1.

104. *See infra* Figure 2.

105. This Figure is derived from data from the European Patent Office's Worldwide Patent Statistical Database, also known as PATSTAT. *PATSTAT*, EUR. PAT. OFF., https://www.epo.org/searching-for-patents/business/patstat.html (data set on file with author). Figure 2 shows how the shares of classes of U.S. patent grants change over time. The World Intellectual Property Organization classes patents into five sectors—electrical engineering, instruments, chemistry and pharmaceuticals, mechanical engineering, and other fields. *See* ULRICH SCHMOCH, CONCEPT OF A TECHNOLOGY CLASSIFICATION FOR COUNTRY COMPARISONS: FINAL REPORT TO THE WORLD INTELLECTUAL PROPERTY ORGANISATION (WIPO) 7–10 (2008), http://www.wipo.int/export/sites/www/ipstats/en/statistics/patents/pdf/wipo_ipc_technology.pdf.

Patent portfolio building for access rather than exclusion is pervasive even outside of high-tech industries. As an in-house intellectual property lawyer from a biopharmaceutical firm described, "What I want is something that I can trade with somebody. . . . I'm not interested in necessarily asserting these against anybody."[106]

But the diversity in purposes for holding patents is not matched by diversity in ways that patentees can signal, express, and communicate their intents. There are no easy ways for patent holders to give up certain rights while retaining others, to commit to holding their patents defensively, or to indicate that their patents are available for licensing. The lack of standardization has led to an increase in the costs of signaling and discovering opportunities for transacting as well as an inability to rely upon commitments that are made, such as Tesla's promise not to enforce its patents in most situations.[107] The increased use of these practices highlights the limitations of existing private ordering solutions—nonreliability, nonpermanence, and high transaction and search costs.

In the last decade, for example, the détente among holders of defensive patents has been disrupted as patents acquired only for defensive purposes have, in some cases, ended up being sold to PAEs, or "trolls," which do not make products but enforce patents as a business model.[108] According to one estimate, over 80 percent of patents litigated by PAEs are acquired from operating companies,[109] and in an analysis of ten patent-assertion campaigns brought against large numbers of defendants, nine patents were bought before being asserted—they were not asserted by their original owners.[110] Concerns about the impact of patent-troll campaigns, particularly on start-ups and small companies,[111] have led all three branches of the federal government,[112] as well as state governments,[113] to

106. SILBEY, *supra* note 101, at 44–45 (internal quotation marks omitted).

107. *See* Netessine & Girotra, *supra* note 7.

108. *See* Chien, *supra* note 24, at 301, 313.

109. Joe Mullin, *How Operating Companies Can Stop Patent Trolls: Cut Off the Ammo*, ARS TECHNICA (July 9, 2014, 2:40 PM), http://arstechnica.com/tech-policy/2014/07/how-operating-companies-can-stop-patent-trolls-cut-off-the-ammo (showing that 39 percent and 43 percent of litigated PAE patents derive from large and small companies, respectively).

110. Colleen V. Chien, *Patent Trolls by the Numbers*, PATENTLY-O (March 14, 2013), http://patentlyo.com/patent/2013/03/chien-patent-trolls.html.

111. *See generally* Colleen V. Chien, *Startups and Patent Trolls*, 17 STAN. TECH. L. REV. 461 (2014) (analyzing the impact of PAEs on start-ups).

112. *See, e.g.*, Innovation Act, H.R. 9, 114th Cong. (2015) (containing a host of measures to address the problems of abusive patent litigation); Octane Fitness, LLC v. ICON Health & Fitness, Inc., 134 S. Ct. 1749, 1755 (2014) (making it easier for judges to award attorneys fees in patent cases); Press Release, White House, Office of the Press Sec'y, Fact Sheet: White House Task Force on High-Patent

take actions to reduce asymmetries in patent assertion. This breakdown of "patent peace" has spawned a number of unilateral and coordinated efforts to prevent the offensive use of once-defensive patents by PAEs.[114]

Patent pool commitments have also been subject to challenges, as patent holders have been accused of taking steps that are inconsistent with preexisting commitments to license patents on RAND terms. The practice of seeking injunctions on standard-essential patents from the International Trade Commission and federal district courts has attracted the criticism of regulatory authorities worried that such actions undermine the procompetitive and proconsumer benefits associated with standards.[115] Finally, as described in greater detail in Part III.D.3, patent pledges, despite their growing popularity, suffer serious legal defects, as one-way promises are generally not enforceable under the law unless there is reasonable reliance.

These problems are not unique to patent law. Owners of expressive works have few ways under copyright law to adjust the amount of protection that cover their works—for example, from completely open to completely closed modes of protection.[116] Contractual arrangements offered by collective rights organizations such as ASCAP and BMI have long offered options for efficient transacting,[117] but these schemes cover only limited works and limited rights, and are not readily customizable to individual works. Creative Commons has addressed this gap by developing

Issues (June 4, 2013), https://www.whitehouse.gov/the-press-office/2013/06/04/fact-sheet-white-house-task-force-high-tech-patent-issues (describing executive actions and legislative priorities to combat patent trolls).

113. *2014 Patent Trolling Legislation*, NAT'L CONF. ST. LEGISLATURES (Sept. 21, 2015), http://www.ncsl.org/research/financial-services-and-commerce/patent-trolling-legislation.aspx (reporting on legislation passed in twenty-nine states to curb bad faith patent demands).

114. Chien, *supra* note 24, at 308–09 (discussing "the growth of defensive patenting" to counteract PAEs).

115. *See, e.g.*, Federal Trade Commission, Comment Before the United States International Trade Commission on Certain Wireless Communication Devices, Portable Music and Data Processing Devices, Computers and Components Thereof 1 (June 6, 2012), https://www.ftc.gov/sites/default/files/documents/advocacy_documents/ftc-comment-united-states-international-trade-commission-concerning-certain-wireless-communication/1206ftcwirelesscom.pdf ("[W]e are concerned that a patentee can make a RAND commitment as part of the standard setting process, and then seek an exclusion order for infringement . . . .").

116. *See generally, e.g.*, Colleen Chien, *Beyond Eureka: What Creators Want (Freedom, Credit, and Audiences) and How Intellectual Property Can Better Give It to Them (by Supporting, Sharing, Licensing, and Attribution)*, 114 U. MICH. L. REV. 1081 (reviewing JESSICA SILBEY, THE EUREKA MYTH (2015)) (describing the desire of copyright holders to control their works and calibrate the level of protection on individual works).

117. Robert P. Merges, *Contracting into Liability Rules: Intellectual Property Rights and Collective Rights Organizations*, 84 CALIF. 1293, 1293–94 (1996).

a number of licenses the copyright holder can adopt that waive certain rights in exchange for attribution and customizing the level of protection covering a work.[118] But rights holders are prevented by law from making these commitments permanent and from making legally binding partial abandonments of their rights.[119] Residual uncertainty about the protection that covers a work has led risk-averse organizations, including libraries, archives, and other memory institutions that have a profound influence on the ability of the public to access works, to refuse collections of works because they fear that the works might be protected and that rights owners would disapprove of this access.[120]

The importance of inclusion and social uses of real property has long been recognized.[121] Owners of real property have a variety of options for customizing and limiting their rights, including covenants, leases, and servitudes, which confer rights to enter and use land without interference, contributing to a general right to include.[122] These mechanisms are not always preferable to informal mechanisms like nonenforcement and waivers, which have the benefit of relative ease and flexibility, but they are more certain and reliable, particularly with respect to the rights of third-party beneficiaries.[123] They are also less vulnerable to changes in ownership and downstream changes in conditions.[124] Patent law could similarly benefit from additional ways to customize patent rights. Part II makes the case for doing so.

118. Lydia Pallas Loren, *Building a Reliable Semicommons of Creative Works: Enforcement of Creative Commons Licenses and Limited Abandonment of Copyright*, 14 GEO. MASON L. REV. 271, 273–74 (2007).

119. *E.g.*, *id.* at 318; Timothy K. Armstrong, *Shrinking the Commons: Termination of Copyright Licenses and Transfers for the Benefit of the Public*, 47 HARV. J. ON LEGIS. 359, 363–64 (2010). *Cf.* 17 U.S.C. § 203 (2012) (specifying the conditions under which licenses must be subject to termination).

120. David R. Hansen et al., *Solving the Orphan Works Problem for the United States*, 37 COLUM. J.L. & ARTS 1, 3 (2013) ("[O]rganizations that cannot obtain permission often do not make their collections available at all.").

121. *E.g.*, THOMAS W. MERRILL & HENRY E. SMITH, PROPERTY: PRINCIPLES AND POLICIES 449 (2d ed. 2012) ("[I]t is important not only to be able to exclude other persons from the thing, but also to be able to include other persons in the use and enjoyment of the thing . . . ."); J.E. PENNER, THE IDEA OF PROPERTY IN LAW 75 (1997) ("[U]nderstanding the social use of property . . . must be as fundamental to understanding property as understanding the way in which property excludes.").

122. Daniel B. Kelley, *The Right to Include*, 63 EMORY L.J. 857, 882–918 (2014) (discussing various ways property law authorizes inclusion).

123. *Id.* at 890–91.

124. *See* Molly Shaffer Van Houweling, *The New Servitudes*, 96 GEO. L.J. 885, 900 (2008) (describing the enforcement of servitudes on future generations as "the problem of the future").

II. THE CASE FOR SUPPORTING INNOVATION BY DIFFUSION

What is "innovation by diffusion"? Diffusion is the spread of an idea, product, practice, or other cultural element as it disseminates or "takes off" throughout society.[125] More precisely, it is "the process by which an innovation is communicated through certain channels over time among the members of a social system."[126] Innovation by diffusion is defined here as innovation in which the invention or other key input to the innovation process comes from an external source.

As new innovations drive economic growth and promote social welfare, the mechanisms and organization of innovation and its diffusion are of broad interest.[127] An extensive literature has considered the inputs to innovation provided by particular outside sources such as universities,[128] users,[129] and customers.[130] When these actors are not well positioned to commercialize their ideas, they must work with external partners to get the job done. Chesbrough's path-breaking work on open innovation describes how looking outside has become an imperative for commercializing firms as well.[131] This Part discusses three examples of innovation by diffusion. Drawn from a variety of contexts, these case studies share two characteristics. First, innovation is happening—not because the inventor retained exclusive rights, but because the invention spread from one setting to another. Second, perhaps surprisingly, the patent system supported this diffusion.

125. THOMAS W. VALENTE, NETWORK MODELS OF THE DIFFUSION OF INNOVATIONS, at xi (1995) (defining the diffusion of innovation as "how ideas, products, opinions, and other things 'take off' and spread throughout society"). *Cf. Definition of "*Diffusion," MERRIAM-WEBSTER, http://www.merriam-webster.com/dictionary/diffusion (last visited Apr. 15, 2016) (defining diffusion as "the spread of cultural elements from one area or group of people to others by contact").

126. EVERETT M. ROGERS, DIFFUSION OF INNOVATIONS 5 (3d ed. 1983).

127. Studies of innovation have not been limited to a single discipline; they have been conducted by scholars in a number of fields. As British economist Christopher Freeman wrote, "Innovation is far too important to be left to scientists and technologists. It is also far too important to be left to economists or social scientists." CHRISTOPHER FREEMAN, THE ECONOMICS OF INDUSTRIAL INNOVATION 309 (1974). For a description of literature on the topic of diffusion, see Bronwyn Hall, *Innovation and Diffusion*, *in* THE OXFORD HANDBOOK OF INNOVATION 459, 461–65 (Jan Fagerberg et al. eds., 2005) (providing an overview of the determinants of diffusion of innovation).

128. *See, e.g.*, Edwin Mansfield, *Academic Research Underlying Industrial Innovations: Sources, Characteristics, and Financing*, 77 REV. ECON. & STAT. 55, 55 (1995).

129. *See, e.g.*, Eric von Hippel, *Lead Users: A Source of Novel Product Concepts*, 32 MGMT. SCI. 791, 791 (1986).

130. *See, e.g.*, Jacques R. Bughin et al., *The Next Step in Open Innovation*, MCKINSEY Q., June 2008, at 113, 113–14.

131. CHESBROUGH, *supra* note 31, at 64.

A. OPEN INNOVATION IN MANUFACTURING

Open innovation is the use of inflows of knowledge to accelerate internal innovation and the use of outflows of knowledge to expand markets for the external use of innovation.[132] It is the "antithesis of the traditional vertical integration model," in which the ideas that are developed come from within a firm.[133]

In 2000, Procter and Gamble ("P&G") found itself in an innovation rut. R&D productivity remained flat even while innovation costs were increasing.[134] Under the leadership of a new CEO, the company launched a new strategy based on its observation that some of the company's best new ideas came from connecting ideas across business lines.[135] Insights from candles were relevant to soap, and insights from soap were relevant to vegetable shortening.[136] Under this new strategy, the company would look even further, beyond the boundaries of the firm, and retool its processes to increase the number of ideas coming not *from* their labs, but *through* their labs, including ideas from suppliers and other partners.[137]

Based on its novel "connect and develop" rather than the traditional R&D approach,[138] P&G reported increasing the share of its product development portfolio with externally sourced key elements to 45 percent by 2006.[139] One example of an externally sourced P&G product is the Mr. Clean Magic Eraser, which was discovered by a technology entrepreneur within the firm who found a stain-removing sponge in a Japanese supermarket.[140] This sponge was, in turn, based on a resin foam developed by German chemical company BASF and marketed for unrelated uses, insulation and sound-proofing.[141] Following this initial discovery, the product was evaluated and launched in new markets and then used as the

132. Henry Chesbrough, *Open Innovation: A New Paradigm for Understanding Industrial Innovation*, *in* OPEN INNOVATION: RESEARCHING A NEW PARADIGM 1, 1 (Henry Chesbrough et al. eds., 2006) (defining open innovation as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively").

133. *Id.*

134. Larry Huston & Nabil Sakkab, *Connect and Develop: Inside Procter & Gamble's New Model for Innovation*, HARV. BUS. REV., Mar. 2006, at 58, 60.

135. *Id.*

136. Mark Dodgson et al., *The Role of Technology in the Shift Towards Open Innovation: The Case of Procter & Gamble*, 36 R&D MGMT. 333, 337 (2006).

137. Huston & Sakkab, *supra* note 134, at 63.

138. Dodgson et al., *supra* note 136.

139. Huston & Sakkab, *supra* note 134, at 61.

140. *Id.* at 65.

141. *Id.*

basis of new products developed by P&G and BASF.[142]

In the transformation of its approach to innovation, P&G embraced the same insight the LEGO Group discovered when it embraced open innovation—that "99.99% of the world's most talented individuals do not work" for the company.[143] LEGO had the additional advantage, however, that this 99.99% "probably grew up with and continue to have a relationship with the LEGO brand."[144] LEGO's turn to open innovation was driven in part by necessity: in the 1990s, the company faced threats from the Internet and digital toys like video games.[145] Lacking experience in interactive toys, the company worked with outside partners to develop LEGO Mindstorms—programmable bricks used to build robots.[146]

Such open innovation approaches have blossomed in recent years.[147] But until recently, it has been unclear whether or not they remain at the periphery of mainstream innovation or are indicative of broader trends.

This question was addressed with respect to the manufacturing sector by Ashish Arora and his colleagues, who asked manufacturers about the sources of their innovations.[148] Probing the 42 percent of firms studied that had recently innovated,[149] the survey focused on "new to the market" innovations—in food, antioxidant chocolates; in chemicals, biosolvents; and in electronics, a new kind of LCD panel, to name a few.[150] The surveyors asked who originated the new-to-market product. Strikingly, 49 percent of respondents reported that an outside source had originated their

142. *Id.*

143. Stiven Kerestegian, *Open Innovation at the LEGO Group*, PIONEERS (Nov. 21, 2013), http://pioneers.io/blog/2013/11/21/open-innovation-lego-group.

144. *Id. See also* Karim R. Lakhani & Jill A. Panetta, *The Principles of Distributed Innovation*, 2 INNOVATIONS: TECH., GOVERNANCE, GLOBALIZATION 97, 97 (2007) (citing the maxim in business attributed to Sun Microsystems cofounder Bill Joy, "No matter who you are, most of the smartest people work for someone else . . . .").

145. *See* David Oliver & Johan Roos, *Decision-Making in High-Velocity Environments: The Importance of Guiding Principles*, 26 ORG. STUD. 889, 895 (2005).

146. *Id.*

147. For example, the Obama Administration has embraced open innovation through prizes and challenges. Between September 2010 and December 2015, 80 federal agencies ran over 640 challenge and prize competitions, with inventions ranging from super-fuel-efficient cars to quiet, practical, green aircrafts. *About Challenge.gov*, CHALLENGE.GOV, http://www.challenge.gov/about (last visited Apr. 15, 2016); *Newest Challenges*, CHALLENGE.GOV, https://www.challenge.gov/list (last visited Apr. 15, 2016).

148. Ashish Arora et al., *The Acquisition and Commercialization of Invention in American Manufacturing: Incidence and Impact*, 45 RES. POL'Y 1113, 1115 (2016).

149. *See id.* at 1116.

150. *Id.* at 1116 & tbl.1.

most important new product.[151]

The role of patents in the transfer of ideas for the manufacturers surveyed depended on the source of the patent. Respondents to the Arora survey identified their innovation sources as suppliers, customers, other firms in the industry, or "technology specialists," defined as independent inventors, consultants, engineering service providers, universities, and commercial or government laboratories.[152] While 55 percent of outside innovations came from customers, 35 percent came from technology specialists,[153] whose contributions were more economically valuable.[154] While only a quarter of outside innovations were patented overall, contributions from specialists were much more likely to be patented:[155] 56 percent of independent inventor-generated inventions and 36 percent of university-generated inventions were patented.[156]

These findings suggest that the diffusion of ideas and inventions across firms has a sizeable effect on innovation and that the patent system is playing an important role. But how do buyers and sellers find each other? An important way is through markets for technology, described below.

B. MARKETS FOR TECHNOLOGY

In a market for technology, an inventor or technology owner transfers an invention to another setting by licensing, partnering, or otherwise contracting for it to be exchanged.[157] The growth of such technology markets is another indicator of the economic significance of including rather than excluding others in the practice of a patent during its term. While markets for technology are not new,[158] they have been growing faster than the world's gross domestic product since the 1980s.[159] The total value of technology transactions from 1985 to 1997 was about $27 billion

151. *Id.* at 1118.

152. *Id.* at 1117–18.

153. *See id.* at 1118 (showing 49 percent of respondents' innovations were externally sourced, 27 percent were sourced from customers, and 17 percent were sourced from technology specialists).

154. *Id.* at 1121–22.

155. *Id.* at 1119.

156. *Id.*

157. *See* ASHISH ARORA ET AL., MARKETS FOR TECHNOLOGY 4–5 (2001) (defining trade in technology as excluding corporate mergers and acquisitions and human capital).

158. *See* Lamoreaux & Sokoloff, *supra* note 30 ("[A]n extensive trade in new technological ideas did develop over the course of the nineteenth century . . . .").

159. Ashish Arora & Alfonso Gambardella, *Ideas for Rent: An Overview of Markets for Technology*, 19 INDUS. & CORP. CHANGE 775, 779 (2010) (reporting that technology royalty payments have increased an average of 10.7 percent per year from 1980 to 2003, faster than the growth in the world's gross domestic product).

per year, the equivalent of about 9 percent of "the total R&D spending in the USA, Japan, Germany, UK, France, Italy and Canada" in 1995.[160] By 2002, the annual market for technology licensing was about $66 billion in the United States and about $100 billion worldwide.[161]

The bulk of technology transactions has been concentrated in a few sectors, including chemicals, software, machinery, and engineering and management services.[162] In chemicals, the licensing of products and processes has been widespread.[163] The approach of BP Chemicals provides one example. In an area in which it was a market leader, acetic acid, BP granted licenses very selectively because its proprietary technology was uniquely strong, but in an area characterized by more competition, polyethylene, BP licensed more extensively.[164] Moreover, the biopharmaceutical industry has a record number of partnerships, with firms signing an estimated $32 billion worth of licensing deals in 2014.[165] In the semiconductor industry, the growth of fabless or chipless design companies has created opportunities to license.[166] Patents can be instrumental in such partnerships, giving patentees something to trade as well as a cheaper way than trade secrets to transact, given the risk of inadvertent disclosure or unprovable theft.[167]

Specialized invention entities like universities have been an important source of new ideas. Earlier work estimated that 15 percent of new industrial products, including 31 percent of new pharmaceutical products and 22 percent of new instrumentation products, could not have been timely introduced without academic research.[168] Though university research often does not originate inventions, it leads to them. For example, research on the organic chemical properties of silicon is credited with leading to the development of industrial silicones.[169] After the Bayh-Dole

160. Ashish Arora et al., *Markets for Technology and Their Implications for Corporate Strategy*, 10 INDUS. & CORP. CHANGE 419, 424 (2001).

161. Arora & Gambardella, *supra* note 159, at 779.

162. *See* Arora et al., *supra* note 160, at 425 tbl.2.

163. *See* Ashish Arora & Alfonso Gambardella, *Evolution of Industry Structure in the Chemical Industry*, *in* CHEMICALS AND LONG TERM ECONOMIC GROWTH 379, 388–89 (Ashish Arora et al. eds., 1998) (describing the "gentleman's club" of chemical industry cartels in Europe before World War II).

164. ARORA ET AL., *supra* note 157, at 21–22.

165. *See* The Bos. Consulting Grp., *supra* note 35 (reporting 559 deals and a $57 million average upfront deal value in 2014).

166. ARORA ET AL., *supra* note 157, at 76–81.

167. LANDES & POSNER, *supra* note 55, at 329.

168. Edwin Mansfield, *Academic Research and Industrial Innovation: An Update of Empirical Findings*, 26 RES. POL'Y 773, 774 tbl.1 (1998).

169. Mansfield, *supra* note 128, at 56.

Act[170] was passed in 1980, making it easier for universities to patent their inventions,[171] partnerships with universities have reportedly created over 4,000 start-ups.[172] The Association of University Technology Managers estimates that in 2012, seventy university alliances led to $36.8 billion of net product sales at start-ups that employed 15,741 full-time employees.[173] According to another estimate, universities originated 330 start-ups in 2003 and 647 in 2012.[174]

Though exclusive licenses dominate at some research institutions, universities make extensive use of nonexclusive licensing to disseminate their technologies. Much of the research at universities is paid for by federal funds and is subject to a license to the federal government.[175] Thus, while about 75 percent of licenses generated by the University of California from 1990 to 2005 were exclusive,[176] nonexclusive licenses have since dominated nationally.[177] More nonexclusive than exclusive licenses were reported to the Association of University Technology Managers from 2000 to 2009.[178] So-called platform technologies such as the seminal Cohen-Boyer patents over DNA technology have been licensed broadly and nonexclusively, consistent with federal funding requirements and scientific norms.[179] National Institutes of Health guidelines and sponsored research

170. Bayh-Dole Act, 35 U.S.C. §§ 200–212 (2012).

171. *See generally* David C. Mowery & Bhaven N. Sampat, *The Bayh-Dole Act of 1980 and University–Industry Technology Transfer: A Model for Other OECD Governments?*, *in* ESSAYS IN HONOR OF EDWIN MANSFIELD 233 (Albert N. Link & F.M. Scherer eds., 2005) (examining the effects of the Bayh-Dole act on collaborations between universities and industries).

172. Ass'n of Univ. Tech. Managers, *The Bayh-Dole Act: It's Working*, AUTM, https://www.autm.net/AUTMMain/media/Advocacy/Documents/BayhDoleTalkingPointsFINAL.pdf (last visited Apr. 15, 2016). *But see* Mowery & Sampat, *supra* note 171, at 242–43 (arguing that the Bayh-Dole Act was neither necessary nor sufficient for stimulating university spinoffs).

173. Ass'n of Univ. Tech. Managers, *supra* note 172.

174. WALTER D. VALDIVIA, UNIVERSITY START-UPS: CRITICAL FOR IMPROVING TECHNOLOGY TRANSFER 13 (2013), http://www.brookings.edu/~/media/research/files/papers/2013/11/start-ups-tech-transfer-valdivia/valdivia_tech-transfer_v29_no-embargo.pdf.

175. Sara Boettiger & Alan B. Bennett, *Bayh-Dole: If We Knew Then What We Know Now*, 24 NATURE BIOTECHNOLOGY 320, 320 (2006).

176. Brian D. Wright et al., *Industry-Funded Academic Inventions Boost Innovation*, 507 NATURE 297, 298 (2014).

177. *See* Loise & Stevens, *supra* note 36, at 187–88 (reporting that in fiscal year 2008, an estimated 56 percent of university licenses were nonexclusive).

178. Jacob H. Rooksby, *University Initiation of Patent Infringement Litigation*, 10 J. MARSHALL REV. INTELL. PROP. L. 623, 632 n.50 (2011).

179. Jay P. Kesan, *Transferring Innovation*, 77 FORDHAM L. REV. 2169, 2173–74 (2009). Some of these commitments are made in the form of mutual agreements not to assert rather than in the form of revenue-generating licenses. *See, e.g.*, Jorge L. Contreras, *Patent Pledges*, 47 ARIZ. ST. L.J. 543, 555 (2015) (describing the commitment of MIT to not assert RNA-based technology in order to support distribution of research reagents); Sharon Begley, *Clash of Scientific Titans: CRISPR Hits the Courts*,

agreements explicitly encode a preference for nonexclusive over exclusive licenses to research tools.[180]

Nonexclusive licensing also forms the basis for the dissemination of technologies subject to the estimated hundreds of thousands of patent standards,[181] each of which covers a handful to thousands of patents.[182] For example, standards enable the makers of devices to design their products with the ability to connect to the Internet even when the technology for doing so is patented.[183] In exchange for the privilege of being included in a standard like Wi-Fi, patent holders that participate in the development of the standard are often required to provide their patents on RAND or royalty-free licensing terms.[184] However, the licensing fees that must be paid to implement the standards can raise barriers to participation.[185]

Markets for technology foster innovation by providing for licensing inventions as well as platforms like standards that promote innovation by diffusion.

C. FREEDOM TO OPERATE AND DEFENSIVE PATENTS

A third mechanism by which patents encourage the spread of ideas is through enabling innovators' freedom to operate.[186] While it often seems that there are only two approaches for supporting innovation with patents—to opt in and exclude or to opt out and share[187]—a widely used approach between the two is the acquisition patents *in order to share*, using mechanisms like nonexclusive patent pooling, standard-setting, or defensive patenting, at times in conjunction with open source strategies. [188]

with Money and Prestige at Stake, STAT (Mar. 8, 2016), http://www.statnews.com/2016/03/08/crispr-patent-fight (describing the commitments that have been made by the Broad Institute to "widely share" access to CRISPR gene editing technology).

180. Boettiger & Bennett, *supra* note 175, at 321.

181. KNUT BLIND ET AL., STUDY ON THE INTERPLAY BETWEEN STANDARDS AND INTELLECTUAL PROPERTY RIGHTS (IPRS) 11 (2011), http://www.iplytics.com/download/docs/studies/ipr_study_final_report_en.pdf ("[S]everal hundred thousands of standards [are] available world-wide.").

182. *See id.* at 36–37 tbl.3-3 (listing total patents claimed in each studied standard, each total ranging from ten to nearly three thousand patents).

183. *See* Chien et al., *supra* note 85, at 2–3.

184. *Id.*

185. BLIND ET AL., *supra* note 181, at 72.

186. *See* Schultz & Urban, *supra* note 24 (providing an overview of various approaches companies have used to preserve freedom to operate).

187. *See generally* ISAACSON, *supra* note 26 (contrasting the open source public domain model that dominated the Internet and web with the proprietary model followed by the hardware and semiconductor industries).

188. *See supra* Part I.

Defensive patenting occurs when an entity acquires patents in order to trade with or deter assertions by others whose patents it may be practicing.[189] In complex technology areas in which advances build upon one another, competitors will often practice one another's patents. The overlapping rights create a sort of détente: due to the risk of retaliation, each firm is deterred from enforcing patents against the other, but each is also relatively freer to access the other's technology without having to clear access to the patent rights first. Defensive patenting gives those who need it the security to share their technology more openly and gives those who want it the ability to access and incorporate features that are patented by others.[190]

These freedoms come at a price, however. The costs required to support defensive patent portfolios have been called a drag on innovation and raise the cost of entry for smaller firms without the resources to develop large defensive portfolios.[191] Thus, even if the smaller company is never sued, the diversion of engineer time and company money to build patent portfolios can be significant.

The dynamic of patent standards is similar. For many technology suppliers, patents provide incentives for making technology widely available through standardization processes.[192] Such firms need assurances that their contributions will be rewarded in order to disseminate them in this way.[193] But the royalty costs associated with the adoption of standards can also deter entry.[194] Those who have large portfolios of patents of their own pay relatively less, but smaller firms with less to trade must pay relatively more, creating a sort of regressive tax on innovation.[195]

Still, the importance to firms of being able to access others' technology is reflected in survey results about the reasons for patenting

189. Chien, *supra* note 24, at 321–22.

190. Wesley M. Cohen et al., *R&D Spillovers, Patents and the Incentives to Innovate in Japan and the United States*, 31 RES. POL'Y 1349, 1360–61 (2002) (describing the acquisition of patents to secure "player" status in an industry, opening access to rivals' technology).

191. Carl Shapiro, *Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting*, *in* 1 INNOVATION POLICY AND THE ECONOMY 119, 124, 126–27 (Adam B. Jaffe et al. eds., 2001).

192. *See* BLIND ET AL., *supra* note 181, at 71–72.

193. *See id.*

194. *Id.* at 72.

195. *Id*. Whether the costs to entrants are a cause for concern is disputed and highly context-dependent. In the mobile telecommunications industry, for example, some argue that entry has continued to be robust and that entrants building on the foundation laid by incumbents should contribute, while others argue that many would-be entrants are deterred or shut out by licensing requirements. *See id*.

previously discussed.[196] Respondents selected among a number of motives for patenting that reflect the pursuit of freedom to operate:[197] preventing suits (58.8%),[198] negotiation or cross-licensing (47.4% and 26%, respectively),[199] and pure defense (45%).[200]

Exactly how many patents are primarily held for reasons of access rather than exclusion is unknown. But among the top fifty patent assignees in 2014,[201] many, if not most of them, can be considered high-tech companies that depend on freedom of action in order to keep up with the rapid pace of competition.[202] Five out of the top ten assignees[203] have taken steps to commit some or all of their patents to defensive uses, as described below.

In a quiet revolution, for example, LG Electronics has opened up tens of thousands of patents to small- and medium-sized companies;[204] and Samsung, Daewoo Shipbuilding & Marine Engineering, Hyundai Motor, and Panasonic have taken similar steps.[205] Google, which received the eighth most patents in 2014,[206] and Canon, which received the third most,[207] have both committed to a cross-licensing agreement restricting the transfer of any of their patents to entities focused on patent litigation.[208] IBM, the top assignee for patents,[209] as well as Sony, Google, LG Electronics, Canon, and over 2,100 other companies are signatories to the Open Invention Network's nonaggression pact ("OIN Pact"),[210] which commits them to granting royalty-free patent licenses over Linux

196. *See supra* notes 95–98 and accompanying text.

197. De Rassenfosse et al., *supra* note 97.

198. Graham et al., *supra* note 36, at 1299 fig.2; Cohen et al., *supra* note 94, at figs.7 & 8.

199. De Rassenfosse et al., *supra* note 97; Graham et al., *supra* note 36, at 1299 fig.2; Cohen et al., *supra* note 94, at figs.7 & 8; Nagaoka & Walsh, *supra* note 94, at fig.13.

200. Nagaoka & Walsh, *supra* note 94, at fig.13.

201. *See IFI CLAIMS 2014 Top 50 US Patent Assignees*, IFI CLAIMS PATENT SERVICES, http://www.ificlaims.com/index.php?page=misc_top_50_2014 (last updated Jan. 29, 2015).

202. *See id.*

203. These include IBM (1st), Canon (3rd), Sony (4th), Google (8th), and LG Electronics (9th). *IFI CLAIMS 2014 Top 50 US Patent Assignees*, *supra* note 201.

204. Ellis, *supra* note 15.

205. Ellis, *supra* note 16.

206. *IFI CLAIMS 2014 Top 50 US Patent Assignees*, *supra* note 201.

207. *Id.*

208. *LOT Agreement*, GOOGLE, http://www.google.com/patents/licensing/lot (last visited Apr. 15, 2016) (activating the pledge upon any transfer, but carving out transfer to a "Non-Assertion Entity").

209. *IFI CLAIMS 2014 Top 50 US Patent Assignees*, *supra* note 201.

210. *The OIN Community*, OPENINVENTIONNETWORK, http://www.openinventionnetwork.com/community-of-licensees (last visited Apr. 15, 2016) (listing 1,946 licensees); E-mail from Keith Bergelt, Chief Exec. Officer, Open Invention Network, to author (July 7, 2016) (on file with author).

technology to other signatories.[211] The OIN Pact is true to the spirit of "copyleft" licenses, which share the aim of creating a software commons through reciprocity—requiring those who benefit from others' forbearance to also forbear.[212]

D. PATENTS AND INNOVATION BY DIFFUSION

The three examples above describe ways patents further innovation through diffusion rather than exclusion. Instead of keeping their ideas and knowhow to themselves, firms are strategically sharing them in order to find partners, generate revenues, and enable greater access to the ideas of others. The patent system is an integral part of this exchange, with consequences for the social organization of innovation and the personal autonomy of creative professionals.[213]

If the Massachusetts Institute of Technology can provide its ideas to LEGO and see those ideas flourish, it can continue doing what it is best at—educating and innovating—while LEGO can do what it does best—developing, marketing, and selling great products. If individual inventors can come up with ideas like biosolvents and partner with companies to bring these ideas to market, they can share the benefits of seeing a successful product come to the market without having to acquire or develop the expertise that commercialization requires. Merges has argued that property rights and the ability to trade them enable creative people to work autonomously, with greater freedom to work on what they want, with whom they want, and in the way they want.[214] Robust markets for

211. *OIN License Agreement*, OPENINVENTIONNETWORK (May 1, 2012), http://www.openinventionnetwork.com/joining-oin/oin-license-agreement. The economic footprint of Linux is significant. The Linux kernel serves as the basis for Android, which captured 82.8 percent of the smartphone market in 2015, and the Chrome web browser, which captured over 60 percent of the browser market in 2015. *Browser Statistics*, W3SCHOOLS.COM, http://www.w3schools.com/browsers/browsers_stats.asp (last visited Apr. 15, 2016); *Smartphone OS Market Share, 2015 Q2*, IDC: ANALYZE THE FUTURE, http://www.idc.com/prodserv/smartphone-os-market-share.jsp (last visited Apr.15, 2016). Linux is used by 53 percent of websites that use UNIX, which in turn powers over 60 percent of all websites. *Usage Statistics and Market Share of Unix for Websites*, W3TECHS: WEB TECH. SURVEYS, http://w3techs.com/technologies/details/os-unix/all/all (last visited Apr. 15, 2016). Linux dominates supercomputer operating systems, though it lags behind Microsoft Windows and Apple Mac OS among desktop operating systems. Steven J. Vaughan-Nichols, *Linux Dominates Supercomputers as Never Before*, ZDNET (June 24, 2014, 12:21 PM), http://www.zdnet.com/article/linux-dominates-supercomputers-as-never-before; *OS Platform Statistics*, W3SCHOOLS.COM, http://www.w3schools.com/browsers/browsers_os.asp (last visited Apr. 15, 2016).

212. Loren, *supra* note 118, at 284–85.

213. MERGES, *supra* note 54, at 195–97. *See* Chien, *supra* note 116, at 1083–84 (describing the importance of autonomy and control, credit, and audiences to creators).

214. MERGES, *supra* note 54, at 212.

innovation create gains from trade and benefits from specialization, which from the time of Adam Smith have been perceived as drivers of modern economic growth.

The result is a more participatory and inclusive innovation ecosystem that does not discriminate on the basis of where an idea is born but enables the best ideas to find their way to the market through any of a variety of pathways. The following Part builds upon these examples to articulate a diffusion-focused framework for viewing the patent system.

III. TOWARD A DIFFUSION FRAMEWORK FOR THE PATENT SYSTEM

This Part articulates a novel diffusion framework for viewing the patent system. As described before, according to traditional accounts, during a patent's term a patentee can exclusively disseminate the technology through its own efforts or that of its licensees, while the world can learn from the technical description in the patent document. Post-expiration, all are free to use the technology. But as the examples in Part II show, technical knowledge need not be spread only through patent documents, nor must broad permission to practice inventions be relegated to the post-patent period. Open innovation and markets for technology enable inventors to transfer their technology and ideas to other settings on exclusive and nonexclusive bases. Defensive patenting strategies allow firms to more freely access each other's technologies without exchanging money before a patent expires. Patents create incentives for companies to share their technology broadly according to the terms dictated by standard-setting bodies.

This Part begins by describing a framework for patent diffusion and then applies this framework to three mechanisms of patent diffusion: disclosure, transfer, and the pursuit of freedom to operate.

A. A FRAMEWORK FOR PATENT DIFFUSION

As discussed, diffusion is the spread of ideas and knowledge from one setting to other settings through specific channels over time.[215] This Section describes a framework of patent diffusion based on the multiple channels by which knowledge of patented or patentable inventions and the permission to use that knowledge are spread from one setting to another.[216]

215. *See* ROGERS, *supra* note 126.
216. *See infra* Table 1.

TABLE 1. A Framework for Patent Diffusion

Mechanism of diffusion	*Channel of diffusion*	*Details*
Disclosure	Patents and related disclosures	Issued patents; product and marketing materials; ancillary disclosures by the inventor; practice of the patent
	Patent applications	Patent applications published eighteen months after filing; provisional patents incorporated into published applications
	Defensive publication	Disclosures intended to preempt patenting of the invention and put the invention in the public domain
Transfer	Technology licenses and agreements	Exclusive or nonexclusive one-way licensing or cross-licensing; technology transfer from universities or federal labs to firms
	Patent pools and standards	Technology made available on RAND or royalty-free terms by collective rights organizations
Sharing	Defensive patent strategies	Holding patents to provide access to technology and freedom from suit; patent trading
	Patent waivers and pledges	Nonassertion or royalty-free licensing promises; humanitarian or related waivers; expiration of patents

The patent system can encourage the spread of technical information and permissions not only through patents themselves, but also through, for example, patent applications, patent practice, defensive publications, and technology licenses. Each of these channels of diffusion can be associated with one of three patent-related mechanisms for spreading technical knowledge and the permission to use it from one setting to another.

Disclosure encompasses the diffusion of information about patented or patentable inventions from the inventor to the world. The diffusion of this knowledge can take place through patent documents and products but comes without the permission to practice the invention until the patent is out of force. However, the patent system also encourages disclosures in the

form of patent applications and defensive publications. When they succeed, defensive publications move the invention into the public domain, enabling all to use them.[217]

Technology *transfers* convey information about and permission to practice the invention from the patentee to one or more commercializers of the technology. This diffusion can take place, for example, through exclusive licenses that transfer technology from one setting to another or through nonexclusive licenses that provide rights to multiple technology implementers. The patent rights are often just one component of the transfer, which also may include know-how, personnel, and related resources needed to implement the technology.[218]

Acts that facilitate *sharing* of patented or patentable technologies enable the freer spread of information and permissions within the innovation ecosystem. These acts can take place before or during the term of a patent and can be initiated by innovators who seek freedom to operate or patentees who want to share their inventions with others. During the term of a patent, permission to practice can be provided by the patentee through mechanisms like selective patent waiver or promises to forbear, and can be extended through practices like defensive patenting. The patentee may also put the invention in the public domain by letting it expire before its full term.[219]

Embracing diffusion does not require rejecting exclusion. In fact, in each of the aforementioned primary mechanisms of patent diffusion, the right to exclude plays an important role. For example, to the extent that it motivates the disclosure of useful information,[220] patent exclusivity is needed to have something to diffuse in the first place. In the case of technology transfer from a patentee to a commercializer, the patentee's right to exclude can be vital to the patentee's willingness to engage in discussions with a potential partner,[221] who may in turn only be interested in an exclusive license. And defensive patenting to enable freedom to operate depends critically on the parties' symmetric ability to retaliate if attacked. Certainly, diffusionary and exclusionary priorities can be at odds—for example, when patentees forbear from patenting due to the

217. *See infra* Part III.B.

218. *See infra* Part III.C.

219. *See infra* Part III.D.

220. The relatively low importance of patents as sources of technical knowledge is discussed in Part III.B.1.

221. *See infra* Part III.C.1 (describing the role of patents in overcoming Arrow's information paradox).

secrets they must reveal.[222] But in many cases, they work in tandem.

However, focusing on patent diffusion does require the patent system to change its orientation and reconsider levers that have largely been overlooked by patent scholars and policymakers. For example, the patent system's current bias toward exclusion manifests itself in certain defaults that presume that patentees prefer "closed" rather than "open" options; a new focus on diffusion would require revisiting them. In addition, the patent system currently does not make it easy for patentees to choose diffusion- or pure defense-based strategies.[223] In addition, those who want to put their technologies in the public domain purposefully have no guarantee of being able to do so. A diffusion focus would change that.

The following Sections draw upon three disparate strands of patent theory and extend them by applying the diffusion framework described above to reveal largely neglected levers of patent diffusion.

B. DIFFUSION BY DISCLOSURE

"The disclosure required by the Patent Act is 'the *quid pro quo* of the right to exclude,'"[224] the Supreme Court held. The patent document must disclose the invention "in sufficient detail to enable one skilled in the art to practice the invention"[225] and "stimulate ideas and the eventual development of further significant advances in the art."[226] This view makes patent documents the primary instrument of patent disclosure and, indeed, the measure of whether exclusive rights are warranted.

A focus on diffusion requires looking beyond the four corners of a patent. The patent system induces disclosure not only in the patent itself, but also through practice and defensive publications. The terms on which this storehouse of information can be accessed also matter. The mere production of knowledge does not guarantee that others will be able to exploit it.[227] This Section extends disclosure theory to consider both

222. *See* Graham et al., *supra* note 36, at 1311 fig.4 (indicating that 35 percent of companies listed "[d]id not want to disclose information" as a reason they decided not to patent).

223. Nagaoka & Walsh, *supra* note 94, at fig.13 (showing that 45 percent of U.S. survey respondents indicated that holding patents for "pure defense" was an important or very important motive for getting patents). *See supra* Figure 1.

224. J.E.M. Ag Supply, Inc. v. Pioneer Hi-Bred Int'l, Inc., 534 U.S. 124, 142 (2001) (quoting Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470, 484 (1974)).

225. Universal Oil Prods. Co. v. Globe Oil & Ref. Co., 322 U.S. 471, 484 (1944).

226. *Kewanee Oil Co.*, 416 U.S. at 481.

227. *See* JOEL MOKYR, THE GIFTS OF ATHENA 8–15 (2002) (describing problems with the transmission of human knowledge).

content and access levers that can boost the diffusion of technical information to society through the patent system.

1. Diffusion by Patent Document

To mature into a patent, each patent application must contain a description of the invention, how it can be made and used, the best way of practicing the invention, and demonstrated possession by the applicant.[228] The main question is whether the "additions to the general store of knowledge" patents provide in accordance with these legal requirements are in fact worth the "high price of . . . exclusive use."[229] Critics argue that they often are not.[230] First, patents today are poorly written because they serve both legal and technical aims[231] in the hybrid language of "patentese."[232] Second, firms may have incentives to omit important technical details[233] and may provide legally insufficient disclosure.[234] Third, disclosed secrets often are not truly secret but are already revealed in the case of self-disclosing inventions, resulting in gratuitous grants of patents.[235] Fourth, patents can hinder disclosure by preventing the publication of ideas that a researcher might later want to patent.[236]

The available survey evidence reinforces a dim view of patents as

228. 35 U.S.C. § 112 (2012) (requiring patents to satisfy the enablement, written-description, definiteness, and best-mode requirements of patent law). *See generally* ROBERT PATRICK MERGES & JOHN FITZGERALD DUFFY, PATENT LAW AND POLICY 262–63 (6th ed. 2013) (describing the four "disclosure doctrines" of patent law).

229. *Kewanee Oil Co.*, 416 U.S. at 481.

230. *See generally, e.g.*, James Bessen, *Patents and the Diffusion of Technical Information*, 86 ECON. LETTERS 121 (2005); Roin, *supra* note 80.

231. Fromer, *supra* note 72, at 564–65 (discussing the two layers—technical and legal—within the patent document and arguing that they should be demarcated).

232. Sean B. Seymore, *The Teaching Function of Patents*, 85 NOTRE DAME L. REV. 621, 633–64 (2010). *See, e.g.*, U.S. Patent No. 6,004,596 col. 4 l. 17–18 (filed Dec. 8, 1997) (describing a piece of bread as "a first bread layer having a first perimeter surface coplanar to a contact surface").

233. *See* Bessen, *supra* note 230, at 127 (concluding that the patent system does not enhance the diffusion of technical information).

234. *See* Subhashini Chandrasekharan et al., *Proprietary Science, Open Science and the Role of Patent Disclosure: The Case of Zinc-Finger Proteins*, 27 NATURE BIOTECHNOLOGY 140, 140–43 (2009) (describing the problem of nonenabling disclosures in information technology and how, in the particular biotechnology context of zinc-fingered proteins, patents confer "'practical excludability' because they do not meet the statutory obligation of enabling scientists to practice the inventions that the patents cover").

235. Katherine J. Strandburg, *What Does the Public Get? Experimental Use and the Patent Bargain*, 2004 WIS. L. REV. 81, 117–18. *See also* PATENT SYSTEM REVIEW, *supra* note 58, at 32 (noting "the inability of manufacturers to keep secret most of the technology they use"); Roin, *supra* note 80, at 2015–16 ("[C]ompanies in the computer hardware industry rarely patent inventions that can be kept secret.").

236. PATENT SYSTEM REVIEW, *supra* note 58, at 32.

sources of information. For example, in a survey of 650 publicly traded firms, patent disclosures placed sixth out of seven types of disclosures listed in the question ranking effectiveness of learning information.[237] Only 8–12 percent of small- and medium-sized enterprises polled in the United Kingdom "consider[ed] patents . . . of some importance as a source of information," but less than customers, suppliers, competitors, and other information sources.[238] In a survey of R&D laboratories in the United States, patents also were considered important less of the time than publications and informal exchanges were.[239] As the opportunities for exchange grow exponentially through communication platforms such as social media and the Internet, and as search technologies make it easier to find relevant information, patents may fall even further behind.

But even if patents are not the most important sources of information, this does not mean that they do not have value. This point is underscored in a forthcoming study. Inventors were asked "to quantify the time saved for the respective invention process" when patent information was and was not available.[240] The responses showed considerable differences across industries.[241] Across all industries, the median time saved was 5.9 hours and the average time saved was 12.2 hours, but in the field of organic chemicals, the median patent reader saved 36 hours of time.[242] In contrast, the median digital communication technology patent reader saved only 1.0 hour.[243] That patents are likelier to disclose more useful details in certain industries than others is reflected in concerns about patenting expressed in other contexts. For example, 59 percent of biotechnology start-ups that responded to the 2008 Berkeley Patent Survey stated that their last decision

237. *See* Richard C. Levin et al., *Appropriating the Returns from Industrial Research and Development*, 3 BROOKINGS PAPERS ON ECON. ACTIVITY 783, 806 tbl.6 (1987).

238. *See* Stuart MacDonald & Bernard Lefang, *Patent Information Survey: Information for Innovation: Surveys of Innovating and Patenting Small Firms*, 13 COMPUTER L. & SECURITY REV. 344, 345–46 (1997) (concluding that 8 percent of nonpatenting firms and 12 percent of patenting firms considered patents important).

239. *See* Cohen et al., *supra* note 190, at 1363 fig.6. *See also* Lisa Larrimore Ouellette, *Do Patents Disclose Useful Information?*, 25 HARV. J.L. & TECH. 531, 534 n.11 (2012) (stating that only 30 percent of surveyed academic nanotechnology researchers reported finding useful technical information in patents and that a subset of those surveyed failed to even consider patents as sources of information).

240. Bronwyn H. Hall & Dietmar Harhoff, *Recent Research on the Economics of Patents*, 4 ANN. REV. ECON. 541, 550 (2012). Dietmar Harhoff confirmed that the survey results from the forthcoming survey by Alfonso Gambardella, Dietmar Harhoff, and Sadao Nagaoka are correctly recounted in this Article. E-mail from Dietmar Harhoff, Munich Sch. of Mgmt., to author (Jan. 28, 2016, 12:18 PM) (on file with author).

241. Hall & Harhoff, *supra* note 240.

242. *Id.*

243. *Id.*

not to patent was influenced by their desire not to disclose their invention.[244] Only 25 percent of software start-ups shared this concern.[245] Even if the invention is disclosed elsewhere, patents often contain details that are not otherwise available.[246]

Thus, the answer to the question of whether patents provide technical teaching seems to be sometimes, but generally less so than other sources of information. However, there are a number of other disclosures besides patent documents that the patent system can encourage.

2. Diffusion by Patent Application

Although studies generally do not do so, it is important to distinguish patent applications from patents as sources of technical information. This is underscored by the relatively lower patent grant rate in other countries. For example, only 56 percent of Japanese applications turn into patents, in contrast with 87 percent in the United States.[247] This means that about 44 percent of applications to the Japanese Patent Office will stay in the public domain, where others may imitate them.[248] Patent applications teach the public in the same way that patents do, but the world is not prevented from practicing the invention if the application never becomes a patent. This may explain, in part, the importance that Japanese innovators assign to patent disclosures compared to other sources of information.[249] In the same survey, U.S. firms ranked patents third, behind publications and informal exchanges.[250] About 85 percent of Japanese firms indicated that patents were moderately or very important sources of information, while about 49 percent of U.S. firms indicated the same.[251]

Despite the United States Patent and Trademark Office's ("USPTO") high patent grant rate, many U.S. patent applications do not mature into patents. Provisional patent applications are informal documents that

244. Graham et al., *supra* note 36, at 1313 & tbl.2.

245. *Id.*

246. *See* Ouellette, *supra* note 239, at 561 (describing the detailed protocols and recipes available in patents but not academic publications).

247. *See* Christopher A. Cotropia et al., *Patent Applications and the Performance of the U.S. Patent and Trademark Office as of FY 2014* tbl.5 (Richmond Sch. of Law, Paper No. 2015-01, 2015), http://law.richmond.edu/docs/FY-2014-Update-Figures-and-Tables-1996-2014-29.pdf (comparing U.S. patent allowance rates "[c]orrected for [r]efiled [c]ontinuing [a]pplications" with the average grant rate in Japan for the period 1996–2003).

248. *See id.*

249. Cohen et al., *supra* note 190, at 1363 fig.6 (ranking patents as the most important source of information on rival's R&D).

250. *See id.*

251. *Id.*

describe an invention.[252] Although they do not become patent applications until a formal application is filed, applicants are incented to include full, enabling descriptions in their provisional submissions.[253] According to current law, provisional patent applications are not published by the USPTO.[254] But filers of provisional applications may want to disclose them, at least in order to decrease the chances that others will secure patents over the same inventions. This calls into question the patent system's blanket nonpublication of provisional applications.

3. Diffusion by Defensive Publication

Another overlooked way in which the patent system encourages technical disclosure is through its ability to provide freedom to operate in return for the disclosure of an idea through defensive publication.[255] Because only new and nonobvious ideas can get patented, creating a public disclosure that describes an invention, yet is not accompanied by a patent application, creates prior art against subsequent applications and therefore thwarts the ability of others to later claim the invention.[256] This means that the discloser and the rest of the world will not be precluded from practice by a later-issued patent, securing freedom of action without the cost of patenting.[257] It also increases the quality of patents that do issue, as it raises the bar by which new applications are evaluated.[258] From a diffusion perspective, this may represent the best of both worlds: society not only gets the content of the disclosure, but also the permission to practice it.

Innovators use a number of outlets to defensively publish. Companies like IBM and Xerox have historically published and distributed their own technical journals to patent offices that detail developments in their

252. *See* Drew Harris et al., *Strategies for Resolving Patent Disputes over Nanoparticle Drug Delivery Systems*, 1 NANOTECHNOLOGY L. & BUS. 372, 378 (2004) (characterizing provisional patent applications as "quick and dirty").

253. *See id.* ("The main benefit [of provisional patent applications] is that the filing date of the provisional application acts as a priority date for filing the patent in other countries under the [Patent Cooperation Treaty].").

254. 35 U.S.C. § 122(b)(2)(A)(iii) (2012).

255. *See* Scott Baker & Claudio Mezzetti, *Disclosure as a Strategy in the Patent Race*, 48 J.L. & ECON 173, 175 (2005) ("[T]he [defensive] disclosures are designed to preempt patents in instances in which the disclosing firm does not itself plan to pursue patent protection but fears that its rivals might.").

256. *Id.* at 175–76. *See* Gideon Parchomovsky, *Publish or Perish*, 98 MICH. L. REV. 926, 927 (2000).

257. *See* Baker & Mezzetti, *supra* note 255, at 176.

258. *See* Douglas Lichtman et al., *Strategic Disclosure in the Patent System*, 53 VAND. L. REV. 2175, 2178 (2000) ("[T]he fact that patent applications are evaluated in light of the prior art gives firms a strategic incentive to disclose information to the public.").

research.[259] There are also well-known outlets for defensive publication,[260] including the website IP.com, which bills its Prior Art Database as "the world's first and largest online prior art disclosure service,"[261] and *Research Disclosure*, a defensive publishing journal that has been around since the 1960s.[262] These are disclosures that happen because of the patent system. However, while defensive publications are reportedly used widely in places like Germany,[263] and while they have been used successfully in certain U.S. biotechnology contexts,[264] domestically, the use of defensive publications as strategic tools is not widespread. Only 28 percent of intellectual property-owner respondents to a survey strongly agreed or agreed with the statement, "Defensive publication is an important strategic tool for my company," while 69 percent of respondents disagreed or strongly disagreed.[265] Given defensive publication's significant advantages for diffusion, it is worth considering why this is the case and whether changes are warranted.

4. Access Levers in the Disclosure of Patent Information

Another dimension of patent diffusion concerns the terms of access to patent texts. Though they have received scant attention, access levers in the disclosure of patent texts, including timing, search costs, and legal penalties, can accelerate or hinder the spread of ideas described in patents. For example, patent applications are typically published eighteen months after they are filed. However, unlike most of the world, U.S. applicants can

259. Baker & Mezzetti, *supra* note 255, at 174.

260. *See id.* at 173–74 (describing services that "place nonpatented technology in the public domain").

261. *Technical Disclosure*, IP.COM, https://ip.com/technical-disclosure (last visited Apr. 15, 2016). *See also* Baker & Mezzetti, *supra* note 255, at 174 n.1 (describing the disclosure services of IP.com).

262. Bill Barrett, *Defensive Use of Publications in an Intellectual Property Strategy*, 20 NATURE BIOTECHNOLOGY 191, 193 (2002); *About Research Disclosure*, RES. DISCLOSURE, http://www.researchdisclosure.com/about-research-disclosure (last visited June 21, 2016).

263. *See* Joachim Henkel & Stefanie Pangerl, Defensive Publishing 2, 17 (May 2008) (unpublished manuscript), http://ssrn.com/abstract=981444 (reporting that 70 percent of sampled companies "in the German DAX 30 stock index active in technology-based industries" used defensive publications for up to 30 percent of their inventions).

264. *See, e.g.*, Robert P. Merges, *A New Dynamism in the Public Domain*, 71 U. CHI. L. REV. 183, 186–91 (2004) (describing the publication of databases to prevent the patenting of gene sequences and genome data).

265. IAIN M. COCKBURN & REBECCA HENDERSON, SURVEY RESULTS FROM THE 2003 INTELLECTUAL PROPERTY OWNERS ASSOCIATION SURVEY ON STRATEGIC MANAGEMENT OF INTELLECTUAL PROPERTY, at I.1 (2003), www.ipo.org/wp-content/uploads/2013/04/survey_results_revised.pdf (surveying Intellectual Property Owners Association member companies).

keep their patent applications secret for their entire pendency.[266] When an unpublished application becomes a patent, it will be released to the world; however, this typically occurs years after the application date.[267]

The timing of patent publications matters. A recent study compared biomedical-patent inventions published eighteen months after the patent application with inventions that were not disclosed until the patent issued.[268] Inventions that were published earlier were licensed ten months earlier on average.[269] The shorter licensing cycle was attributed to the earlier clarification of the inventor's rights.[270]

Another variable that impacts access to patented information is the ability to sift through large quantities of patents and find relevant ones. Numerous commentators have lamented the high costs of searching for relevant patents in fields of cumulative information.[271] But there is no easy way to tell who owns which patents,[272] which patents are being practiced, or how to discern other indicia of relevance.

Finally, the legal doctrine of willfulness creates strong disincentives for inventors to read patents.[273] Under the willful-infringement rule, a court can award treble damages to a patentee if it finds that the infringer acted

266. *See* Stuart Graham & Deepak Hegde, *Disclosing Patents' Secrets*, 347 SCIENCE 236, 236 (2015) (noting that despite congressional efforts to harmonize U.S. patent application publication "with virtually all other nations," U.S. applicants still can opt out of publication).

267. U.S. PAT. & TRADEMARK OFF., FISCAL YEAR 2014 PERFORMANCE AND ACCOUNTABILITY REPORT 2 (2014), http://www.uspto.gov/about/stratplan/ar/USPTOFY2014PAR.pdf (reporting the average total pendency of a patent to be 27.4 months).

268. Deepak Hegde & Hong Luo, *Patent Publication and the Market for Ideas* 3 (Harv. Bus. Sch., Working Paper No. 14-019, 2016), http://ssrn.com/abstract=2293225 (forthcoming in MGMT. SCI. (2016)).

269. *Id.* at 21.

270. *Id.* at 25–26. *See also* Joshua S. Gans et al., *The Impact of Uncertain Intellectual Property Rights on the Market for Ideas: Evidence from Patent Grant Delays*, 54 MGMT. SCI. 982, 996 (2008) (documenting a 70 percent increase in the hazard rate for licensing when a patent is granted and concluding that "innovators are causally influenced by the receipt of [intellectual property] rights and . . . the dynamics of commercialization strategy are influenced by the operation of the patent system").

271. *See, e.g.*, Rebecca S. Eisenberg, *Patent Costs and Unlicensed Use of Patented Inventions*, 78 U. CHI. L. REV. 53, 55 (2011) ("Information costs and transaction costs may dwarf potential gains to users from identifying and clearing rights . . . ."); Christina Mulligan & Timothy B. Lee, *Scaling the Patent System*, 68 N.Y.U. ANN. SURV. AM. L. 289, 291–92 (2012) (discussing the high discovery costs of finding relevant patents).

272. *See* Colleen V. Chien, *The Who Owns What Problem in Patent Law* 2 (Santa Clara Univ. Sch. of L., Working Paper No. 03-12, 2012), http://ssrn.com/abstract=1995664 (explaining the lack of an ownership recording requirement and the disambiguation challenge that results from the nonuniform use of assignee information).

273. Fromer, *supra* note 72, at 587.

willfully.[274] Firms are disincentivized from reading others' patents because doing so "avoid[s] the risk of any knowledge of relevant patents and thus any willful infringement."[275] This structural problem with respect to enabling effective diffusion of patented knowledge has been widely recognized.[276] In addition, while no penalty accompanies the reading and practice of patents that have entered the public domain, it is very difficult to tell if a patent has expired or is still in force.[277]

In sum, applying a diffusion framework to the issue of patent disclosure reveals a number of largely ignored levers for influencing the content, timing, and uptake of disclosures encouraged by the patent system. These include pre-grant publication of patent applications, publication of provisional applications, and the encouragement of defensive publication. These levers are explored in Part IV.

C. DIFFUSION BY TRANSFER

Another justification for the patent system is that it facilitates the diffusion of technology from one setting to another through technology licensing. With some notable exceptions,[278] commercialization justifications for the patent system have received less attention than the classic reward-for-invention-and-disclosure rationale for the patent system. But the changing nature of innovation justifies paying more attention to the ways the patent system supports technology transactions.

274. *Id.* at 587–88.

275. *Id.* at 588.

276. *See, e.g.*, *id.* ("[T]he rule of willful infringement hinders the patent system's disclosure function."); Timothy R. Holbrook, *Possession in Patent Law*, 59 SMU L. REV. 123, 142 (2006) ("The doctrine of willful infringement provides another structural infirmity to the ability of patents to perform a teaching function.").

277. A number of factors limit the ability of the public to find patents that are no longer in force. First, while the status of an individual patent can be determined by looking at the USPTO website, there is no ability to search among expired patents. *See Patent Full-Text Databases*, U.S. PAT. & TRADEMARK OFF., http://patft.uspto.gov (last visited Apr. 15, 2016). In addition, when a patent is no longer in force due to the failure to pay maintenance fees rather than due to the end of its term, it can be revived at any time during its potential term upon a showing that the patent was "unintentionally abandoned," spawning the term "zombie patent." John M. Griem, Jr. & Theodore Y. McDonough, *Zombie Patents: Stronger than Ever*, CARTER LEDYARD & MILBURN LLP (May 14, 2014), http://www.clm.com/publication.cfm?ID=489.

278. *See generally, e.g.*, Michael Abramowicz & John F. Duffy, *Intellectual Property for Market Experimentation*, 83 N.Y.U. L. REV. 337 (2008); F. Scott Kieff, *Property Rights and Property Rules for Commercializing Inventions*, 85 MINN. L. REV. 697 (2001); Kitch, *supra* note 76; Ted Sichelman, *Commercializing Patents*, 62 STAN. L. REV. 341 (2010).

1. Diffusion by Trust

According to commercialization theory, patents make transacting easier in several ways. First, they increase trust between patent owners and potential partners, providing a solution to the problem of selling information, known as Arrow's information paradox. Arrow's theory suggests that in the absence of legal protection, sales of information are hampered by the disclosure of the information during negotiation because the owner will have to disclose the information in the process of selling it, obviating the need for the transaction.[279] Applying this theory, patents give inventors the security they need to engage in discussions with potential partners with diminished risk that their ideas will be appropriated.[280] Trade secrets are practically harder to transfer because disclosing a secret can destroy it.[281] Patents also encourage transactions by helping prevent duplicative investments.[282] Upon getting a patent, an inventor may have an incentive to seek out and license the technology to others.[283] Patents can play a coordinating role, drawing together complementary users.[284]

Yet reality is more complicated. For technology to be transferred from one setting to another through a technology license, a number of steps are required.[285] Not only must the parties trust and be willing to talk to each other, but they also first need to find each other and then go through a series of other steps, including agreeing on scope, price, and term before a deal can be reached.[286] Even when direct negotiations take place, almost half of the time the deal fails, according to a survey by Razgaitis and his colleagues.[287] The leading causes of failure reported by respondents to the survey were disagreements on financial and non-financial terms.[288]

European corporate patent holders are willing to license 70 percent

279. Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, *in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITY 609, 615 (Univs.-Nat'l Bureau Comm. for Econ. Research ed., 1962). *But see* Michael J. Burstein, *Exchanging Information Without Intellectual Property*, 91 TEX. L. REV. 227, 230 (2012) (criticizing the conventional premise that intellectual property can be justified on the basis of its limited ability to resolve Arrow's paradox).

280. *See* Arrow, *supra* note 279.

281. *See* Kitch, *supra* note 76, at 278.

282. *See* Arora et al., *supra* note 160, at 443.

283. Kitch, *supra* note 76, at 271–75, 277–78.

284. Kieff, *supra* note 278, at 712.

285. *See* Richard Razgaitis, *U.S./Canadian Licensing in 2006: Survey Results*, 42 LES NOUVELLES 641, 649 (2007).

286. *Id.* at 645–47 (recounting the various reasons why licensing deals fail).

287. *See id.* at 647 fig.2.

288. *See id.* at 647 fig.3.

more patents than are currently licensed;[289] the number may be even higher among university patent holders.[290]

There is room for reducing duplicative research. The European Union estimates that $20 billion is spent every year to develop innovations and technologies that have already been built.[291] To prevent this duplication, the parties need to be aware of each other, be willing to transact, and must agree on the terms of transfer.

To address undercommercialization, some have proposed more and stronger patent rights.[292] But stronger patent rights by themselves will not make it more likely that parties will find each other or agree to transact. In fact, stronger rights can have the opposite effect when they cause rights holders to overvalue their technology.[293] In transactions with universities, for example, companies often complain that universities aggressively patent, overvalue their intellectual assets, and issue unreasonable licensing terms.[294]

A diffusion lens for viewing the patent system picks up where commercialization theory leaves off. Rather than focusing only on trust and the theoretical ability to reduce duplicative research, a diffusion framework also takes into account existing barriers to technology-diffusing transactions.

2. Diffusion by Reduction of Search and Transaction Costs

Why are technology transactions not happening more readily? Those who have studied this question have identified a number of reasons. A persistent problem across both commercial and academic partnership settings is inherent uncertainty about the value of technology.[295] Patent values are so skewed that they have been analogized to lottery tickets.[296] In

289. Alfonso Gambardella et al., *The Market for Patents in Europe*, 36 RES. POL'Y 1163, 1164, 1180 (2007) (reporting that while 18 percent of European patents are offered for licensing, only 11 percent are actually licensed).

290. *See id.* at 1172–73 (reporting that although universities have a great propensity to license technologies, their share of licenses is very small).

291. Arora et al., *supra* note 160, at 424 n.5.

292. *E.g.*, Abramowicz & Duffy, *supra* note 278, at 408 (recommending consideration of a commercialization patent "where the hurdles to commercialization seem particularly daunting"); Sichelman, *supra* note 278, at 397–412 (proposing a commercialization patent that would be granted in exchange for the commitment to make and sell a substantially novel product).

293. *See* NAT'L RESEARCH COUNCIL ET AL., MANAGING UNIVERSITY INTELLECTUAL PROPERTY IN THE PUBLIC INTEREST 31, 48 (Stephen A. Merrill & Anne-Marie Mazza eds., 2011).

294. *Id.* at 31.

295. Arora & Gambardella, *supra* note 159, at 789–90.

296. Gideon Parchomovsky & R. Polk Wagner, *Patent Portfolios*, 154 U. PA. L. REV. 1, 24 (2005)

the university technology transfer context, for example, the 2007 revenue leader was New York University, which made more than $794 million, the vast majority of which was derived from one pharmaceutical license for a single commercially successful drug.[297] Only about 0.5 percent of license agreements generate more than $1 million in royalty income.[298] From 1993 to 2013, 87 percent of university technology transfer offices did not break even.[299] Prior to issuance of a patent, the parties have asymmetric information about the likelihood of its grant; the buyer may want a discount to account for the risk that a patent will not issue or will issue with inadequate scope.[300] Uncertainty about not only patent rights, but also threats to patents can have an impact.[301] Specifically, the presence of litigation or licensing demands on a young company can interfere with its ability to get financing or reduce the value of the firm. For example, an American technology firm that was sued saw its valuation plunge due to ongoing litigation, making it an easy target for a Chinese firm to acquire it at a deep discount.[302] Likewise, potential buyers of young firms may be deterred from buying technology due to the threat of a lawsuit against the target[303] or may ask for money to be put into escrow to cover the costs associated with resolving an existing legal threat. [304]

Company size and business culture also contribute to the likelihood of technology transactions. Large firms are less willing to license than small firms.[305] But they likely have the greatest stock of uncommercialized patents.[306]

Search costs in finding a technology partner and the friction in the licensing transaction also can be prohibitive.[307] There is no universal

(explaining the lottery theory of patents).

297. NAT'L RESEARCH COUNCIL ET AL., *supra* note 293, at 22.

298. *See id.* at 22 ("[O]nly one out of every 200 license agreements is expected to generate more than $1 million in royalty income. . . .").

299. *See* VALDIVIA, *supra* note 174, at 9 ("[O]ver the last 20 years, on average, 87% [of university technology transfer offices] did not break even.").

300. *See* Gans et al., *supra* note 270, at 988–94.

301. *See, e.g.*, Colleen V. Chien, *Patent Assertion and Startup Innovation* app. B at 48 (Santa Clara Univ. Sch. of L., Working Paper No. 26-13, 2013), http://ssrn.com/abstract=2321340 (describing how patent litigation risks "creat[e] friction in the acquisition process").

302. *Id.* app. B at 46–47.

303. *Id.* app. B at 47–48.

304. *Id.* at 17.

305. Arora & Gambardella, *supra* note 159, at 784.

306. *See id.* ("[L]arge firms are a significant reservoir of patents available for licensing, higher than the smaller firms.").

307. *See, e.g.*, NAT'L RESEARCH COUNCIL ET AL., *supra* note 293, at 9; Lamoreaux & Sokoloff, *supra* note 30 (describing the international search challenges that make trade in technological

marketplace for technology in which patentees can signal their willingness to license their technology or patents and in which potential buyers can express their desire to purchase such technology or patents.[308]

Deal friction is also a problem. Within commercial contexts, Arora and Gambardella cite fear of a "winner's curse" on the highest bidder when there are multiple potential buyers.[309] While this dynamic is not necessarily limited to technology transactions, because of the unique nature of intangible goods and the lack of an agreed-upon approach to technology valuation, the parties lack a common price anchor, and therefore may be separated by an unbridgeable distance in negotiations.[310]

Technology agreements in university settings have both similar and distinct issues. The asymmetries between technology buyer and seller are compounded by the fact that the party negotiating on behalf of the university seller is the technology transfer office rather than the university inventor with subject-matter expertise.[311] University negotiations are known to be accompanied by friction and delays.[312] When the buyer is an investor in a university spinoff, not only must the university trust that the investor will not steal its idea, but the investor also must trust the spinoff to perform. This creates what Cooter and Schäfer call a "double trust dilemma,"[313] a problem that is challenging because "the investor distrusts the innovator with her money, and the innovator distrusts the investor with his ideas."[314] The National Academy of Sciences has recommended that universities seeking to encourage entrepreneurship should consider instituting more standardized terms for licensing university-generated technology;[315] several universities have followed the recommendation.[316]

information difficult, and arguing that such obstacles have been overemphasized).

308. *See, e.g.*, Michael Risch, *Patent Portfolios as Securities*, 63 DUKE L.J. 89, 94 (2013).

309. *See* Arora & Gambardella, *supra* note 159, at 790.

310. Risch, *supra* note 308, at 103–05.

311. NAT'L RESEARCH COUNCIL ET AL., *supra* note 293, at 50 (describing technology transfer offices as having "little knowledge of the invention and, generally speaking, inadequate knowledge of the marketplace for it").

312. *Id.* at 8–9.

313. ROBERT D. COOTER & HANS-BERND SCHÄFER, SOLOMON'S KNOT 27–28 (2012).

314. ROBERT COOTER WITH AARON EDLIN, THE FALCON'S GYRE, at ix (version 1.4 2014).

315. NAT'L RESEARCH COUNCIL ET AL., *supra* note 293, at 8–9.

316. *See, e.g.*, *Supporting Innovation in the 21st Century Economy: Hearing Before the Subcomm. on Tech. and Innovation of the H. Comm. on Sci. and Tech.*, 111th Cong. 15–21 (2010) (statement of Mark Kamlet, Provost, Carnegie Mellon Univ.); *Five Percent, Go in Peace*, CARNEGIE MELLON UNIV.: GREENLIGHTING STARTUPS, http://www-test.cmu.edu/startups/go/index.html (last visited Apr. 15, 2016) (describing Carnegie Mellon University's "Five Percent, Go in Peace" model for technology transfer). The University of Minnesota, the University of California, San Diego, and Pennsylvania State University all have similar programs. *Licensing Process*, U. MINN.: OFF. FOR TECH.

To make a deal, the parties must want to sell or buy technology, be able to locate potential partners, be willing to talk to each other, and be willing to agree to the terms of the deal. Part IV considers how the patent system may be able to reduce some of the information and search costs that accompany each of these steps in transacting.

D. DIFFUSION BY SHARING

A final way by which technological knowledge spreads is by sharing. By affirmatively giving up rights to exclude, patent owners spread permissions to access and use technical knowledge. Freedom to operate motivates 45–59 percent of companies to patent.[317] But for patents to serve this purpose, they must be shared with, rather than held back from others. The more that others practice one's patents, the freer one is to practice others' patents.

Sharing may be done for humanitarian reasons as well. With patent licenses it has secured from the National Institutes of Health, Roche, Bristol-Meyers Squibb, and AbbVie, among others, the Medicines Patent Pool has expanded access to HIV medicines in over a hundred developing and emerging countries where the majority of people with HIV live.[318] The SARS corona virus pool, supported by the World Health Organization, and the Golden Rice pool, a prospective agricultural pool over patents to enrich rice with beta-carotene, also have humanitarian aims.[319] On the other hand, a desire to encourage and not impede downstream research has motivated the broad sharing of platform technologies[320] as well as the formation of technology exchanges and clearinghouses.[321] One such exchange is the Re:SEARCH initiative formed by the World Intellectual Property Organization ("WIPO") and BIO Ventures for Global Health "to catalyze new research and development for neglected tropical diseases," malaria and

COMMERCIALIZATION, http://www.research.umn.edu/techcomm/license-process.html (last visited Apr. 15, 2016); *Licensing Technology*, UC SAN DIEGO: OFF. INNOVATION & COMMERCIALIZATION, http://invent.ucsd.edu/invent/industry/licensing-technology (last visited Apr. 15, 2016); *Patents and Licensing*, PENNSTATE: OFF. VICE PRESIDENT FOR RES. PENN ST., http://www.research.psu.edu/patents (last visited Apr. 15, 2016).

317. *See supra* Figure 1.

318. *See Endorsements: What People Are Saying About the MPP*, MEDICINES PAT. POOL, http://www.medicinespatentpool.org/about/endorsements (last visited Apr. 15, 2016).

319. Geertrui Van Overwalle, *Patent Pools and Clearinghouses in the Life Sciences: Back to the Future*, *in* RESEARCH HANDBOOK ON IP AND THE LIFE SCIENCES (D. Mathews & H. Zech eds., forthcoming 2016) (manuscript at 11–12), http://ssrn.com/abstract=2729809.

320. *See supra* note 179 and accompanying text.

321. Van Overwalle, *supra* note 319, (manuscript at 12–14).

tuberculosis.[322]

Sharing can serve any of a variety of corporate or personal interests. Public-sector entities can achieve aims such as broader dissemination of the research they fund, and private companies can enhance profits, stimulate and clear the path for subsequent innovation, and generate feedback and innovation inputs.

Scholars have tended to look at particular vehicles of patent sharing in isolation.[323] But a diffusion lens looks more broadly at the potential gains and costs of more formally supporting sharing. That is because acts of sharing not only confer private benefits to patentees, but also have social benefits through greater diffusion and freedom of action.[324] Yet private and social benefits do not always align; for example, a company may receive positive press from promising that it will share its technology with others, but society does not benefit if this promise is not kept. There may be social gains from formalizing sharing commitments as long as formalization does not deter initial commitment making; for example, though patent pools can benefit many stakeholders, the start-up and administrative costs can be significant, potentially resulting in their underformation.[325]

This Section considers the various ways companies have tried to share their patents. The strong desire, and even need, to share patents in complex interdependent technologies and the checkered record of attempts to do so present opportunities to enhance the patent system's diffusive role.

1. Diffusion by Inclusion: Property Theory

How to square the exclusive rights of property with the inclusive desires of property owners has, over time, captured the attention of property scholars. The right to exclude allows, but does not obligate, property owners to exclude, making property owners like gatekeepers who can exclude or include others based on the circumstances.[326] Under Coasian conceptions of property, well-defined property rights are starting

322. *Id.* (manuscript at 14–15).

323. *See generally, e.g.*, Contreras, *supra* note 179 (discussing patent promises); Rebecca S. Eisenberg, *Noncompliance, Nonenforcement, Nonproblem? Rethinking the Anticommons in Biomedical Research*, 45 HOUS. L. REV. 1059 (2008) (discussing patent nonenforcement); Schultz & Urban, *supra* note 24 (describing the use of defensive patenting for sharing patented inventions).

324. *See* Kelley, *supra* note 122, at 871–77.

325. *See infra* notes 363–66 and accompanying text.

326. Henry E. Smith, *Property as the Law of Things*, 125 HARV. L. REV. 1691, 1710 (2012) ("The right to exclude does not require an owner, whether it be an individual, a group, or the state, to actually exclude others; the gatekeeper can decide to *include*.").

points rather than endpoints in the allocation of rights and relations between firms and people.[327]

In advancing the idea of a right to include alongside the right to exclude, Kelley cataloged the various ways property owners can include others and evaluated their costs and benefits.[328] Informal mechanisms like nonenforcement and waivers have the benefit of relative ease of administration and low transactions costs—no other party needs to be negotiated with or consulted. Informal mechanisms also have flexibility, as property owners can specify the range of rights that they give up, revealing their intentions according to their own timing.[329] But such mechanisms are less reliable and certain than more formal legal arrangements. Contracts with one or more parties giving up rights provide more certainty but are costly to administer and vulnerable to defects in formation.[330] Because contracts commit only their parties rather than the properties that they impact, they are also susceptible, like informal mechanisms, to changes in ownership and other future events,[331] and can leave the rights of third-party beneficiaries uncertain.[332]

Each of these mechanisms has been used to share patents. The largest number of patents are shared through nonenforcement, but they are increasingly shared through waiver and contract mechanisms. Each mechanism has its advantages and drawbacks, as described below.

2. Diffusion by Nonenforcement

Most patents are not enforced.[333] Unlike other means of sharing, nonenforcement is passive and ex post: it is effected through the failure of a

327. *See, e.g.*, Thomas W. Merrill & Henry E. Smith, *What Happened to Property in Law and Economics?*, 111 YALE L.J. 357, 359–60 (2001) (attributing to Coase the concept that "property has no function other than to serve as the baseline for contracting or for collectively imposing use rights in resources").

328. *See* Kelley, *supra* note 122.

329. *Id*. at 882–85.

330. *Id*. at 887.

331. *See* Van Houweling, *supra* note 124 (describing this limitation in contracts as "the problem of the future").

332. Kelley, *supra* note 122, at 890–91.

333. Mark A. Lemley, *Rational Ignorance at the Patent Office*, 95 NW. U. L. REV. 1495, 1496 (2001) (asserting that the "overwhelming majority" of patents are never enforced). Lerner and his colleagues found that the litigation hazard rate for a selected group of financial services-related patents averaged 2.11 percent—about four times more likely to be litigated than patents from other sectors. Josh Lerner et al., *Financial Patent Quality: Finance Patents After* State Street 28 tbl.9 (Harvard Bus. Sch., Working Paper No. 16-068, 2015), http://www.hbs.edu/faculty/Publication%20Files/16-068_702dabb8-70c5-4917-a257-75dc8b0c4f6b.pdf. However, this study likely understates the rate because the patents studied "have had relatively little time to be litigated yet." *Id.* at 28.

patentee to bring a suit once infringement has occurred.[334] In many cases, nonenforcement is not deliberate; instead, it is an artifact of the low commercialization rate of patents and the high cost of enforcement, including the discovery of infringement and uncertain or low damages.[335]

However, some nonenforcement is deliberate. As described earlier, the largest portfolios of patents are held by companies that rely crucially on freedom of action.[336] Sharing is facilitated by the mutually assured destruction that would result if parties exercised their overlapping rights in court. Nonenforcement is so pervasive that it has been suggested that it has caused the large proliferation of patents and that its potential harm to innovation has effectively become a nonproblem.[337]

However, in a number of cases, patents that companies have acquired for the sake of defensive purposes have turned offensive.[338] Triggers include changes to the patentee's business model or the transfer of patents to PAEs that face lower costs and constraints on assertion.[339] These transfers bring into focus the largest drawback to nonenforcement as a tool of sharing: its lack of durability. There is no reason, once a patent has changed hands, to expect that nonenforcement will continue.

3. Diffusion by Waiver

A more proactive way of promoting sharing is through affirmative waiver.[340] The number of public commitments to waive patent rights has proliferated in recent years, leading a nonprofit entity to memorialize such pledges in an online database.[341] This counteracts two limitations of waivers: their impermanence and the costs of searching for them, given the multiple forms that they can take.[342] Cisco and Yahoo! have used blog

334. *See* Lemley, *supra* note 333, at 1506 & n.51.

335. *See id.* at 1506.

336. *See supra* Part II.D.

337. Eisenberg, *supra* note 323, at 1075–76 (asserting that problems with patent clearance are not seriously affecting downstream product development).

338. Chien, *supra* note 24, at 342–43 (describing the phenomenon of once-defensive patents being used offensively).

339. *Id.*

340. *See generally* James Bessen & Alessandro Nuvolari, *Knowledge Sharing Among Inventors: Some Historical Perspectives*, *in* REVOLUTIONIZING INNOVATION 135–56 (Dietmar Harhoff & Karim R. Lakhani eds., 2016) (reviewing the history of knowledge-sharing, which included affirmative waivers of rights).

341. *Non-SDO Patent Statements and Commitments*, PROGRAM ON INFO. JUST. & INTELL. PROP., http://www.pijip.org/non-sdo-patent-commitments (last updated June 11, 2015).

342. *See* Contreras, *supra* note 179, at 596–98.

posts[343] and congressional testimony,[344] respectively, to announce promises not to sell patents to trolls. Airbnb, Dropbox, and other companies have signed on to YCombinator founder Paul Graham's "Patent Pledge," which commits firms listed on a website to refrain from enforcing software patents against companies with fewer than twenty-five employees.[345]

Patent holders have used waivers to drive technology adoption.[346] For example, commitments made in the context of technical standards—protocols that provide a common design for a product or process[347]—are meant to clear the way for the uptake of standards, which can implicate thousands of patent families.[348] A commitment to make these patents available on fair, reasonable, and nondiscriminatory ("FRAND") terms reassures standard adopters that they will not be subject to surprise attacks after adoption.[349] Standard-setting organizations commonly include these commitments in their bylaws, which patent holders agree to comply with when they submit membership applications in exchange for participating in the standard-setting process.[350]

Promises not to enforce patents have also been used to respond to public concerns. Following scrutiny of a broad patent Southern California Edison held on communications between utility companies and their customers, the company released the patent to the public.[351] Myriad Genetics, a company whose practices led the American Civil Liberties Union to file a suit to invalidate its highly controversial DNA patents,

343. Mark Chandler, *Good News for the Innovation Economy: The Tide's Turning Against Patent Trolls*, FORBES (Oct. 20, 2013, 8:30 AM), http://www.forbes.com/sites/ciocentral/2013/10/20/good-news-for-the-innovation-economy-the-tides-turning-againt-patent-trolls/#58b397f86254 ("Cisco in the past sold a small number of patents to two [nonpracticing entities] . . . . But we won't do it again.").

344. *Improving the Patent System to Promote American Innovation and Competitiveness: Hearing Before the H. Comm. on the Judiciary*, 113th Cong. 5 (2013) (statement of Kevin T. Kramer, Vice President and Deputy General Counsel, Intellectual Property, Yahoo! Inc.) ("We act responsibly when selling patents. Our policy has been to sell patents only to operating entities rather than to non-practicing entities. We do not want our patents to be obtained by a troll and irresponsibly asserted against others in the Internet industry.").

345. *The Patent Pledge*, THE PATENT PLEDGE, http://www.thepatentpledge.org (last visited Apr. 15, 2016).

346. *See supra* notes 13–14, 211 and accompanying text.

347. Mark A. Lemley, *Intellectual Property Rights and Standard-Setting Organizations*, 90 CALIF. L. REV. 1889, 1896 (2002).

348. For example, the Wideband Code Division Multiple Access standard, which covers mobile telecommunications, includes an estimated one thousand patent families. BLIND ET AL., *supra* note 181, at 62.

349. *See id.* at 12.

350. Contreras, *supra* note 42, at 516 tbl.2.

351. Contreras, *supra* note 179, at 554.

pledged to give free access to the patents to academic researchers.[352] This allowed the company to bolster its claim that it was not an aggressive enforcer of patents.[353]

While relatively easy to make, promises are hard to enforce under the law, except under limited circumstances. Those who have made promises to standard-setting bodies have been criticized for deviating from their public commitments.[354] Under the theory of promissory estoppel, though, only promises that lead to reasonable reliance are actionable against the promisor.[355] Showing reliance would be challenging in the case of pledges not to sell patents to PAEs: What action can a company reasonably say it took as a result of just this specific promise? But even in cases where a company adopts a patented technology and can prove that the patentee's promise not to sue factored into the decision, showing that the company otherwise would *not* have adopted the technology can be difficult. In addition, in some cases the promisee is not the implementer, but is instead a third-party organization—for example, one that sets the standard. But third-party promissory estoppel claims are generally harder to prove. Patent promises are often vague, failing to identify the patents that they cover.[356] Whether a court would find a promise that does not specify the scope of its own rights reasonable to rely upon is difficult to predict. Finally, if the patent changes hands, enforcement becomes far more challenging because promissory estoppel binds the promisor but not the promisor's successors in interest.[357]

4. Diffusion by Contract

Contract would seem to address some of the limitations of waivers and nonenforcement. Some companies have memorialized their promises to share patents through formal contracts with their employees[358] and with

352. *Id.*

353. *Id.*

354. *See, e.g.*, Merges & Kuhn, *supra* note 42, at 1 (describing the use of "bait-and-switch" and "snake-in-the-grass" tactics by patent holders).

355. RESTATEMENT (SECOND) OF CONTRACTS § 90 (AM. LAW. INST. 1981) ("A promise which the promisor should reasonably expect to induce action or forbearance on the part of the promisee or a third person and which does induce such action or forbearance is binding if injustice can be avoided only by enforcement of the promise. The remedy granted for breach may be limited as justice requires.").

356. Contreras, *supra* note 179, at 556 tbl.2.

357. Juliet P. Kostritsky, *The Rise and Fall of Promissory Estoppel or Is Promissory Estoppel Really as Unsuccessful as Scholars Say It Is: A New Look at the Data*, 37 WAKE FOREST L. REV. 531, 546 (2002).

358. Adam Messinger, *Introducing the Innovator's Patent Agreement*, TWITTER: BLOG (Apr. 17,

other companies,[359] for example. These deals yield reciprocal benefits, or consideration, and access to contract remedies. Yet they entail coordination and formation costs, raise antitrust concerns, and are vulnerable to some of the same problems that apply to waivers.

For example, the Inventor Protection Agreement that Twitter uses promises employees that Twitter will only use their patents for "defensive purposes,"[360] a commitment that has been used to attract talent and build culture at the firm.[361] While innovators outside the company are the main beneficiaries of the agreement, they are mere third parties to the contract, leaving them on shaky legal ground.[362]

Patent pools illustrate some of the issues that can beset patent contracts. While procompetitive, patent pools can also entail significant formation costs. Setting up a patent pool requires figuring out which patents belong in the pool.[363] The parties need to agree on royalties.[364] To capture the greatest efficiency gains, the pool must attract key patent holders, but often the included patents represent a small fraction of the relevant patents.[365] And patent pools are subject to antitrust scrutiny because restrictive licensing terms can raise anticompetitive concerns.[366]

This Part has articulated and applied a diffusion lens to the patent system. It has uncovered a largely overlooked set of levers that the patent system has for promoting the diffusion of technical knowledge and the rights to practice this knowledge. But, not surprisingly, many of these levers are currently set to default to exclusion. The changing nature of innovation makes it timely to reconsider these policies.

2012, 5:00 PM), https://blog.twitter.com/2012/introducing-innovators-patent-agreement.

359. *See supra* notes 204–208, 210–211 and accompanying text.

360. Benjamin Lee, *Brewing Our First IPA Patent, and New Adopters*, TWITTER: BLOG (May 21, 2013, 6:31 AM), https://blog.twitter.com/2013/brewing-our-first-ipa-patent-and-new-adopters.

361. *See* Joe Brockmeier, *Why Every Company Should Adopt Twitter's Innovator's Patent Agreement*, READWRITE (Apr. 17, 2012), http://readwrite.com/2012/04/17/why-every-company-should-adopt (describing the recruiting benefits of Twitter's move).

362. *See generally* David M. Summers, *Third Party Beneficiaries and the Restatement (Second) of Contracts*, 67 CORNELL L. REV. 880 (1982) (describing past and current challenges of nonparties in securing benefits from contracts).

363. *See* Shapiro, *supra* note 191, at 127.

364. *See id.* at 127–28.

365. Layne-Farrar & Lerner, *supra* note 83, at 298.

366. Richard J. Gilbert, *Antitrust for Patent Pools: A Century of Policy Evolution*, 2004 STAN. TECH. L. REV. 3, ¶ 105. *See supra* note 83 and accompanying text.

IV. DIFFUSIONARY PATENT LEVERS

This Part explores some ideas as to how our patent system could be changed to be more supportive of innovation by diffusion. In some cases, this Part borrows from suggestions others have already advanced, while in other cases, the suggestions below are starting points rather than endpoints for discussion. However, there are some potential concerns to address at the outset.

First, it is important that new options for diffusion represent true options rather than hard-coded presets—at least to start. For some inventions, the current patent system strikes the right balance between exclusion and diffusion. Giving innovators more options to diffuse their technologies should not disrupt the balance where diffusion is already working. But by giving inventors incentives to select, for example, earlier publication or "defensive-only" patents, the options here can further both private and public interests in the diffusion of technology and permissions when they are aligned.

Second, some may question why the patent system should be responsible for ensuring that innovators can diffuse technology to rivals and others when the system's constitutional mandate is to promote progress by securing "exclusive Right[s]."[367] This is a fair question with several responses. First, securing exclusive rights to inventors arguably requires giving control of these rights to inventors to loosen or tighten at their discretion. Providing inventors with more options to share their inventions and practice them with others, even during the term of the patent, is tantamount to giving them fine-grained controls over their rights to exclude. Second, a diffusion lens largely enhances, rather than displaces, existing rationales for the patent system. Diffusionary levers can be used to further the disclosure function of the patent system. When the patent system makes it easier to transfer technology, it achieves the constitutional goal of "promot[ing] the Progress."[368]

Institutional choice questions are also relevant. It is important to consider what Congress, courts, and executive agencies can and should do, as compared to the private sector. Within the public sector, the different duties and powers of the various institutions—for example, the USPTO, the Department of Justice, and the International Trade Commission—create

367. U.S. CONST. art. I, § 8, cl. 8.
368. *Id.*

options for the expression of different policy ideas.[369]

The specific design of any intervention is crucial to its successful implementation, but that is beyond the scope of this Article. The implementation options presented here all need further fleshing out and vetting. With these provisos in mind, the following Sections describe a few potential diffusionary levers for opening the patent system.

A. DIFFUSION BY DISCLOSURE

Some patent disclosures contain useful information, but there are currently a number of barriers to diffusing information on the earliest schedule possible. Removing these barriers could enhance the disclosure function of the patent system.

1. Default to Early Publication

A U.S. patent holder can keep a patent application it files in the United States secret during its entire pendency. When Congress debated about a bill that would eventually become the American Inventors Protection Act, a provision requiring U.S. inventors to publish their applications received harsh criticism.[370] A group of twenty-four Nobel Laureates declared that the policy would be "very damaging to American small inventors and thereby discourage the flow of new inventions that have contributed so much to America's superior performance in the advancement of Science and technology."[371] As a result of such criticism, American inventors retain the option of electing secrecy if they do not file for international protection.[372] Provisional patents are never published, presumably to keep inventors' secrets.[373]

Despite the strong rhetoric, it is unclear that patentees actually desire secrecy. According to a recent study, the majority of inventors given the option of keeping their patent applications secret chose not to do so,[374] even when they had to pay fees to have their secrets revealed.[375] Small

369. *See generally* Tejas N. Narechania, *Patent Conflicts*, 103 GEO. L.J. 1483 (2015) (describing a wide range of administrative actors with patent interests).

370. *See, e.g.*, *An Open Letter to the U.S. Senate*, EAGLE FORUM, http://www.eagleforum.org/patent/nobel_letter.html (last visited Apr. 15, 2016).

371. *Id.*

372. *See* 37 C.F.R. § 1.213(a) (2015).

373. *See* 35 U.S.C. § 122(b)(2)(A)(iii) (2012); 37 C.F.R. § 1.211(b) (2015).

374. Graham & Hegde, *supra* note 266.

375. Courtenay C. Brinckerhoff, *Can You Wait to Take Advantage of USPTO Fees Decreasing January 1, 2014?*, PHARMAPATENTS (Oct. 23, 2013) http://www.pharmapatentsblog.com/2013/10/23/uspto-fees-decreasing-january-2014 (noting the $300 fee that, until 2014, accompanied publication of a

inventors, about whom critics were particularly concerned, were just as likely as large U.S. entities to select publication.[376]

To the extent patent disclosures are useful, earlier disclosure benefits the public, as it leads to the earlier dissemination of technology to the world, including through related publications; it also improves notice.[377] It can also benefit patentees, enabling them to stake out their position in a technological area,[378] leading to earlier licensing.[379] More, it allows the patent application to serve as prior art and limits the applications of others.[380] These benefits, in many cases, can outweigh any costs associated with earlier transparency.

The insight that inventors do not always want to keep their inventions secret, especially in the face of advocacy asserting the opposite, has broader implications for patent-publication policy. As of the date of this publication, utility patent applications are published with an eighteen-month delay.[381] Forty-eight percent[382] of an estimated two million provisional patent applications[383] are never even released to the public because they do not mature into patent applications.[384] It is worthwhile to consider changing these defaults. While patentees already can request early publication,[385] explicitly giving patentees the choice could have great social benefits. A diffusionary alternative is to adjust the default for provisional applications to be open rather than closed and to publish utility applications upon filing rather than after an eighteen-month delay, all while giving inventors the right to opt out of these defaults.

patent).

376. Graham & Hegde, *supra* note 266.

377. Peter S. Menell & Michael J. Meurer, *Notice Failure and Notice Externalities*, 5 J. LEGAL ANALYSIS 1, 34–35 (2013).

378. Baker & Mezzetti, *supra* note 255.

379. Hegde & Luo, *supra* note 268, at 3.

380. *See supra* Part III.B.3.

381. 37 C.F.R. § 1.211(a) (2015).

382. Dennis Crouch, *Abandoning Provisional Applications*, PATENTLY-O (Jan. 2, 2013), http://patentlyo.com/patent/2013/01/abandoning-provisional-applications.html (reporting a 48 percent provisional-application abandonment rate in 2011).

383. Dennis Crouch, *Claiming Priority to Provisional Applications*, PATENTLY-O (Apr. 8, 2014), http://patentlyo.com/patent/2014/04/priority-provisional-applications.html (estimating that the USPTO has a "database of about 2,000,000 provisional applications").

384. When a patent application refers to a provisional application, the provisional application is accessible through the public electronic record of the patent application. *See id.* However, provisional applications are not publicly available in bulk. *Id.*

385. 37 C.F.R. § 1.219 (2015).

2. Remove Disincentives to Reading Patents

It is worth revisiting the current willfulness disincentive for reading patents.[386] The criterion of "knowledge of the patent" that the willfulness doctrine is connected to is arguably both overinclusive and underinclusive with respect to what the patent system is trying to deter. For example, an innovator who studies and reverse-engineers a patentee's product or website should not be less subject to a finding of willfulness than one who happens to read a patentee's patent among many others in the course of doing routine research. At the same time, innovators should not be punished for being comprehensive in checking different sources of technical knowledge by reading patents if there is no evidence that the patentee actually derived anything from the patent. But the current law leads to both outcomes.

One solution, suggested by Lemley and Tangri, is to substitute the current willfulness standard with one that would penalize not those with knowledge of a patent, but those who adopt a technology with knowledge—from any source—that it was derived from the patentee.[387] Mere knowledge of a patent would not raise the likelihood that an infringer will be assessed treble damages; in this solution, there also would need to be indicia that the patentee took advantage of the information in the patent document in order to trigger the penalty.[388] Another intervention is to enable patentees to search among expired and lapsed patents, to which no willfulness penalty applies. While reading expired and lapsed patents would not subject the reader to risk of a finding of willfulness, there is currently no easy way to access just these patents.[389]

3. Remove Barriers to Putting Technology in the Public Domain

It is worth considering how to remove barriers to putting technology in the public domain. Defensive publication offers an important avenue, but for it to work, it requires the USPTO to be aware of the publication and to apply it to limit the grant of a related application. While this process can be successful, patent examiners tend to rely on patents, not publications, for prior art,[390] and they have limited time to search for new references when

386. *See supra* notes 273–276 and accompanying text.

387. *See* Mark A. Lemley & Ragesh K. Tangri, *Ending Patent Law's Willfulness Game*, 18 BERKELEY TECH. L.J. 1085, 1118–19 (2003).

388. *See id.* at 19.

389. *See supra* note 277.

390. John R. Allison & Mark A. Lemley, *Empirical Evidence on the Validity of Litigated Patents*, 26 AIPLA Q.J. 185, 229 (1998) (reporting that the median number of nonpatent references cited by

they examine patents.[391] At times, defensive publications fall short of preemption because they do not contain sufficient technical disclosures.[392] These realities may contribute to the low repute of defensive publication in the United States.[393]

The USPTO has long recognized the importance of defensive publication. From 1968 to 1985, applicants who waived their rights to enforceable patents could have their abstract published under the auspices of the Defensive Publication Program.[394] This program was replaced by the Statutory Invention Registration ("SIR") program in 1999.[395] A SIR contained the specifications of a regularly filed application for a patent but was not examined.[396] A SIR was not a patent, but because it was filed with the USPTO and prepared like a patent, it was more likely to be seen and applied by examiners.[397] However, the SIR program was unpopular, likely due to the cost of preparing registrations, and it was repealed in 2011.[398]

Recently, the USPTO has taken a number of executive actions to improve the quality of patents by using crowd-sourced prior art.[399] International patent practices may be instructive to consider as it does so. The Patent Cooperation Treaty requires a mandatory search of certain databases featuring nonpatent references to which the public can submit

examiners is zero).

391. *See* Michael D. Frakes & Melissa F. Wasserman, *Is the Time Allocated to Review Patent Applications Inducing Examiners to Grant Invalid Patents?: Evidence from Micro-Level Application Data* 7 (Nat'l Bureau of Econ. Research, Working Paper No. 20337, 2014), http://www.nber.org/papers/w20337 ("[O]n average, an examiner spends only nineteen hours reviewing an application, including reading the patent application, searching for prior art, comparing the prior art with the patent application, writing a rejection, responding to the patent applicant's arguments, and often conducting an interview with the applicant's attorney . . . .").

392. Wendell Ray Guffey, *Statutory Invention Registration: Defensive Patentability*, 16 GOLDEN GATE U. L. REV. 291, 293 (1986).

393. *See supra* note 265 and accompanying text.

394. *See* U.S. PAT. & TRADEMARK OFF., MANUAL OF PATENT EXAMINING PROCEDURE § 711.06 (9th ed. Rev. 07.2015, Nov. 2015). The effectiveness of the Defensive Publication Program was limited by USPTO decisions that delayed the effective date of references to after they were reviewed and published by the USPTO. Guffey, *supra* note 392, at 295–97.

395. *See* Statutory Invention Registration, 64 Fed. Reg. 66,170, 66,170 (Nov. 24, 1999).

396. *Id.*

397. *See id.*; Guffey, *supra* note 392, at 294, 297.

398. Jim Pravel, *US Patent and Trademark Office (USPTO) Repeals Statutory Invention Registration (SIR)*, INTELLALEGAL (Mar. 14, 2013), http://www.intellalegal.com/2013/03/us-patent-and-trademark-office-repeals-statutory-invention-registration.

399. *USPTO-Led Executive Actions on High Tech Patent Issues*, U.S. PAT. & TRADEMARK OFF., http://www.uspto.gov/patent/initiatives/uspto-led-executive-actions-high-tech-patent-issues (last visited Apr. 15, 2016) (describing several initiatives to make greater use of external inputs to decide which inventions are truly novel and deserve patents, including improving examiner training and "crowdsourcing prior art").

prior art.[400] This provides greater reassurance that submitted documents will actually be reviewed. The European Patent Office has worked to integrate technical databases of practice with patent-search databases.[401] The USPTO has been urged to do the same.[402] But to ensure a thorough search, the USPTO would need to give examiners adequate time to search nonpatent references.

B. DIFFUSION BY TRANSFER

Commentators have identified a number of challenges in current markets for technology. While few would argue that the government is in the best position to make markets, there may be ways for the patent system to reduce the search and information costs of transacting in technology, which have been identified as obstacles to technology transfers.[403]

One of the USPTO's two enumerated duties is to "be responsible for disseminating to the public information with respect to patents and trademarks."[404] The USPTO, by virtue of its position in the patent system, is well positioned to collect and disseminate a number of types of information. It could use this power in a few ways.

1. Enable Public Recordation of Licensing Offers Without Litigation Impact

The USPTO could make it easier for potential technology partners to find one another by enabling patentees to indicate—and enabling the public to discover—the availability of the technology for licensing. This idea is not new; since 2012,[405] applicants for international patents can report licensing information and terms to international patent authorities to be

400. *E.g.*, RES. DISCLOSURE, http://www.researchdisclosure.com (last visited Apr. 15, 2016) ("Patent examiners are required to search Research Disclosure by PCT statute.").

401. NAT'L RESEARCH COUNCIL ET AL., PATENT CHALLENGES FOR STANDARD-SETTING IN THE GLOBAL ECONOMY 10–11 (Keith Maskus & Stephen A. Merrill eds., 2013) (describing collaborations between the European Patent Office and a standard-setting organization to incorporate technical, nonpatent documents in the search for prior art).

402. *E.g.*, E-mail from Linda Kahl, Dir., Legal Program, Biobricks Found., to Nicole Dretar Haines, Patent Adm'r, U.S. Pat. & Trademark Off. (Apr. 18, 2014), http://www.uspto.gov/sites/default/files/patents/law/comments/cr_f_kahl_20140418.pdf (recommending that the USPTO ensure that existing registries of biological parts are available to and searchable by USPTO examiners).

403. *See supra* Part III.C.2.

404. 35 U.S.C. § 2(a)(2) (2012).

405. *New PCT Licensing Feature*, WORLD INTELL. PROP. ORG.: PCT NEWSL. (Dec. 2011), http://www.wipo.int/pct/en/newslett/2011/12/article_0001.html (noting that the reporting system will launch in January 2012).

disseminated to the public in order to promote voluntary licensing.[406] In November 2013, WIPO introduced the WIPO GREEN online marketplace, which enables sellers and buyers to more readily find one another, in order to promote the innovation and diffusion of green technologies.[407]

One persistent concern with these programs, however, is that if patentees list patents for licensing, they may lose the ability to seek exclusive rights later. In the United States, courts consider the inadequacy of legal damages to decide whether to grant injunctions.[408] But that inadequacy can be harder to prove if the patentee has an open-licensing policy. To address this concern, courts should recognize that listing patents for licensing does not mean that patentees are giving up exclusion, even as they seek diffusion through transfers. To the contrary, exclusive licenses reinforce the importance of the right to exclude.[409]

Another issue is the lack of dissemination of information regarding the availability of patents for license once patentees disclose licensing opportunities. U.S. patent owners already can provide "notice of the availability of an application or a patent for licensing or sale" to the USPTO;[410] however, this information is disseminated only through a little-read weekly publication of the USPTO, the *Official Gazette*, which is not searchable by patent number.[411] A small administrative change, enabling licensing offers to be searchable and recorded in the patent record, could greatly enhance the discoverability of license information. Taking such steps could reduce the costs of ensuring that willing buyers and willing sellers can find one another.

406. *See Patent Cooperation Treaty: Request for Indication of Availability for Licensing Purposes*, WORLD INTELL. PROP. ORG. (Jan. 2012), http://www.wipo.int/export/sites/www/pct/en/forms/ib/editable/ed_ib382.pdf.

407. *About WIPO GREEN*, WORLD INTELL. PROP. ORG., https://www3.wipo.int/wipogreen/en/aboutus (last visited Apr. 15, 2016) (describing the goal of the WIPO Green marketplace as the acceleration of green-technology innovation and transfer).

408. *See* Chien & Lemley, *supra* note 78.

409. *See supra* Part II.B.

410. 37 C.F.R. § 1.21 (2015). *See* U.S. PAT. & TRADEMARK OFF., *supra* note 394, § 1703 (providing an overview of the *Official Gazette*). *See, e.g.*, *Patents and Serial Numbers Available for License of Sale*, 1374 Off. Gaz. Pat. & Trademark Office 121 (Jan. 10, 2012) (including examples of such listings).

411. *See* U.S. PAT. & TRADEMARK OFF., *supra* note 394, § 1703; *Official Gazette*, U.S. PAT. & TRADEMARK OFF., http://www.uspto.gov/learning-and-resources/official-gazette (last visited Apr. 15, 2016) (lacking a robust search function).

2. Enhance Patent Information Infrastructure and Create Registries of Licensing Data

To make an accurate market, available data is essential. Although the USPTO must transmit patent information in fulfillment of its statutory mandate,[412] the current patent information and reporting infrastructure suffers from gaps in the statutory authority, compliance, and reporting of patent information that could be filled.

The most glaring recent omission concerns the question of who owns a patent. Patent ownership is a critical determinant of the patent's likely path, but reporting changes in patent ownership to the USPTO is currently voluntary.[413] Though current law protects against certain types of fraud when changes in ownership occur,[414] there is no way to know for sure who owns a particular patent. Although the USPTO, implementing an executive action, recently undertook an initiative to require recordation of patent ownership, it ultimately concluded that exercise of legislative authority was the best way to impose this requirement.[415]

Even existing rules requiring the production of patent information are not necessarily followed. Trial courts are required by law to inform the USPTO when a patent is litigated and what the adjudicated outcome is.[416] The USPTO is required, in turn, to include this information in the file of each patent.[417] However, only about 65 percent of patent files contain the requisite information.[418] Knowing if a patent has been previously litigated—and the outcome of any such litigation—clearly has significance for an invention's dissemination. If the patent's claims are invalidated as a result of the litigation, for example, the patent essentially enters the public domain and is no longer subject to the patentee's exclusive rights.

Patent information has been underreported in the context of federally funded inventions. The Bayh-Dole Act allows recipients of federal research

412. *See* 35 U.S.C. § 2(a)(2) (2012) (describing the USPTO's dissemination duty).

413. *See* Chien, *supra* note 272 (describing the lack of an ownership recordation requirement).

414. *See* 35 U.S.C. § 261 (2012) ("An interest that constitutes an assignment, grant or conveyance shall be void as against any subsequent purchaser or mortgagee for a valuable consideration, without notice, unless it is recorded in the Patent and Trademark Office within three months from its date or prior to the date of such subsequent purchase or mortgage.").

415. Ryan Davis, *USPTO Backs Away from Patent Transparency Rules*, LAW360 (Oct. 24, 2014, 4:48 PM), http://www.law360.com/articles/590197/uspto-backs-away-from-patent-transparency-rules.

416. 35 U.S.C. § 290 (2012).

417. *Id.*

418. *See* Robin Feldman et al., *The AIA 500 Expanded: The Effects of Patent Monetization Entities*, UCLA J.L. & TECH., Fall 2013, at 67 (reporting on an analysis of 6000 patents known to be in litigation).

funding, such as universities, to take title to inventions created using federal funds.[419] While the Act affords universities considerable latitude when exercising their patents rights, it contains a number of accountability safeguards to ensure that federally funded intellectual property is being disseminated appropriately. Specifically, grantees must report any subject invention developed using federal funding,[420] and they may need to periodically report on utilization and efforts at obtaining utilization.[421] But an analysis of academic biomedical patents found "*prima facie* evidence of underdisclosure" of government-interest in federally funded research,[422] with a government-interest reporting rate of 60–80 percent among the government-funded patents studied.[423] Utilization data, which could be used to drive greater dissemination of federally-funded inventions, is even harder to come by.[424]

Yet this information is essential to several functions that directly bear on how the invention is disseminated. Without this information, it is difficult for the government to determine whether to compel licensing, as the government is entitled to do in cases where the invention has yet to achieve practical application.[425] More generally, the federal government cannot effectively carry out its oversight role—as the saying goes, if you can't measure it, you can't manage it. Citing a U.S. Government Accountability Office study that found patent information to be incomplete and access-restricted, the National Academy of Sciences recommended that federal research agencies reinvigorate data reporting by institutions.[426] The university community, in turn, has suggested that improving the functionality and usability of databases that contain data about federally funded inventions would enhance compliance.[427]

Greater information about patent licenses could be used to facilitate technology transfer. The lack of comparable licensing data contributes to the gulf in licensing terms that parties to a patent transaction must bridge in

419. *See generally* Mowery & Sampat, *supra* note 171.

420. 35 U.S.C. § 202(c)(1) (2012).

421. 35 U.S.C. § 202(c)(5) (2012).

422. Arti K. Rai & Bhaven N. Sampat, *Accountability in Patenting of Federally Funded Research*, 30 NATURE BIOTECHNOLOGY 953, 954 (2012).

423. *See id.* at 955.

424. *See id.*

425. *Id.* at 953. *See* 35 U.S.C. § 202(c)(5) (2012).

426. *See* NAT'L RESEARCH COUNCIL ET AL., *supra* note 293, at 11.

427. *See generally Strategy for American Innovation: RFI Responses*, WHITE HOUSE, https://www.whitehouse.gov/sites/default/files/microsites/ostp/compiled_rfi_responses_redacted.pdf (last visited Apr. 15, 2016) (compiling responses to a request for information regarding a presidential plan to improve innovation ecosystems).

order for the license to be formed. But several sets of licensing data could help close the gaps: licenses that are reported in the process of litigation—as long as they are not sealed—become part of the public litigation record, material patent licenses entered into by public companies must be reported to the Securities and Exchange Commission, and licenses based on government-funded inventions are required to be reported by law.[428] Although these forms of license information are in the public record, practically speaking, they are difficult to access: licensing litigation court records are often sealed, unsealed records often contain redactions, the Securities and Exchange Commission does not tag licenses or otherwise make them easy to find, and licenses that are recorded by the USPTO are largely unavailable electronically.[429] In the case of court licenses, confidential information could be stripped through a redaction protocol, consistent with President Obama's Open Data Policy.[430] An industry effort to share sanitized licensing data, conducted in a way consistent with antitrust concerns, could also help to narrow the gap in expectations between parties.

C. DIFFUSION BY SHARING

A final set of diffusionary levers would make it easier for patentees to give away or share their patent rights and for others to rely on such commitments.

1. Make It Easier to Waive and Rely on Waivers of Patent Rights

Currently, there is no easy way for patent holders to give some of their rights to the public while reserving other rights to themselves, for example, through the waiver of assertion rights against companies of a certain size,

428. *See* Rai & Sampat, *supra* note 422 (describing the Bayh-Dole Act's requirement for reporting information regarding the licensing, assignment, and practical utilization of federally funded patents); U.S. GEN. ACCOUNTING OFF., GAO/RCED-99-242, TECHNOLOGY TRANSFER: REPORTING REQUIREMENTS FOR FEDERALLY SPONSORED INVENTIONS NEED REVISION 5 (1999) (discussing Exec. Order No. 9424, 3 C.F.R. § 303 (1943–1948), *reprinted in* 35 U.S.C. § 207 (2012) which established a Government Register, "the official register for the government's rights to federally sponsored inventions"). The author and several collaborators are currently exploring the nature and extent of data that could be harvested and will make the information publicly available in the near term.

429. These conclusions are based on the author's own research and attempts to access these forms of information. *E.g.*, E-mail from Thomas F. Cotter, Briggs & Morgan Professor of Law, Univ. of Minn. Law Sch., to author (July 31, 2015, 6:31 AM) (on file with author) (noting the denial of a Freedom of Information Act request for USPTO records and suggesting that the only ways to view records were "either to view them in person, or to pay $25 each for copies"). *See supra* note 277.

430. Exec. Order No. 13,642, 78 Fed. Reg. 28,111, *reprinted in* 5 U.S.C. § 552 (2012) (May 14, 2013) (mandating that agencies make government data open as a default, but in a way that safeguards privacy and confidentiality).

as made by the companies that have taken Paul Graham's "Patent Pledge"[431] and by the LG Corporation,[432] or through committing to royalty-free licensing of patents over neglected diseases.[433] To address each of these defects, Jorge Contreras has proposed creating a public registry of patent pledges, based on one he is building himself.[434] A public registry would reduce the risk of failing to discover that a patent is encumbered with a pledge, and it would reduce the cost of finding pledges, which may otherwise "disappear."[435] A promise that is memorialized as an official government record has a better chance of traveling with the patent, even if the patent changes hands or the patent holder goes through bankruptcy. Multiple commentators have suggested that courts should embrace expanded reliance theories to obligate patentees to keep their promises,[436] as an individual defendant has a better chance of prevailing if the defendant actually knows of the promise, which can be proven more easily if the promise is recorded.

Two refinements to Contreras's registry suggestion would do much to bolster the legitimacy of patent pledges. First, recorded pledges should be integrated with the patent record—at the patent level, when possible, or at the assignee level, if the pledge is not specific enough. Otherwise, the efficiency gains from a centralized repository risk going unrealized. Fortunately, the USPTO already has an existing mechanism for recording encumbrances on a specific patent: recordation cover sheets, which allow patentees to record security interests others have in the patent.[437] This form could be modified to include waivers. Second, members of the public should be allowed to initiate, though not to complete, public recordation of waivers. This can help create a record of reliance for the party initiating recordation and discourage shirking by patentees who, without public

431. *See supra* note 345 and accompanying text.

432. *See supra* note 15 and accompanying text.

433. *Pool for Open Innovation Against Neglected Tropical Diseases: Core Principles*, BIOVENTURES FOR GLOBAL HEALTH, http://www.bvgh.org/LinkClick.aspx?fileticket=B_OLmqvC-QGM= (last visited Apr. 15, 2016). *See supra* note 322 and accompanying text.

434. *See* Contreras, *supra* note 179, at 600–07 (considering the merits of a patent pledge information registry). Contreras's database of patent pledges is available online. *Non-SDO Patent Statements and Commitments*, *supra* note 341.

435. Contreras, *supra* note 179, at 597–98 (describing impermanent patent-pledge links and content).

436. *See* Contreras, *supra* note 42, at 541–57 (advocating the expansion of reliance theories to bind patent promises); Merges & Kuhn, *supra* note 42, at 21–30 (describing an estoppel doctrine that would accommodate standards).

437. U.S. PAT. & TRADEMARK OFF., FORM PTO-1595, RECORDATION FORM COVER SHEET: PATENTS ONLY (2012), http://www.uspto.gov/forms/pto1595.pdf.

recordation, could publicly promise to waive, receive the public relations benefits from doing so, and then fail to keep the promise. The actual mechanics of recording waivers would need substantial refinement; for example, patentees should receive protection from opportunistic or false waiver-recordation requests. This concern could be addressed by imposing a fine on recorders whose suggestions prove to be false, with proceeds from the fine to be split between the USPTO and the patentee, or through requiring upfront bonding before the USPTO undertakes action to verify the claim and record it.

Another statutory waiver-enforcement regime suggested by Merges would enable items to be sold with a "Patent Waived" notice.[438] Mirroring existing statutory schemes in which items are marked with "Patent Pending" or "Patented" notices, a "Patent Waived" scheme would create rights for the public, which would be able to rely on the public-domain status of the item.[439] While Merges's idea is promising and would reduce search costs, further proof of the demand for this sort of mark is warranted before investing in a new regime.

2. Create an "Open" or "Defensive-Only" Option

Other options for supporting innovation by sharing are to allow patent holders who want to waive certain rights—for example, to support environmental, educational, or noncommercial uses—to offer patents on RAND bases or to give up offensive rights and patent only defensively. Although many patent "flavors" could be explored, this Article focuses on the idea of an "open" or "defensive-only" patent because the broad use of defensive patenting suggests that there is demand for this option.[440] While the exact parameters would need to be tested and refined, a new type of patent that is "defensive-only" could have limited enforceability in general, but full enforceability when the patentee is first attacked. Electing the "defensive-only" option would allow patent holders to signal to the world which patents they are holding not for the sake of excluding others, but for defensive reasons. This would dramatically reduce the likelihood of litigation by limiting the ability of patentees to later "change their mind" in the same way that many patent pledges are meant to do.[441]

The class of "proprietary inclusion mechanisms," which includes

438. Merges, *supra* note 264, at 201.
439. *See id.* at 201–02.
440. *See supra* Parts II.C, III.D.4.
441. *See infra* notes 464–465 and accompanying text.

easements and servitudes and to which a "defensive-only" patent would belong, has a number of benefits and drawbacks.[442] The "defensive-only" status of a patent is likely to be more enforceable than a contract or waiver because it is attached to the property rather than to the owner.[443] This puts third-party beneficiaries on equal footing with others and also makes the disarmed status of the purely defensive patent generally less vulnerable to changes in ownership.[444] Notice costs would be lower than notice costs for less formal mechanisms as long as the limitation of rights is publicly recorded.[445] Standardization reduces information and bargaining costs[446] and reduces possibilities for opportunism.[447] For example, standardization would eliminate problems associated with clever contract drafting, a practice that can reserve many rights for the patent holder even while maintaining goodwill with the promisee. Another advantage of sanctioned sharing mechanisms is the availability of remedies, including specific performance, that go beyond the traditional compensatory damages typically available in contract law.[448]

However, proprietary inclusion mechanisms also have their critics. They are less flexible than contracts and waivers,[449] and certainly a "defensive-only" option would not capture the full range and conditions of desires to share patents that exist. In addition, those who promote the *numerus clausus* ("number is closed") principle—the idea that the number of forms of property should be limited—point to the burdens on third parties that property forms create.[450] The existence of nonstandard property rights increases the cost of transacting in the property regimen.[451] In addition, creating a new property right may require congressional authorization, an expensive undertaking that may not allow for the continual refinement that would be needed to ensure that a new property form is appropriate and enduring.[452]

442. *See* Kelley, *supra* note 122, at 860 (describing proprietary inclusion mechanisms).

443. *See id.* at 890–91 (noting that property rights run with the property, unlike contract rights).

444. *See id.*

445. *See* Menell & Meurer, *supra* note 377, at 41 (suggesting that investment in notice information could address notice problems in the intellectual property context).

446. Thomas W. Merrill & Henry E. Smith, *Optimal Standardization in the Law of Property: The* Numerus Clausus *Principle*, 110 YALE L.J. 1, 40 (2000).

447. *See* Kelley, *supra* note 122, at 889 (describing the anti-opportunism effects of proprietary inclusion mechanisms).

448. *Id.* at 893–94.

449. *Id.* at 891.

450. Merrill & Smith, *supra* note 446, at 8.

451. *Id.* at 33.

452. *Id.* at 68 ("[I]t is not clear that these forces will operate with more virulence in legislative

However, a number of these objections could be addressed by adopting a "defensive-only" option for inventors that is reflected not in a new property form, but in discounting patent maintenance fees. Such a discount would be given in exchange for the voluntary waiver of the exclusive rights held by patentees. Though this idea is novel, it is not completely unprecedented. In several countries, patent holders can pay discounted fees to maintain their patent if they voluntarily agree to offer their patents for licensing to all comers. Under Germany's "License of Right" ("LOR") scheme, for example, a patent owner that declares that anyone can practice the invention in return for reasonable compensation receives a 50 percent discount on maintenance fees.[453] The United Kingdom has a similar scheme.[454] The German LOR option is elected for about 6 percent of granted patents, but the rate varies significantly by technology area: a 2012 study found that 11 percent of electrical engineering patents had LOR declarations, but only 1.3 percent of biotechnology patents did.[455]

Several modifications would be needed to make such an option viable in the United States. One problem with LOR options is that they curtail the ability of patentees to enforce patents.[456] However, the defensive choices that companies make demonstrate that patentees often want to be able to enforce their patents in some contexts.[457] Thus, a variant of the LOR approach would limit patent holders' rights to defensive contexts in exchange for a discount on patents' maintenance fees. Drawing upon the efforts of Tesla and Twitter, as well as the Defensive Patent License,[458] the License on Transfer,[459] and other defensive initiatives, some thinking needs to be devoted to flesh out what "defensive" really means.[460] However, assuming that a manageable definition can be determined, the savings

than in judicial forums.").

453. Ilja Rudyk, *The License of Right, Compulsory Licensing and the Value of Exclusivity* 2 (Governance & the Efficiency of Econ. Sys., Discussion Paper No. 415, 2012), http://www.sfbtr15.de/uploads/media/415.pdf.

454. U.K. Intellectual Prop. Office, *Licensing Intellectual Property*, GOV.UK, https://www.gov.uk/guidance/licensing-intellectual-property (last updated Feb. 22, 2016) (providing that for patents endorsed with a "licence of right," patent holders "must grant a licence to anyone who wants one" in exchange for annual renewal fees to be cut in half).

455. Rudyk, *supra* note 453.

456. *See* Kelley, *supra* note 122, at 860 (discussing waivers in the context of formal contracts).

457. *See supra* Part II.C.

458. *See* Schultz & Urban, *supra* note 24, at 37–44 (introducing the model for a "standardized open patent license—the Defensive Patent License," which combines defensive and open values).

459. *See supra* note 208 and accompanying text.

460. *See supra* Part I.

could be quite considerable. For a medium-sized company with a portfolio of one thousand patents of various ages, a third of which are renewed in any given year, a 50 percent discount in fees could represent $1.4 million of savings in maintenance fee costs.[461]

Another departure from current practice concerns permissible changes to the patent's status. In the United Kingdom and Germany, patent holders can change the LOR status at will—in the United Kingdom, at any time,[462] and in Germany, at any time a maintenance fee is paid.[463] However, in order to enable patentees to rely on and make investments based on the "defensive-only" status of patents, it is important that patentees be unable to change their mind after a patent has taken on "defensive-only" status. Clearly, that is the intent of companies like Twitter and Tesla. Twitter's "promise stays with the patent,"[464] and Tesla will only transfer patents "to a party that agrees, by means of a public declaration intended to be binding on such party, to provide the same protection" that Tesla pledged.[465] Of course, the binding nature of a "defensive-only" election must be considered in view of its impact on uptake of the option, especially in light of the changing priorities of companies. One could imagine a one-way ratchet: patentees could elect or default to the "defensive-only" option later in a patent's life, after patentees have more information about their intent to practice; however, once patents become "defensive-only," they cannot lose their "defensive-only" status. Extensive testing and further refinement would be needed. Important variables to consider include the definition of "defensive-only" uses and the size of the fee discount.

The salutary effects of disarming a large number of patents make these details worth considering further. To the extent that society gets the benefits of the patent system—invention and disclosure—without the higher costs that come with exclusive rights, "defensive-only" patents may represent the best of both worlds. For those who seek to provide licenses and have freedom of action, these measures would reduce the costs and risks of participating in the patent system. With a defensive intent recorded and provided transparently, "defensive-only" patenting would provide an

461. This assumes that one-third of the firm's renewed patents cost regular maintenance fees of $1600 per patent, another third cost $3600 per patent, and the last third cost $7400 per patent. *See USPTO Fee Schedule*, U.S. PAT. & TRADEMARK OFF., http://www.uspto.gov/learning-and-resources / fees-and-payment/uspto-fee-schedule#Patent Maintenance Fee (last updated Apr. 6, 2016).

462. U.K. Intellectual Prop. Office, *supra* note 454.

463. *See* Rudyk, *supra* note 453, at 5.

464. Lee, *supra* note 360.

465. *Privacy & Legal*, TESLA: LEGAL, https://www.teslamotors.com/about/legal (last visited Apr. 15, 2016).

easier way for industries to collectively self-correct and overcome the patent system's prisoner's dilemma—the whole may be better off when all forbear from exclusive rights, but no individually forbearing firm is better off when it forbears by itself.

3. Reconsidering Maintenance Fees

It is worth exploring further how to calibrate maintenance fees, the fees that patentees pay to keep their patents in force after they are issued,[466] in order to strike the right balance between diffusion and exclusion. U.S. patents are a relative bargain; in a survey of thirty patent offices worldwide, U.S. fees were among the lowest third surveyed, with low fees paid both before and after a patent is granted.[467] U.S. fees are the lowest in the world in relation to total gross domestic product.[468] The USPTO's relatively lower fees correlate with a relatively higher patent renewal rate. Close to 50 percent of U.S. patents remain in force by their twentieth year, as compared with about 20 percent of European patents.[469] But letting patents lapse hastens their diffusion. Currently, fees are set based on the principal of "cost recovery" to the USPTO.[470] But it makes sense to base USPTO fees on the public benefits created by letting patents lapse rather than basing them on the reduction in cost to the USPTO of the action.[471] Although this topic deserves much more discussion than is provided here, raising maintenance fees, particularly at the end of a patent's life when the inventor has likely already reaped the reward,[472] could hasten this diffusion without undercutting the benefits of exclusion.

466. Dennis Crouch, *Paying Maintenance Fees*, PATENTLY-O (Mar. 25, 2011), http://patentlyo.com/patent/2011/03/paying-maintenance-fees.html.

467. Gaetan de Rassenfosse & Bruno van Pottelsberghe de la Potterie, *The Role of Fees in Patent Systems: Theory and Evidence*, 27 J. ECON. SURVEYS 696, 703 tbl.1 (2013).

468. Walter G. Park, *On Patenting Costs*, 2 WIPO J. 38, 42 fig.1 (2010).

469. FIVEIPOFFICES, IP5 STATISTICS REPORT: 2013 EDITION 57 fig.4.8 (Korean Intellectual Prop. Off. ed., 2014), http://www.fiveipoffices.org/statistics/statisticsreports/2013edition/ip5sr2013corr.pdf.

470. Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284, 316 (2011) (restricting fees collected "only to recover the aggregate estimated costs").

471. As Menell and Meurer put it, fees should be set "so that applicants internalize not only the costs that they impose on the government, but also the costs that they impose on third parties." Menell & Meurer, *supra* note 377, at 41.

472. Brian J. Love found that most assertions of patents at the end of their lives are not brought by practicing entities, but nonpracticing entities. Brian J. Love, *An Empirical Study of Patent Litigation Timing: Could a Patent Term Reduction Decimate Trolls Without Harming Innovators?*, 161 U. PA. L. REV. 1309, 1331–32 (2013).

CONCLUSION

The U.S. patent system rewards invention and disclosure with exclusion. But its ultimate aim in doing so is "[t]o promote the Progress of Science and useful Arts" through the diffusion of ideas, products, and learnings to the public.[473] The nature of innovation is changing, enabling greater collaboration and fostering interdependence between innovators. The patent system can support the disclosure of technical information, reduce the cost of transacting in technology, and facilitate the exchange of permissions in support of freedom to operate. This Article has articulated and applied a diffusionary lens to these roles, uncovering several overlooked levers for promoting innovation.

Specifically, to enhance patent disclosure, the USPTO could enable patentees to publish provisional and utility applications upon filing, rather than waiting until eighteen months after filing.[474] Though current policies are meant to protect innovators from diffusing their ideas prior to excluding others, the data suggest inventors do not always want such protections.[475] The USPTO could also make it easier for innovators to put their inventions in the public domain—for example, by better integrating databases of practice and purposive disclosure in patent searches and by giving patent examiners more time to search through nonpatent references. The courts or Congress could also do their part by removing barriers to the reading of patents.

The USPTO and the private sector could support markets for technology further by making it easier for potential patentees and licensees to find each other and successfully complete transactions. The USPTO could consider making it easier for patentees to waive their rights by creating infrastructure for the recordation of patent waivers that courts can uphold, creating a "defensive-only" fee option, and calibrating maintenance fees.

As the needs of innovation change, the patent system should consider changing as well, creating more options for innovators to individually tailor the patent system to meet their specific needs. By embracing an all-of-the-above approach that embraces exclusion and diffusion, the patent system can broaden its support for innovation in all forms.

473. U.S. CONST., art. I, § 8, cl. 8.
474. Publication of Applications, 37 C.F.R. § 1.211 (2015).
475. Graham & Hegde, *supra* note 266.