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TECHNOLOGICAL COST AS LAW IN INTELLECTUAL PROPERTY

Harry Surden*

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^{*} Associate Professor of Law, University of Colorado Law School. B.A. Cornell University; J.D. Stanford University. Many thanks to Paul Ohm, Phil Weiser, Pierre Schlag, Andrew Schwartz, Ming Chen, Scott Moss, and the rest of my excellent colleagues at the University of Colorado Law School for their suggestions. Many thanks also to Seema Shah, Andrew Coan, James Grimmelmann, Vic Fleischer, Jake Lindford, Will Hubbard, Bernard Chao, Charles Heenan, Viva Moffat, Ted Sichelman, Joseph Fishman, and Gaia Bernstein for their very helpful comments. I am grateful also to Stephanie Minnock and Nicole Drane for their excellent assistance.

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I. Introduction

Changes in the scope of intellectual property ("IP") legal rights are generally thought to be linked to changes in positive law. IP laws grant private parties the right to control certain types of information (e.g., books in copyright). Lawmakers set the scope of these rights by allowing control over some uses of IP goods but not others. They also set rights at a particular strength: strong enough to mitigate the economic problems that animate IP law, but deliberately bounded in light of social costs arising from excessive control over information.

^{1. &}quot;Positive law" in this sense refers to statutes, case law holdings, and other explicitly promulgated laws fixed in authoritative legal texts. *See, e.g.*, BLACK'S LAW DICTIONARY 1280 (9th ed. 2009) ("Positive law typically consists of enacted law — the codes, statutes, and regulations that are applied and enforced in the courts.").

^{2.} See, e.g., 17 U.S.C. § 106 (2012) (granting copyright owners, among other rights, the right to reproduce copyrighted works); 35 U.S.C. § 154 (2006 & Supp. V 2011) (granting patentees the right to exclude others from making, using, or selling in the United States inventions covered by a patent claim).

The Copyright Act, for example, allows private parties to control certain uses of information (e.g., the copying of books) but not others (e.g., control over criticism). An increase or decrease in legal scope is usually thought to occur by an explicit change in statute or case law.

This Article argues that shifts in the scope of IP laws are often driven by changes in technological feasibility and not by changes in positive law. To understand this argument, consider how activities important to IP law can be implicitly constrained by technological limitations and how this constraint can influence positive IP law. The unauthorized copying of creative works by third parties is a core concern of copyright law, as such copying can diminish the value that an author can appropriate. However, throughout much of the twentieth century, federal copyright law did not protect sound recordings (e.g., music albums) from duplication.⁵ This was a notable omission because during this same period federal copyright law *did* include explicit protection for many other types of creative works, including books, sheet music, etc.⁶

In part, the absence of federal copyright protection was due to the limited state of copying technology for sound recordings in that era. For most of the early twentieth century, third-party copying of sound recordings was technologically difficult. Creating copies required access to both tightly controlled, physically distant "master records" and

^{3.} See 17 U.S.C. §§ 106–07; Fair Use, U.S. COPYRIGHT OFFICE, available at http://www.copyright.gov/fls/fl102.html (describing criticism as fair use) (last visited Dec. 20, 2013).

^{4.} See, e.g., Jake Linford, A Second Look at the Right of First Publication, 58 J. COPYRIGHT SOC'Y U.S.A. 585, 586–87 (2011).

^{5.} See PETER JASZI & NICK LEWIS, PROTECTION FOR PRE-1972 SOUND RECORDINGS UNDER STATE LAW AND ITS IMPACT ON USE BY NONPROFIT INSTITUTIONS: A 10-STATE ANALYSIS 2–4 (2009). Although sound recordings had no federal copyright protection prior to 1972, the unauthorized duplication of sound recordings was prohibited under a variety of state laws. *Id.* at 4. However, most states did not statutorily prohibit unauthorized duplication until the late 1960s, leaving the first half of the twentieth century with weak legal protection for sound recordings. *See id.* at 2–4.

^{6.} See, Carol Barnhart Inc. v. Econ. Cover Corp., 773 F.2d 411, 415 (2d Cir. 1985) (discussing scope of Copyright Act of 1870).

^{7.} The technological difficulty of copying was not the only reason that sound recordings received no federal copyright protection, but likely it was a significant reason for continued lack of protection. For example, the National Commission on New Technological Uses of Copyrighted Works stated:

Certain states made it illegal to duplicate [sound recordings], but federal copyright remained almost powerless in this area. While this rule was often criticized, its effect was apparently not too deleterious to producers of recorded sounds, so long as the cost of . . . duplication made commercial piracy an expensive undertaking.

NAT'L COMM. ON NEW TECHNOLOGICAL USES OF COPYRIGHTED WORKS, FINAL REPORT OF THE NATIONAL COMMISSION ON NEW TECHNOLOGICAL USES OF COPYRIGHTED WORKS 10 (1979).

large, prohibitively expensive industrial-grade machines.⁸ It was infeasible to make unauthorized duplications in quantities large enough to harm the commercial market.⁹ The absence of a positive legal right over sound recordings was thus partly explainable because technological limitations were, in effect, reliably performing the constraining function normally performed by copyright law.¹⁰ Because the underlying economic problem was cabined effectively by technological infeasibility, an explicit legal right to prevent copies would have been superfluous.¹¹

Note a parallel between the way in which positive copyright law explicitly constrained certain activities (e.g., copying books) and technological limitations implicitly constrained others (e.g., copying sound recordings). In general, there is no good terminology to express this latter quality of implicit technological constraint. This Article proposes the term "Technological Cost" to capture how activities can be implicitly constrained by limitations inherent to technological processes of the past. In this usage, the copying of sound recordings had a high Technological Cost because the implicit technological limitations of the time period made copying difficult as a practical matter. ¹²

Technological Cost is important to consider because it can influence the shape and impact of positive IP law. IP laws are often structured upon unarticulated presumptions that activities will be implicitly restricted by technological limitations. The copyright legal framework, for example, by omitting protection for sound recordings, appeared to depend upon sound recording copying remaining implicitly constrained and Technologically Costly. However the Technological Cost of activities can change over time. Emerging technologies frequently eliminate the capacity-limiting constraints common in the previous technological era. When legal frameworks depend upon activities being Technologically Costly, they are susceptible to shifts in

^{8.} ROBIN SANTOS DOAK, THE PHONOGRAPH 13–16 (2006); DAVID L. MORTON JR., SOUND RECORDING 92–93 (2004); see also Robert P. Merges, One Hundred Years of Solicitude: Intellectual Property Law, 1900–2000, 88 Calif. L. Rev. 2187, 2195 (2000).

^{9.} A small number of unauthorized duplications of sound recordings occurred during this era by highly motivated parties. For example, jazz enthusiasts duplicated jazz recordings that had been orphaned or abandoned. However, by and large these uses were small and did not undermine the commercial market for sound recordings. *See* Note, *Piracy on Records*, 5 STAN. L. REV. 433, 433–35 (1953).

^{10.} Cf. id. (explaining how recording companies' copyright rights were threatened only after technological advancements make disk replication less costly).

^{11.} *Id.* at 434 ("Although there were occasional instances of pirating in the years immediately after the introduction of . . . the phonograph, the activity that bothered the recording companies did not begin until much later.").

^{12.} BARRY KERNFELD, POP SONG PIRACY: DISOBEDIENT MUSIC DISTRIBUTION SINCE 1929 128 (2011) (describing how record copying equipment was tightly controlled and difficult to access in the early twentieth century).

^{13.} *Id.* (describing how sound recording commercialization in the early twentieth century relied upon the difficulty of accessing record copying facilities).

strength, scope, or effectiveness when the Technological Cost of activities decreases.

Consider how a decrease in Technological Cost impacted the copyright legal framework. In the 1960s, tape recording technology emerged and for the first time enabled high-quality, inexpensive duplications of sound recordings. Third parties no longer needed to access physically remote master records or industrial-grade equipment to make usable copies. In a short amount of time the unauthorized copying of creative works — copyright's core economic concern — increased significantly. Third parties suddenly had the capacity to threaten the commercial market for original recordings in ways that were previously technologically infeasible. With background technological limitations no longer a reliable barrier, lawmakers responded by altering positive law. A patchwork of state common-law protections began to emerge, and Congress finally added explicit federal protection for sound recordings in 1972.

The sound recording example is illustrative of a more general pattern throughout IP law. Technological limitations of the past often have a practical constraining effect on activities that are important to IP governance, such as copying in copyright law or manufacturing goods in patent law. Positive IP laws may be structured upon the premise that such activities will be implicitly constrained and Technologically Costly. However, as new technologies emerge, such implicit constraints often dissipate, and activities can become dramatically more expansive in capacity and can acquire entirely new and expansive properties that were previously infeasible. As this occurs, IP laws that are linked to these activities can subtly but meaningfully shift in scope. Such technologically induced shifts in legal scope may be hard to observe because positive law often remains unchanged. Description of the past o

This Article offers a framework for reifying relationships of implicit constraint by technological limitations of the past. Diminishing background constraint is an under-acknowledged factor driving

^{14.} See Merges, supra note 8, at 2196.

^{15.} See KERNFELD, supra note 12, at 141 ("Tape production was much simpler . . . than phonograph-record production.").

^{16.} See NAT'L COMM. ON NEW TECHNOLOGICAL USES OF COPYRIGHTED WORKS, supra note 7, at 10 ("The development of inexpensive transistorized tape recording equipment and its use by organized pirates posed serious economic problems for either the 1908 rule or the recording industry."); see also Merges, supra note 8, at 2195–97.

^{17.} See NAT'L COMM. ON NEW TECHNOLOGICAL USES OF COPYRIGHTED WORKS, supra note 7, at 10; see, e.g., KERNFELD, supra note 12, at 141 (concerning developments in tape duplication technology in the late 1960s).

^{18.} JASZI, supra note 5, at 7.

^{19.} This phenomenon is not exclusive to IP law and is prevalent in law. See generally Julia A. Singer, et al., The Impact of DNA and Other Technology on the Criminal Justice System: Improvements and Complications, 17 ALB. L.J. SCI. & TECH. 87 (2007).

^{20.} See infra Part II.B (discussing changes in the impact of patent law's novelty doctrine due to changes in Technological Cost).

changes in IP law. Part II provides examples from the major IP legal regimes (patent, copyright, trade secret, and trademark law) in which the structure of positive law has depended upon high Technological Cost, and a change in Technological Cost has led to subtle, but meaningful, shifts in law. Scholars have previously observed this phenomenon in particular contexts, such as in the transition from analog to digital music in copyright law. However, this dynamic has generally not been systematically studied nor understood as part of a shared phenomenon across IP legal domains.

Highlighting this dynamic of diminishing implicit constraint clarifies certain issues within IP policy. IP laws are thought to reflect carefully crafted regulatory balances.²² Changes in legal scope are usually accompanied by changes in law, but when Technological Cost decreases, there can be, in effect, shifts in legal scope even as positive law remains constant. In practice, IP laws may regulate differently over time, becoming effectively stronger (or weaker), or covering different activities as compared to a previous era. In some cases core assumptions of implicit constraint that undergirded IP laws in a prior era may no longer apply after technological change.²³ However, when there has been no alteration in positive law, it is often rhetorically difficult to articulate that a substantive shift in IP law has occurred. In actuality, sound policy may require rebalancing positive IP frameworks following an externally induced shift. Changing Technological Cost is an important dimension that needs to be accounted for within IP legal analysis but is today difficult to express directly. Part II thus provides a vocabulary for articulating how technological limitations can implicitly constrain activities important to IP law and how the dissipation of such constraint can shift the scope of IP laws.²⁴

^{21.} See, e.g., I. Trotter Hardy, Contracts, Copyright and Preemption in a Digital World, 1 RICH. J.L. & TECH. 2 (1995); Mark A. Lemley & R. Anthony Reese, Reducing Digital Copyright Infringement Without Restricting Innovation, 56 STAN. L. REV. 1345, 1373–75 (2004) (observing how digital media is changing copyright owners' responses to infringement); Linford, supra note 4, at 587 (observing how technology implicitly limited what could be done with physical books in the context of copyright's first publication right); Gideon Parchomovsky & Philip J. Weiser, Beyond Fair Use, 96 CORNELL L. REV. 91, 101 (2010)

^{22.} See, e.g., Pfaff v. Wells Elecs., Inc., 525 U.S. 55, 63 (1998) ("As we have often explained . . . the 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").

^{23.} Anuj Desai, *Big Entertainment Needs a Sequel to the Highly Anticipated Flop:* MGM v. Grokster, 41 GA. L. REV. 579, 596 (2007) ("Today, MP3 and P2P systems are prime examples of technologies that stress the meaning of copyright law and the doctrine of secondary liability."); *see also* Recording Indus. Ass'n of Am. v. Verizon Internet Servs., Inc., 351 F.3d 1229, 1238 (D.C. Cir. 2003) ("The Congress had no reason to foresee the application of § 512(h) to P2P file sharing, nor did they draft the DMCA broadly enough to reach the new technology when it came along.").

^{24.} Scholars have observed this issue in particular discrete contexts. See, e.g., Jane C. Ginsburg, Copyright and Control over New Technologies of Dissemination, 101 COLUM. L.

Part III argues that there may be implicit IP values embedded in the technological limitations of the past. 25 A value is *explicitly* protected when there is a positive law that constrains others from interfering with a valued activity. However, a value can be implicitly protected when it is technologically infeasible for others to interfere with a valued activity. For example, when books were only distributed in paper (rather than electronic) form, it was technologically infeasible for copyright holders to prevent purchasers from lending their books to others. Thus, there was an activity valued by certain societal groups (e.g., lenders) that was protected, not by an affirmative legal right to lend, but implicitly by the technological infeasibility of constraining that activity. From this arrangement, one might arguably infer an implicit value embedded in the technological limitations of paper book technology. The inability of copyright holders to constrain post-sale lending may not simply have been an artifact of a past technology, but may arguably have reflected an embedded (but uncodified) social value — that the post-sale control of copyrighted works by authors should be limited. ²⁶ High Technological Cost may implicitly protect IP values in ways that may not be readily apparent.

Problematically, when values are only implicitly protected by high Technological Cost rather than explicitly enshrined in positive law, they can subtly erode with technological change.²⁷ New technologies may allow interference with valued activities in ways that were previously infeasible. For example, publishers can now constrain what purchasers do with electronic books post sale in ways that were not possible in the paper book era.²⁸ To the extent that the ability to lend books reflected an IP value implicitly protected by past technological

REV. 1613, 1614 (2001) (focusing upon shifts in the scope of copyright law driven by the development of new technologies).

^{25.} To the extent that scholars have emphasized the *regulatory* role of technology, they have tended to focus on the micro level, and how design choices of technological systems (e.g., websites, software, the Internet) can foster or inhibit societal values (e.g., privacy, anonymity, transformative uses). *See, e.g.*, LAWRENCE LESSIG, CODE AND OTHER LAWS OF CYBERSPACE 6 (2000) (arguing how software code and software design can effectively promote or inhibit values in electronically mediated environments such as the Internet); Julie E. Cohen, *DRM and Privacy*, 18 BERKELEY TECH. L.J. 575, 575–76 (2003); John S. Erickson & Deirdre K. Mulligan, *The Technical and Legal Dangers of Code-Based Fair Use Enforcement*, 92 PROCEEDINGS OF THE IEEE 985, 985 (2004); Joel R. Reidenberg, *Lex Informatica: The Formulation of Information Policy Rules Through Technology*, 76 TEX. L. REV. 553, 554–55 (1998). *But see* Merges, *supra* note 8, at 2193–99 (focusing on a macrolevel view of technology).

^{26.} For an analogous line of arguments in Constitutional law that there may be implicit (non-written) rights or values embedded in practice or structure, see generally Andrew B. Coan, *The Irrelevance of Writtenness in Constitutional Interpretation*, 158 U. PA. L. REV. 1025 (2010), and Thomas C. Grey, *Do We Have an Unwritten Constitution?*, 27 STAN. L. REV. 703 (1975).

^{27.} See infra Part III.

^{28.} International Federation of Library Associations, IFLA E-Lending Background Paper 9 (2012).

infeasibility, such values may "Technologically Erode" when emerging technologies allow such activities to be restricted. At this point such implicit values are left unprotected either by high Technological Cost or positive law. High Technological Cost may have been functionally substituting for positive law. This raises a public policy question: should policymakers use positive law (or some other means) to explicitly protect values that were embedded in the technological limits of the earlier period?²⁹ Part III illustrates how a Technological Erosion model can clarify certain intuitions in IP, including observed disruptions in copyright fair use, and in patent and copyright exhaustion.

Part IV theoretically grounds the Technological Cost framework in the work of earlier scholars.³⁰ IP legal frameworks depend upon certain activities being Technologically Costly to maintain central regulatory balances, for example balancing incentives to produce IP goods against sufficient public access to these goods.³¹ This Part identifies general principles that have tended to characterize technologically induced shifts in legal scope. Changing technological feasibility shifting the scope of law is not a phenomenon exclusive to IP law.³² However, as IP law's topic of regulation is information itself,³³ it is particularly susceptible to such shifts as emerging technologies have

^{29.} This question is complex because technological change can unlock novel, welfare-enhancing activities, which lawmakers should be wary of inhibiting when replicating the value protections of an earlier legal framework. *See, e.g.*, Omer Tene & Jules Polonetsky, *Big Data for All: Privacy and User Control in the Age of Analytics*, 11 Nw J. TECH & INTELL. PROP. 239, 258–61 (2013). The benefits found in big data analysis exemplify how duplicating privacy protections from an earlier framework may inhibit novel, socially desirable activities.

^{30.} The term "general regulation scholars" is the term I use to reference scholars such as Lawrence Lessig and others, discussed *supra* at page 5 and note 25, who advanced the concept of legal policymakers considering the major factors that influence behavior beyond law. *See* Lawrence Lessig, *The New Chicago School*, 27 J. LEGAL STUD. 661, 661 (1998); *see also* Edward K. Cheng, *Structural Laws and the Puzzle of Regulating Behavior*, 100 NW. U.L. REV. 655, 657 (2006); Joel R. Reidenberg, *Governing Networks and Rule-Making in Cyberspace*, 45 EMORY L.J. 911, 912 (1996); Harry Surden, *Structural Rights in Privacy*, 60 SMU L. REV. 1605, 1606 (2007).

^{31.} See, e.g., William M. Landes & Richard A. Posner, An Economic Analysis of Copyright Law, 18 J. LEGAL STUD. 325, 326 (1989) ("Striking the correct balance between access and incentives is the central problem in copyright law."). Similar balance issues appear in patent law. It is important to balance patent rights in foundational inventions against later improvements. See Mark A. Lemley, The Economics of Improvement in Intellectual Property Law, 75 TEX. L. REV. 989, 990–91 (1997).

^{32.} For example, information privacy law is subject to a similar phenomenon. *See, e.g.*, Chris Evans, *It's the Autonomy, Stupid: Political Data-Mining and Voter Privacy in the Information Age*, 13 MINN. J.L. SCI. & TECH. 867, 879–80 (2012); Surden, *supra* note 30, at 1617. For discussion of a property law changing in scope due to the invention of the airplane, see LAWRENCE LESSIG, FREE CULTURE 1–3 (2004).

^{33.} See, e.g., Brett M. Frischmann, An Economic Theory of Infrastructure and Commons Management, 89 MINN. L. REV. 917, 1001 (2005). ("Intellectual property law creates exclusive rights and thereby facilitates private restrictions on access to new information goods....").

decreased the Technological Cost of disseminating, aggregating, duplicating, and analyzing information.³⁴

Part V applies this Article's framework to contemporary IP problems. Three-dimensional printing is thought to be disruptive to copyright and patent law.³⁵ The framework provides a theoretical explanation as to why, and in what respects, it will be disruptive. In short, copyright and patent laws are currently premised upon unarticulated assumptions about the Technological Costliness of reproducing three-dimensional objects.³⁶ Three-dimensional printing will drastically lower the Technological Cost of duplicating and disseminating physical objects, thereby undermining these premises that existing legal frameworks implicitly depend on.³⁷ This observation can be used to predict upcoming issues, such as a likely increase in the importance of secondary liability in infringement actions.³⁸

The Technological Cost framework also reveals a new class of "policy levers" to calibrate IP law. ³⁹ Lawmakers might reduce Technological Cost in targeted areas to achieve policy goals rather than changing law. For example, invalid but issued patents are a problem in patent law. In some cases, prior art documents exist that would demonstrate invalidity, but the Technological Cost of actually locating these documents is high given the large universe of documents to search through and limited patent examination time. ⁴⁰ Recognizing that laws implicitly depend upon Technological Cost, the most effective approach to achieve IP policy ends may not be changes in law, but rather computational techniques that reduce the Technological Cost of finding relevant prior art. ⁴¹

^{34.} See infra Part IV.C. Moreover, as discussed, IP goods tend to be more closely aligned with technology than other substantive areas. See Merges, supra note 8, at 2202 (noting how the DMCA amendment to the Copyright Act directly regulated specific technologies).

^{35.} Peter Hanna, *The Next Napster? Copyright Questions as 3D Printing Comes of Age*, ARS TECHNICA (Apr. 6, 2011), http://arstechnica.com/tech-policy/news/2011/04/the-next-napster-copyright-questions-as-3d-printing-comes-of-age.ars.

^{36.} See infra Part V.A.2.

^{37.} CHRIS ANDERSON, MAKERS: THE NEW INDUSTRIAL REVOLUTION 88–89 (2012).

^{38.} See infra Part V.B.

^{39.} For a pioneering discussion of mechanisms to calibrate patent policy, see Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1579 (2003).

^{40.} See, e.g., John R. Thomas, Collusion and Collective Action in the Patent System: A Proposal for Patent Bounties, 2001 U. ILL. L. REV. 305, 314 (2001) (noting that the average time allocated to examining patents was about sixteen to seventeen hours, a short time given the large universe of prior art).

^{41.} Advances in machine learning algorithms have enabled the scanning of corpuses of text documents to identify relevant exemplars. STUART RUSSELL & PETER NORVIG, ARTIFICIAL INTELLIGENCE 865–77 (3d ed. 2010).

II. TECHNOLOGICAL COST AND SHIFTS IN IP LAW

A. The Technological Cost Framework

1. IP Legal Scope and Positive Law

There are four major IP legal regimes — patent, copyright, trademark, and trade secret law. In general, what these regimes have in common is that they grant private parties some exclusive legal control over information. ⁴² IP rights have a particular scope, meaning that IP law does not give private parties the right to control every possible piece of information, nor does it permit private parties to constrain every use of information by others. Rather, IP law allows control over only information that meets certain criteria, and the right to constrain legally specific third-party activities concerning that information. Let us describe the scope of an IP legal right as the strength and expanse of control over information allowed under the law.

We normally think of the scope of IP legal rights as arising from positive law. 43 To determine the scope of IP rights one obvious source is the body of positive IP law (i.e., statutes and case law) that expressly grant legal rights to control information. The copyright statute, for example, identifies specific types of information (e.g., creative works) that are the subject of the statute's exclusive control provisions and grants specific exclusive rights concerning these works (e.g., the right to prevent others from making copies). 44 Similarly, the patent act identifies certain types of inventive knowledge that are subject to exclusive control (e.g., those that meet the requirements of patentability), and grants specific exclusive rights concerning that information (e.g., the right to prevent others from selling products embodying claimed inventive technology). 45 Hence, one dimension to consider when discerning the scope of IP legal rights is the private control over information expressly created by positive statute and doctrine. We might term those IP statutes and doctrines that expressly allocate exclusive legal control over information "Control Structures."

^{42.} The underlying social value of a patent, for instance, is generally not understood to be in any particular product manufactured (e.g., a pharmaceutical drug that cures a disease), but rather in the information describing how to make and use an invention that emerges once developed. See, e.g., R. Polk Wagner, Information Wants To Be Free: Intellectual Property and the Mythologies of Control, 103 COLUM. L. REV. 995, 998 (2003). Similarly, the value of copyrighted creative works is in the particular configurations of words, concepts, artistic arrangements, or musical compositions that can be expressed as information. See Frischmann, supra note 33, at 1001–02.

^{43.} See, e.g., Linford, supra note 4, at 586–87 (discussing alterations to positive law to add a limited copyright right of first publication online).

^{44.} See generally 17 U.S.C. § 106 (2012) (specifying the exclusive rights in copyrighted works).

^{45.} See generally 35 U.S.C. § 271 (2006 & Supp. V 2011) (specifying the patent rights).

In assessing scope, it is also important to consider how IP rights are directly or indirectly bounded. All IP legal rights are cabined in various ways because it is generally understood that too much private exclusive legal control over information can create more harm than good. We might call the various statutory provisions, doctrines, or procedures that constrain the scope of exclusive IP rights "Bounding Structures." For example, patent law's subject matter requirement and non-obviousness doctrine, copyright's merger doctrine, or trademark's distinctiveness requirement bound the scope of exclusive rights by restricting certain information from being subject to exclusive legal control. Other Bounding Structures grant non-owners (e.g., the public) an affirmative right to use, without express authorization, information protected by IP rights. Copyright's fair use doctrine is one such example. The positive scope of an IP legal right is thus comprised of both those positive legal structures that expressly grant exclusive rights and those structures that bound those rights.

Under one common view, lawmakers assess the appropriate scope of IP legal rights and then calibrate positive law to implement their determination.⁵³ In this characterization, positive law reflects a deliberate balance ensuring that IP rights are sufficiently robust to address the underlying economic (or other) concerns that animate IP law but with Bounding Structures designed to lessen the cost of exclusive control in particular settings.⁵⁴ Thus, IP rights are thought to be framed by positive law at particular set points that reflect this balance

^{46.} See, e.g., William W. Fisher, Property and Contract on the Internet, 73 CHL-KENT L. REV. 1203, 1211–12 (1998) (discussing the proper scope of intellectual property rights); John M. Golden, Principles for Patent Remedies, 88 Tex. L. Rev. 505, 517–18 (2010) (discussing social costs imposed by patents).

^{47. 35} U.S.C. § 101 (restricting patents to inventions that constitute a "new and useful process, machine, manufacture, or composition of matter").

^{48. 35} U.S.C. § 103.

^{49.} See Morrissey v. Procter & Gamble Co., 379 F.2d 675, 678–79 (1st Cir. 1967) (summarizing the doctrine that if a copyrighted work expresses an idea, and there are only a limited number of ways to express that idea, then the work merges with the idea and is not copyrightable).

^{50.} See, e.g., Zatarain's, Inc. v. Oak Grove Smokehouse, Inc., 698 F.2d 786, 790 (5th Cir. 1983) (describing how trademark law's distinctiveness requirements normally prevent trademark control over marks classified as generic).

^{51. 17} U.S.C. § 107 (2012).

^{52.} See, e.g., Ginsburg, supra note 24, at 1614 ("[T]he copyright statute and the judges who interpret it attempt a balance: Creators should maintain sufficient control over new markets to keep the copyright incentive meaningful, but not so much as to stifle the spread of the new technologies of dissemination.").

^{53.} See J. H. Reichman, Legal Hybrids Between the Patent and Copyright Paradigms, 94 COLUM. L. REV. 2432, 2451 (1994) (describing how the choice as to what to cover and not cover in patent law and copyright law is deliberate).

^{54.} See, e.g., ROBERT P. MERGES ET AL., INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE 132 (6th ed. 2012) ("[D]esigning the proper economic incentive requires the policymaker to balance the length of the patent term, the appropriate standard of invention, and the nature of the rights granted to patentees.").

determination. When there is a change in the scope of an IP right (i.e., a law covers new or different activities, or becomes stronger) — we normally presume that this has been the result of an explicit change to positive law (e.g., a statute has been amended or there has been new case law). 55

2. IP Legal Scope and Implicit Technological Constraint

This Section suggests that IP rights can be scoped and bounded, not just by positive law, but also by technological infeasibility. IP laws are often linked to activities that are implicitly constrained by technological limitations. As this implicit constraint dissipates due to technological change, the scopes of these IP laws can subtly shift. This dynamic will be captured through the concept of changing Technological Cost.

Consider an illustrative example of changing Technological Cost impacting IP law. During the course of research, scholars often find it useful to copy library materials for use at a later time. In the early 1900s, it was commonly understood that copyright's fair use doctrine⁵⁶ permitted researchers to duplicate library books and articles as needed, without permission, for their personal research records.⁵⁷ Let us call this the "Research Doctrine."

The Research Doctrine emerged in an era when the technology for copying texts had significant limitations. In the early 1900s, the primary means of duplicating the texts of library books and articles was hand transcription.⁵⁸ There are constraints inherent to the manual

[I]t is Congress that has been assigned the task of defining the scope of the limited monopoly that should be granted to authors or to inventors Because this task involves a difficult balance between the interests of authors and inventors . . . and society's competing interest in the free flow of ideas, information, and commerce on the other hand, our patent and copyright statutes have been amended repeatedly.

[I]t is almost unanimously accepted that a scholar can make a handwritten copy of an entire copyrighted article for his own use, and in the era before photoduplication it was not uncommon (and not seriously questioned) that he could have his secretary make a typed copy for his personal use and files.

Williams & Wilkins Co. v. U. S., 487 F.2d 1345, 1350 (Ct. Cl. 1973). See Jennifer E. Rothman, *The Questionable Use of Custom in Intellectual Property*, 93 VA. L. REV. 1899, 1916–18 (2007) (describing the so-called "Gentleman's Agreement" of 1935 which committed to writing an agreement reflecting the long standing practice of allowing researchers to make copies of library materials even without permission of the copyright holder).

^{55.} For example, the Supreme Court has noted that:

Sony Corp. of Am. v. Universal City Studios, Inc., 464 U.S. 417, 429 (1984).

^{56.} In brief, copyright's fair use doctrine permits third parties to reproduce copyrighted works without permission under certain circumstances without infringing. *See* MERGES ET AL., *supra* note 54, at 435.

^{57.} The Court of Claims noted:

^{58.} Williams, 487 F.2d at 1346.

copying of texts — it is labor intensive and slow — and the Research Doctrine, as it was generally expressed at the time, subtly reflected these limitations. The doctrine tended not to include or even address limits on the number of works that could be copied by any given researcher. ⁵⁹ Including such scope limitations in the text of this doctrine may have appeared unnecessary at that time because constraints inherent to manual copying already provided a natural bound on the scope of copying that any one researcher could realistically accomplish.

Around 1910 early machine-aided copying technology emerged. Although early copying machines, such as the "Photostat machine," had some modest advantages over hand copying in certain circumstances, in general this early technology had its own limitations that constrained the scope of copying. Photostat machines were expensive and centralized in specialty reproduction departments, and the copying itself was slow and produced poor quality reproductions. A change in technology had occurred, but the Research Doctrine largely operated as it had in the previous technological era. As a practical matter, limitations inherent to early machine-aided technologies continued to bound the amount of third-party copying permitted under the doctrine.

Several decades later a new technology for reproducing texts — photocopying — emerged. Although initial photocopy machines had some limitations, advances in the technology allowed researchers to duplicate materials at a speed, cost, and quality previously infeasible. This significant increase in technological feasibility exposed tensions between the Research Doctrine and copyright law that had not been previously problematic. For example, in the 1973 *Williams* case, government researchers were sued for copying articles for their research collections. The researchers were operating as they had historically, but due to technological changes were able to photocopy articles at a pace and scope that had previously been infeasible. The *Williams* court struggled to reconcile the long standing Research Doctrine within a new environment in which many of the technological

^{59.} See Randall Coyne, Rights of Reproduction and the Provision of Library Services, 13 U. ARK. LITTLE ROCK L.J. 485, 489 (1991) (describing the so-called Gentleman's Agreement which formalized the understanding that "the practice of [a library] providing a single copy of a copyrighted work to a user for the purpose of research, study, or other educational use was well within the fair use doctrine").

^{60.} DAVID OWEN, COPIES IN SECONDS: HOW A LONE INVENTOR AND AN UNKNOWN COMPANY CREATED THE BIGGEST COMMUNICATION BREAKTHROUGH SINCE GUTENBERG — CHESTER CARLSON AND THE BIRTH OF XEROX MACHINE 79 (2004).

^{61.} See id. at 61.

^{62.} See id. at 10.

^{63.} See id. at 283

^{64.} Williams & Wilkins Co. v. U.S., 487 F.2d 1345, 1347-49 (Ct. Cl. 1973).

constraints of the past had been shed.⁶⁵ The Research Doctrine had arguably increased in its scope over time, and that increase occurred due to a change in technology and not an alteration of positive law.

By the 1990s, these conflicts were starkly illustrated as photocopying technology improved to the point where it had lost even its initial technical limitations. No longer relegated to specialty departments, photocopying machines became decentralized, inexpensive, common, and accessible to individual researchers. ⁶⁶ This enabled individual researchers to copy materials on a much larger scale than previously possible in an era of hand transcription, Photostat, and even early photocopying technology.

It became clear that the Research Doctrine, were it to have persisted unaltered, would have allowed significantly more permissionfree copying than it had in the past when technological limitations implicitly constrained the scope of copying. This tension was revealed in the American Geophysical case, in which a for-profit firm used modern photocopying machines to duplicate copyrighted materials enmasse for its multiple research scientists, in lieu of paid purchases or subscriptions for these materials. 67 The company defended its copying as a continuation of the historical practice permitting researchers to copy materials for their personal archives under fair use. 68 In finding the copying not fair use, the court noted the importance of limiting fair use copying when it impacted commercial sales — a topic not previously problematic in the prior technological era. ⁶⁹ In short, although the court did not have the vocabulary to articulate it, it struggled with the implications of a law having a differential impact over time due to intervening changes in technological feasibility.

3. Technological Cost as a Measure of Implicit Constraint

The prior example illustrated how implicit technological constraint can shape the scope of IP rights and boundaries. There was an IP law (the Research Doctrine), and an activity central to its scope (copying texts). Notably, in the early half of the twentieth century, technological limitations implicitly constrained this activity, limiting the amount of copying that could feasibly be done. This implicit technological constraint, in effect, limited the scope of the Research Doc-

^{65.} Williams, 487 F.2d at 1380 ("The legitimate interests of copyright owners must, accordingly, be measured against the changed realities of technology.").

^{66.} See OWEN, supra note 60, at 4 (describing the introduction of "copiers intended for personal use").

^{67.} Am. Geophysical Union v. Texaco Inc., 60 F.3d 913, 931 (2d Cir. 1994). In response, courts began changing the fair use rules of this era to impose restrictions on the scope of copying. *See also id.* at 928–29 (discussing subscription purchases Texaco would have made in the absence of photocopying).

^{68.} See id. at 914-15.

^{69.} See id. at 928.

trine. However, as this activity became less technologically constrained, the boundary of the Research Doctrine shifted. This IP law began to operate differently over time as technological change enabled copying on a previously infeasible scale, undermining presumptions upon which the law had likely originally been based.

The specific dimension of change just described — changing levels of implicit technological constraint — is an important driver of change in IP law and should be accounted for directly in legal and policy analysis. Today, however, this property is difficult to express directly for lack of terminology. This Section thus provides an analytical framework, based upon the introduced concept of Technological Cost, to more explicitly capture changes in technological feasibility as a component of legal scope.

We can define Technological Cost more formally as a measure of the way activities are often inherently restricted, constrained, limited, or otherwise infeasible due to limitations characteristic of technologies of the past. For example, under this definition, the copying of texts had a *high* Technological Cost in the early 1900s because manual copying had inherent limitations such as labor intensiveness that provided a natural bound to the scope of copying that could practically be done. Hence, Technological Cost is a property of activities relevant to IP governance — such as copying texts, manufacturing products, or disseminating information — in a particular time period. Moreover, the term "cost" is used metaphorically, to express implicit constraint due to technological infeasibility, and is not meant literally as monetary cost. The more that an activity is implicitly constrained due to the technological limitations of a given time period, the higher the Technological Cost of that activity will be.

The most important point about Technological Cost is that implicit technological constraint can decrease over time with innovation. In this Article's usage, an activity decreases in Technological Cost when a new technology reduces or entirely eliminates limitations that inhered in earlier methods for conducting this activity. For example, the Technological Cost of copying text decreased significantly with the advent of photocopying because that technology did not suffer from the significant speed and quality limitations of earlier technologies. In general, following technological change, the same activity can often be conducted much more expansively, or can acquire new properties, and previously infeasible behaviors can become feasible. Changing Technological Cost thus captures a particular dimension of change — that of dynamically shifting technological feasibility over time — that is not easy to articulate given current terminology.

This dimension of change is important to consider because there is often a subtle relationship between positive IP law and Technological Cost. The positive expression of an IP legal rule — what rights

and limits are included or omitted in a law — can reflect unarticulated presumptions about the Technological Cost of activities in the era in which the rules are promulgated. For instance, the early formulations of the Research Doctrine generally did not encompass limits on the number of individual library books that a researcher could copy. ⁷⁰ The absence of such scope restrictions likely reflected the fact that the Technological Cost of copying was high during that period, and the scope of copying was already constrained by limitations inherent to manual and early machine-aided copying. ⁷¹ More generally, we can think about the structure of individual IP laws — what rights and limits are included or omitted in the legal rules as expressed — as often premised upon unstated understandings about the technological feasibility of relevant activities.

Observing this relationship between positive IP law and high Technological Cost is important because it highlights a specific way in which IP laws (or IP legal frameworks) can begin to operate differently over time due to technological changes external to law. In the prior scenario, the Research Doctrine, on its face, began to permit significantly more fair use copying with the emergence of photocopying technology than the doctrine had permitted in the prior technological era. Part of the reason for this change was that this legal doctrine was based upon presumptions about the high Technological Cost of copying that were true in the early 1900s, but were no longer true sixty years later following technological change. Thus, unstated presumptions of technological feasibility that initially shape the scope or coverage of a given IP law can create a latent link between the impact of the law and external changes in technological feasibility.

4. Changing Technological Cost as a Pattern of Disruption in IP Law

More generally, this example was meant to illustrate a broader pattern in the way IP laws are frequently disrupted by technological change throughout all of the IP legal regimes. In this pattern, there was some activity, such as copying texts, that was relevant to the scope, coverage, or effectiveness of a particular IP legal rule (such as the Research Doctrine). That activity was implicitly constrained due to limitations inherent to technological processes of the past. Reflecting understandings about the technological state of the era, positive IP laws promulgated during that era were structured upon unstated pre-

^{70.} See Coyne, supra note 59, at 489 (noting the content of the so-called "Gentleman's Agreement," which was generally believed to reflect contemporary beliefs about fair use like permission for copying for research. Although the Gentleman's Agreement provided a limit on the number of times that a researcher could copy any one book, it did not appear to address limits on the number of different books that could be copied by a researcher).

^{71.} See id. at 491 (noting that the Research Doctrine had been "crafted at a time when photocopying was relatively expensive, cumbersome, and infrequent").

sumptions that this activity would be implicitly constrained. These unarticulated presumptions created a link between the scope of the IP law and external technological change that was difficult to observe.

New technologies eventually emerged that reduced or eliminated the technological constraint that had characterized the prior era. With this reduction in Technological Cost, actors were able to conduct a given activity at a speed, scope, or scale that was previously technologically infeasible. There were several consequences of this reduction of implicit constraint. First, certain long-standing IP laws began to operate differently (e.g., enlarged or strengthened in legal scope) compared to their earlier baseline. The presumptions of implicit technological constraint upon which these laws were originally promulgated no longer held. Second, the new technology gave rise to completely novel factual scenarios driven by fundamental changes in technological feasibility. The existing IP legal framework was ill equipped to handle these novel situations; the lawmakers of the prior era, quite sensibly, had not bothered formulating legal rules to address scenarios that had previously been technologically infeasible.

This pattern has been previously observed in particular contexts in IP scholarly literature. For example, Trotter Hardy has studied the way in which limitations in the state of the art of technology have often provided practical, non-legal constraints upon which the authors of creative works have depended to capture economic value. ⁷² Tom Bell has analyzed the way in which decreases in the cost of requesting and receiving permission to use copyrighted works put pressure on fair use rules premised upon transaction costs. 73 Multiple scholars, including Gideon Parchomovsky and Philip J. Weiser, 74 Mark Lemley and Anthony Reese, 75 and Jane Ginsburg, 76 observed that prevailing equilibria in copyright law fundamentally shifted when creative works migrated from analog to digital form in the 1990s, reducing technological limitations inherent to analog technology that had previously provided natural bounds on duplication. ⁷⁷ Each of these scholars can be understood as previously examining the phenomenon labeled here as changing Technological Cost.

In general, however, the IP literature has not studied this dynamic in a systematic or generalizable way. A methodical approach to analyzing this pattern can be helpful for several reasons. First, this dynamic is an important source of change in the impact and effectiveness of IP law. IP legal architectures frequently depend upon

^{72.} Hardy, supra note 21, at 6.

^{73.} See Tom W. Bell, Fair Use vs. Fared Use: The Impact of Automated Rights Management on Copyright's Fair Use Doctrine, 76 N.C. L. REV. 557, 557 (1998).

^{74.} Parchomovsky and Weiser, *supra* note 21, at 101.

^{75.} Lemley and Reese, supra note 21, at 1373-76.

^{76.} Ginsburg, supra note 24, at 1614.

^{77.} Lemley and Reese, supra note 21, at 1375–76.

activities being implicitly constrained by technological limitations, and this relationship creates a latent link between the operation of IP laws and external technological change. The elusive dimension of changing technical feasibility described above is one that needs to be directly accounted for within IP policy analysis. However, in general, this aspect of change is difficult to express due to a lack of terminology and concepts.

Second, relationships of implicit constraint can be subtle and difficult to observe unless one is affirmatively primed. The concept of changing Technological Cost specifically is intended to capture the phenomenon by which activities that were subtly cabined become less constrained as the technological constraints of the past diminish. This, in turn, allows us to observe more directly the way in which technological infeasibility may sometimes serve a functional role in the overall architecture of IP legal regimes.

Finally, as will shortly be suggested, the lens of changing Technological Cost can help us better understand technological disruptions in IP law, and see these changes as part of a larger pattern.

B. Structurally Constrained Activities

An activity has a high Technological Cost when it is implicitly constrained by technological limitations. In some instances, it would be informative to identify the particular technical limitations of the past that had such a constraining effect. For instance, in the prior example, the Research Doctrine coexisted in harmony with competing copyright goals for many years before suddenly presenting problems for IP policymakers in the 1970s. Why did a longstanding IP law abruptly operate differently compared to its historical baseline? The reason proposed was that an activity — copying texts — had previously been implicitly constrained by limitations inherent to past technologies, and that new technologies enabled copying at a finer granularity and broader scope that was simply not possible in the prior technological era.

To convey the source of such change we need terminology to directly reference those background barriers of the past that had the practical effect of limiting the scope of particular activities. This part proposes the term "Structural Constraint" to refer to any such background feature of the past that had the practical effect of making some activity more difficult, more limited, slower, less granular, more labor intensive, or generally less feasible. Relatedly, we can refer to any activity that appears to have been fundamentally limited in this manner as having been "Structurally Constrained."

1. Structural Constraints in Patent Law

Consider another example of a law shifting in scope due to changing Technological Cost, this time from a different IP domain — patent law. This example will also illustrate how identifying Structural Constraints can reveal how activities were implicitly technologically constrained in the past.

Patent law's novelty provision (section 102 of the patent statute) mandates that patents only be issued on "new" inventions. That provision bars, in other words, patents for technologies that have been previously created by an earlier inventor. One demonstrates that a claimed invention is not novel by providing a "prior art" reference. Prior art typically takes the form of a document — such as an earlier patent or an article from a scientific journal — that signals earlier creation. If such a document predates a claim and describes the claimed invention in sufficient detail, the claim should be invalid for lack of novelty. By finding prior art documents that signal earlier creation, defendants in a lawsuit (or patent examiners) can show that technology has been created by an earlier inventor and thus does not meet the statutory novelty standard.

The strength of the novelty requirement partially depends upon the ease of finding invalidating prior art documents. If such invalidating documents tend to be difficult to locate, the novelty provision will be a weaker legal barrier. As a practical matter, defendants will be unable to find existing, but inaccessible, documents that can demonstrate invalidity. Conversely, if such documents tend to be easier to find, it is likelier that defendants may be able to demonstrate invalidity, and the provision will tend to be a more substantial legal barrier.

For most of the history of patent law there were significant practical, physical, and technological barriers (i.e., Structural Constraints) that limited the feasibility of finding prior art documents. In the early twentieth century, for instance, the relevant documents were in paper form. The physical nature of paper technology created obstacles to locating certain types of documents as compared to the digital era. Some potentially invalidating documents, such as student dissertations, were practically inaccessible, housed in obscure library or gov-

^{78. 35} U.S.C. § 102 (2006 & Supp. V 2011).

^{79.} The priority date by which one measures whether an invention was "earlier" has shifted following the American Invents Act (AIA). Rules for determining priority date are fairly complex under pre-AIA rules and are based upon invention date, but are substantially simplified, and largely based upon filing date, for post-AIA patents (filed after Mar. 16, 2013). Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284, 285 (2011).

^{80. 35} U.S.C. § 102.

^{81.} Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. at 285-86.

ernment archives, often embodied in only one physical copy. 82 Others, such as issued U.S. patents, were available only in voluminous paper collections.

In addition, documents located abroad, such as foreign patents or overseas scientific journals, represent large troves of potentially relevant documents. However, for much of this period, such documents were physically distant and often practically inaccessible. Moreover, many were written in languages unfamiliar to U.S. searchers. This linguistic hurdle acted as a distinct constraint limiting the scope of English-language searches.

As a result, physical distance, the difficulty of finding obscure documents resting in distant paper archives, and the laboriousness of searching through large paper collections acted as barriers to locating these invalidating prior art documents.⁸⁴

The technological feasibility of finding such remote prior art increased significantly during the 1990s. First, many relevant documents began to be created in (or converted into) digital form during this period. Second, many of these digital documents were placed on the Internet and were accessible electronically from distant locations. 85 These technological changes enhanced the capabilities of prior art searchers in novel ways. Troves of remote or obscure documents — patents, patent applications, and scientific journals in foreign countries — that are full of potentially invalidating prior art references and that were practically inaccessible became available to distant researchers. 86 With computerization, documents also became easier to search and sort on a mass scale. Moreover, the internal contents of these documents, such as the text of a thesis, rather than just the name and subject of the document on a library index, became accessible to computer-based searches. Finally, automated translation software made non-English documents comprehensible to Englishonly speakers.87

^{82.} See, e.g., Bruckelmyer v. Ground Heaters Inc., 453 F.3d 1352, 1354 (Fed. Cir. 2006) (Newman, J., dissenting); In re Cronyn, 890 F.2d 1158 (Fed. Cir. 1989) (describing a case in which three student theses, housed in an obscure part of a library, were found).

^{83.} An earlier foreign patent, for example, can serve as an invalidating prior art document for a U.S. claim. *See, e.g.*, SRAM Corp. v. AD-II Eng'g, Inc., 367 F. App'x. 150, 154–55 (Fed. Cir. 2010) (holding that a Japanese patent application anticipated the U.S. patent).

^{84.} In one well-known patent case, a defendant managed to find an obscure thesis in a remote part of a university library that demonstrated the invalidity of the litigated patent. *See, e.g., In re* Hall, 781 F.2d 897, 897 (Fed. Cir. 1986).

^{85.} See, e.g., Invention Machine Corporation Launches Knowledge and Innovation Server at NMW '99, SINOCAST (Mar. 19, 1999) ("The [product] enables users to conduct Internet searches of the U.S. and Japanese Patent Office databases.").

^{86.} For example, patents from the Japanese Patent Office are searchable online. *Searching PAJ*, NATIONAL CENTER FOR INDUSTRIAL PROPERTY INFORMATION AND TRAINING, http://www19.ipdl.inpit.go.jp/PA1/cgi-bin/PA1INIT? (last visited Oct. 19, 2013).

^{87.} See, e.g., Google Translate, GOOGLE, http://translate.google.com/ (last visited Dec. 20, 2013).

2. Structural Constraints and Shifts in Legal Scope

In analyzing the patent example, observe that the prior scenario illustrated a change in Technological Cost that subtly shifted an IP law. Patent law's novelty provision was structured around an activity with a high Technological Cost — the finding of prior art documents. In the era of paper documents, researchers could not easily find prior art that was located in distant libraries, shelved in obscure or voluminous paper archives, or written in unfamiliar languages. The impact of the novelty provision was thus intermediated by the state of technological advancement and the Structural Constraints of the era that implicitly constrained this activity that was central to the scope of the law. With the subsequent emergence of digitization, the Internet, networking, and computer-aided sorting, analysis, and translation, the Technological Cost of finding and using remote and voluminous prior art decreased. These emerging technologies diminished the effects of Struc-Structural Constraints that had previously limited the central activity.

The decrease in Technological Cost, in turn, likely altered the impact of the novelty provision (and other provisions, such as nonobviousness, which also depend upon finding such documents). 88 As a practical matter, prior art searchers were able to access a broader trove of previously inaccessible documents that could be used to demonstrate invalidity, and sort through large volumes of prior art documents, in ways not previously technologically feasible. 89 Following this technological change, it was possible to engage in significantly more of an activity —which the scope of the provision depended upon — as compared to the era in which the provision was originally promulgated. To the extent that the novelty provision was structured upon presumptions of implicit constraint, the impact of the provision likely shifted as compared to its earlier baseline due to intervening changes in technological feasibility. 90 More theoretically, if we think of the novelty provision as a Bounding Structure (since it limits the type of inventions that can be the subject of exclusive patent rights). then the scope of this Bounding Structure may have shifted from its original legislative set point.

^{88.} See, e.g., Jay Erstling, Patent Law and the Duty of Candor: Rethinking the Limits of Disclosure, 44 CREIGHTON L. REV. 329, 361–62 (2011) (describing efforts to make foreign prior art more accessible electronically); cf. Bhaven N. Sampat, Determinants of Patent Quality: An Empirical Analysis 3 (Sept. 2005) (unpublished manuscript), available at http://www.immagic.com/eLibrary/ARCHIVES/GENERAL/COLUMBIA/C050902S.pdf (suggesting that patent examiners prior to 2003 had "a comparative disadvantage in searching for . . . foreign patents".)

^{89.} Erstling, *supra* note 88, at 357–65.

^{90.} See, e.g., JANICE M MUELLER, PATENT LAW 191 (4th ed. 2013) ("Why are there geographic distinctions? The statute probably reflects a historical notion, translated into an evidentiary presumption, that 'personal' activities . . . require greater effort to disseminate to U.S. citizens than do domestic activities.").

Note that Technological Cost was useful as a comparative metric to express that a core activity relevant to the novelty provision's scope meaningfully changed from one period to the next as the Structural Constraints from the past diminished. Such a metric is crucial because, with technological change, previously infeasible behaviors can become feasible and existing activities can often be conducted at a speed or extent that represents a significant departure from what could be done in the prior era. Following digitalization, prior art researchers effectively gained a novel property that they did not previously have — the ability to find and remotely search document archives. In general, to the extent that a law such as the novelty provision may have been premised upon the implicit constraint of the prior technological era, such a change directly needs to be accounted for in IP policy analysis.

The patent example provided a clear illustration of identifying Structural Constraints — the specific constraining features of past technological environments that normally may be overlooked as mere background elements. In articulating such Structural Constraints, we gain the ability to directly reference background mechanisms of the past that implicitly limited activities important to the scope of IP laws. In the prior example, the Structural Constraints that limited the finding of prior art included the inability to access distant paper archives (e.g., because of the need to access a physical paper document in order to use it), and the difficulty of searching through voluminous paper collections. More generally, a Structural Constraint can be any feature of the past that had a practical limiting effect on an activity relevant to a law. Identifying Structural Constraints allows us to explain directly why certain IP laws begin to operate differently from their historical baseline following a technological change.

3. Technologically Induced Shifts in Legal Scope

Some additional terminology will be helpful. Substantive changes in the scope of the law brought about by decreases in Technological Cost can be captured by the concept of the "Effective Scope" of a law. If we define the "Positive Scope" of a law as those activities a particular law does or does not cover based upon what is enumerated in the text of statutes or doctrine, then the "Effective Scope" of the law takes into account how the impact of positive law increases (or decreases) as a practical matter as technology changes. In the above patent example, we can say that the Effective Scope of the novelty doctrine may have increased as patent examiners and litigation defendants were able to find previously inaccessible invalidating documents. The Effective Scope of the law describes the practical impact of a law as mediated by the prevailing state of technology.

Most laws are affixed in authoritative texts such as statutes, case law, or constitutions, and such texts can persist in fixed form over time. However, with technological change, novel activities can come under the prima facie ambit of existing laws. If a particular law covers new or different activities than it did previously as a result of a change in Technological Cost, or allows significantly more of an existing activity, then it has undergone a shift in Effective Scope. When a law changes in effective strength or scope due to the changes in Technological Cost of an activity upon which the law depends, this is termed a "Technologically Induced Shift in Scope."

Two issues arise from a Technologically Induced Shift in Scope that are worth highlighting. First, such a shift may be overlooked because a change in the impact of a law is caused by a factor external to the law — a technological change — while the positive text of the law may remain unaltered. For example, section 102's novelty provision likely shifted in scope, possibly even strengthening, as previously inaccessible invalidating documents became accessible, but the text of this provision remained the same during this period, making any shift difficult to observe. ⁹¹ Second, even when noticed, such Technologically Induced Shifts in Scope are often difficult to articulate and characterize in policy terms for lack of vocabulary.

In sum, the Technological Cost framework provides the terminology to reify the implicit capacity-limiting effects of technological barriers of the past in IP policy discussions. The concept of high Technological Cost allows us to convey succinctly that a core IP activity was implicitly constrained. Relatedly, by identifying Structural Constraints we can specifically articulate the particular mechanisms from the past that were doing the constraining. It is important to be able to directly reference Structural Constraints because they may be overlooked as mere background elements but can be highly relevant to the scope and impact of IP laws. Their capacity-limiting role is often revealed only in retrospect after a new technology emerges and permits us to conduct the activity in a different, unconstrained way. By contrast, a change in a positive IP statute or doctrine that changes IP governance is less likely to be missed because of the explicit and identifiable legal form that positive law takes.

^{91.} The technological shift described above makes it likely that the novelty provision increased in Effective Strength, at least along the dimension of accessing remote prior art. However, it is difficult to know whether it increased in strength overall — this is an empirical matter. There may have been countervailing technological changes that opposed this decrease in Technological Cost. For example, in what one might call the "growing haystack" effect — as in the metaphor for searching for a needle in a haystack — while the Technological Cost of sorting through each document may have decreased, the overall size of the haystack may have increased when a much larger universe of prior art documents for which to search through became available electronically.

Technological Cost can be useful because the shift in Effective Scope just described is illustrative of a larger phenomenon throughout IP law. In general, such shifts take the following form: (1) there is some aspect of positive IP law — such as a statutory provision or overall IP legal framework — that depends upon an activity (e.g., finding prior art); (2) that activity is implicitly limited by Structural Constraints inherent to the prevailing technology of the past; (3) that activity becomes technologically less costly with innovation and is no longer restricted by the Structural Constraints, increasing its feasibility or endowing the activity with novel properties; and (4) the decrease in Technological Cost causes an Effective Shift in the impact of the positive law or is disruptive of a prevailing legal equilibrium.

C. Changing Technological Cost and Novel Problems for IP Policy

Having fully developed the Technological Cost framework, let us apply it to additional issues of IP public policy. The earlier sound recording and photocopying examples illustrated a common scenario within IP law. In each case, there was a long-standing IP law, and for many years competing IP policies coexisted in harmony under the prevailing arrangement. At some point, an activity that had not historically been problematic — such as third-party copying — abruptly began to raise novel policy tensions following a technological change. The lens of changing Technological Cost and Structural Constraints allows us to understand better such scenarios by drawing our attention to relationships of earlier, implicit technological constraints that are otherwise difficult to see. Consider the following example.

1. Google Books and Legal Shifts via Changing Technological Cost

The Google Books project brought about shifts in copyright that can be captured by changing Technological Cost. ⁹² In this project, Google partnered with several major university libraries to convert the libraries' paper books into electronic form. ⁹³ Google used high-speed optical scanners to image each page of millions of books housed in the libraries' permanent collections. ⁹⁴ The texts of these books were then extracted using optical character recognition (OCR) software, which converted images of printed text into digital form, and thereby allowed each individual word of the text to be edited and processed by computers. ⁹⁵

^{92.} See Google Books, GOOGLE, http://books.google.com/ (last visited Dec. 20, 2013).

^{93.} James Grimmelmann, *How To Fix the Google Book Search Settlement*, 12 No. 10 J. INTERNET L. 1, 11 (2009).

^{94.} Id.

^{95.} Id.

This conversion allows the internal text of these paper books to be fully searchable by computer — many for the very first time. He are tool known as Google Book Search, Google can match search queries to the full text of scanned paper books. Importantly, and by design, Google Book Search will not show the entirety of the text of any scanned book that matches a query. Rather, Google typically displays on the screen a limited "snippet" or excerpt of the text that shows a restricted part of the book and some surrounding lines or paragraphs for context. Search will not show the entirety of the text that shows a restricted part of the book and some surrounding lines or paragraphs for context.

The fact that Google only displays limited excerpts is important for complying with copyright's fair use doctrine. As discussed, the fair use doctrine permits third parties to reproduce copyrighted works under certain circumstances without permission and without infringing. 99 Historically, under what I'll call the "Excerpt Doctrine," fair use permitted third parties to excerpt the text of copyrighted works without authorization in a number of scenarios with high social value, as long as the excerpt was reasonably limited in scope, in good faith, and with minimal commercial impact. 100 For example, it was generally understood that scholars could include limited verbatim quotes from an original source in a scholarly work without infringing. ¹⁰¹ Similarly, critics reviewing books could generally excerpt a direct quote from a book under review without permission and without infringing. 102 These are what I'll call "Embedded Excerpts" — in which a limited verbatim portion of the text of an original source appears somewhere within the larger text of a third-party paper book or article. Google has argued that its on-screen excerpts, displayed in response to Google Book Search queries, are similarly covered under fair use. 103

With the advent of Google Book Search it became intuitively clear that some fundamental structural shift in copyright law and prevailing fair use rules had occurred. Indeed, fearing the economic impact of the project, several groups representing book authors sued Google for copyright infringement, arguing that Google Book

^{96.} Id.

^{97.} About Google Books, GOOGLE, http://www.google.com/googlebooks/about/ (last visited Dec. 20, 2013).

^{98.} Grimmelmann, supra note 93, at 11.

^{99.} See 17 U.S.C. § 106 (2012). To be clear, not all excerpts are considered fair use, but those that are used in scholarly and limited contexts are likely to be fair use. See, e.g., Maxtone-Graham v. Burtchaell, 803 F.2d 1253, 1263 (2d Cir. 1986); Basic Books, Inc. v. Kinko's Graphics Corp., 758 F. Supp. 1522, 1533 (S.D.N.Y. 1991).

^{100.} See Supermarket of Homes, Inc. v. San Fernando Valley Bd. of Realtors, 786 F.2d 1400, 1409 (9th Cir. 1986); Peter S. Menell, *Knowledge Accessibility and Preservation Policy for the Digital Age*, 44 HOUS. L. REV. 1013, 1067–69 (2007).

^{101.} See, e.g., Penelope v. Brown, 792 F. Supp. 132 (D. Mass. 1992) (finding verbatim quotes in a writing manual from a scholarly work to be fair use).

^{102.} Pamela Samuelson, *Unbundling Fair Uses*, 77 FORDHAM L. REV. 2537, 2551–53 (2009) (describing criticism and fair use).

^{103.} See Grimmelmann, supra note 93, at 12.

Search's use of excerpts does not constitute fair use. 104 However, it has been difficult, from a public policy perspective, to articulate the precise nature of the change that occurred.

Why did a doctrine, which had permitted fair use excerpting without controversy for many years, abruptly raise novel policy tensions following the emergence of Google Books? Viewing this through the lens of changing Technological Cost provides some clarification. In the era of paper books, the Technological Cost of accessing Embedded Excerpts was high. Structural Constraints arising from paper book technology had the practical effect of limiting the extent to which Embedded Excerpts from the text of third-party books could be used or accessed by others. Consider a long scholarly treatise that included a five-line excerpt from another source embedded somewhere in its paper text. As a practical matter, such a deeply Embedded Excerpt would not be accessible to a researcher who does not know ahead of time that the volume contains that excerpt. Locating such an Embedded Excerpt would require reading the text of the volume until the passage was found — a laborious exercise. Such a Structural Constraint on the ability to find and access such Embedded Excerpts limited the degree to which any excerpt would commercially substitute for the same passage in the original source.

Other Structural Constraints of the past meant that Embedded Excerpts from paper books were unlikely to harm in a meaningful way the commercial demand for originals. Excerpts are by definition selections of text from a larger original source, and therefore generally contain incomplete amounts of information. One excerpt alone may be of limited research use compared to the broader range of information often found in an original. A limited Embedded Excerpt from a third-party paper treatise may not functionally substitute for access to the original source for most research purposes. In the past, if a researcher needed more context beyond that which was excerpted in a third-party volume she would have had to access a copy of the original source. In general, as these points illustrate, the Technological Cost of accessing and using Embedded Excerpts from the text of paper volumes was high, as the Structural Constraints of paper provided natural limits on the usefulness and accessibility of any given excerpt.

This implicit limitation arising from the Structural Constraints of paper technology was important for copyright policy. The Excerpt Doctrine reflects a wider tension at the heart of copyright law. Copyright law permits authors to prevent others from copying their creative works without permission. ¹⁰⁵ If copyright legal rights are not strong enough and if unauthorized copies of creative works proliferate, it is

^{104.} See, e.g., Authors Guild v. Google, Inc., 770 F. Supp. 2d 666 (S.D.N.Y. 2011). 105. See, e.g., Sega Enters. Ltd. v. Accolade, Inc., 977 F.2d 1510, 1518 (9th Cir. 1992) (describing the broad rights granted under copyright law).

generally believed that the commercial value that the author herself can capture from her work will be diminished. This raises concerns that socially valuable creative works will be underproduced society-wide if authors believe, as a general matter, that they will not be able to recoup their creative investments in the market after devoting resources to their creation. 107

However, if copyright legal rights allow too much control over information, other socially beneficial uses of copyrighted works — such as creating scholarly texts or critical essays that use excerpts — will be unduly inhibited. Lex Excessive legal control over information might diminish important societal values such as the right to speak freely or create works that build upon earlier creations, if legal permission is required in every instance. Mindful of these competing concerns, policymakers are thought to craft deliberately the scope and strength of copyright laws at a general set point: strong enough to address the underlying economic issues that are particular to information-based IP goods, but consciously bounded by fair use rules that allow permission-free uses of creative works in socially desirable circumstances. Leave the social strength of the scope and strength of the scope and strength of copyright laws at a general set point: strong enough to address the underlying economic issues that are particular to information-based IP goods, but consciously bounded by fair use rules that allow permission-free uses of creative works in socially desirable circumstances.

The high Technological Cost of the previous era played an implicit, but crucial, role in maintaining such a balance between control over, and access to, copyrighted works. In that era, copyright's Excerpt Doctrine permitted third parties to embed limited excerpts in works without permission. This unauthorized use provided the larger social benefit — permitting scholars or critical essayists to provide freely context within their writings, without acquiring a license for the use — that animates the fair use doctrine. Permitting this class of unauthorized uses was reasonable within the policy balance between control and use because the commercial impact of Embedded Excerpts was limited by high Technological Cost. Structural Constraints arising from paper technology prevented Embedded Excerpts from functioning as commercials substitute for the original source in most cases. This, in turn, limited the impact of Embedded Excerpts on the

There are situations, nevertheless, in which strict enforcement of this monopoly would inhibit the very 'Progress of Science and useful Arts' that copyright is intended to promote. An obvious example is the researcher or scholar whose own work depends on the ability to refer to and to quote the work of prior scholars.

^{106.} See Princeton Univ. Press v. Mich. Document Servs., Inc., 99 F.3d 1381, 1399 (6th Cir. 1996) (describing incentive structure and limits in copyright law).

^{107.} See Landes & Posner, supra note 31, at 328.

^{108.} Justice Blackmun wrote:

Sony Corp. of Am. v. Universal City Studios, Inc., 464 U.S. 417, 477 (1984) (Blackmun, J. dissenting).

^{109.} See Pac. & S. Co. v. Duncan, 744 F.2d 1490, 1495 (11th Cir. 1984) ("Where strict enforcement of the rights of a copyright holder . . . would conflict with the purpose of copyright law or with some other important societal value, courts should be free to fashion an appropriate fair use exemption." (internal citation omitted)).

^{110.} See Sony, 464 U.S. at 431-32.

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value that could be appropriated to the original. As in the sound recording example discussed earlier, a central equilibrium at the core of copyright was implicitly maintained by high Technological Cost, an activity relevant to IP governance. As long as the high Technological Cost prevailed, the central implicit policy balance was maintained.

Following the advent of the Google Book project and the release of the Google Book Search tool, the prevailing balance was disturbed. Google Book Search decreased the Technological Cost of displaying, accessing, and manipulating excerpts as compared to the previous era of paper books. Google Book Search is completely electronic, allowing for full text searching of the contents of books. The excerpts displayed in the Google Books context are therefore dynamic, changing in response to each specific query. Moreover, these queries can be arbitrary, in the sense that the text of books can be searched against any word or phrase, multiple times, producing a different set of excerpts each time. By contrast, Embedded Excerpts from paper books are limited to a number of pre-selected portions that are affixed to a printed page. Thus, dynamic, electronic, on-screen Google excerpts are unlike the Embedded Excerpts of the past, which were structurally limited in accessibility, quantity, and surrounding context.

Google Book Search technology disrupted other capacity-limiting Structural Constraints from the past. Google Book Search can display excerpts from any part of the text of the original source that has been scanned and converted into electronic form. This permits random access to excerpts. By contrast, as discussed, Embedded Excerpts from paper books were often functionally obscured within the pages of a larger third-party text. Additionally, since Google Books excerpts are displayed electronically on screen they can be shown to millions of users simultaneously. 113 Paper books are physical and are therefore rival goods, meaning that if one is using a particular copy of a book it necessarily precludes another person from simultaneously using it. Each person who desires use of a rival good, such as a copy of a book, either has to acquire his or her own copy or wait until the existing copy is no longer being used. Relatedly, the physical form of paper books meant that the use of distant books was not practical. In sum, electronic Google Books excerpts have novel properties that Embedded Excerpts from paper books do not possess.

The change in Technological Cost resulting from electronic display and access to excerpts meant that Google Book excerpts, while superficially the same as excerpts in the paper world, in fact, bore novel technological properties that impacted copyright policy. The

^{111.} See supra Part I.

^{112.} See supra Part II.B.1.

^{113.} See Emily Anne Proskine, Google's Technicolor Dreamcoat: A Copyright Analysis of the Google Book Search Library Project, 21 BERKELEY TECH. L.J. 213, 228 (2006).

policy justifications that undergirded the Excerpt Doctrine in the paper world may no longer apply in a world in which excerpts are no longer implicitly bounded in scope by Structural Constraints.

Thus, an Excerpt Doctrine which persisted from one era to the next and which permitted one to display limited portions of copyrighted text without permission operated very differently in the later period due to technological change. In this Article's terminology, the legal doctrine underwent a Technologically Induced Shift in Effective Scope with the change in Technological Cost. In the past, the implicit scope-limiting effects of the Structural Constraints meant that Embedded Excerpts met a reasonable policy balance between commercial impact and excessive control. After the advent of Google Books, this balance no longer prevailed, with Google Book Search excerpts capable of commercially substituting for original works in ways that Embedded Excerpts from paper books were not able to previously.

2. IP Public Policy and Changing Technological Cost

Legal shifts such as the one induced by Google Book Search have implications for IP policy. Although such disruptive shifts are common throughout IP law, there is neither a good vocabulary for discussing these shifts nor a framework for characterizing what occurred in the context of policy decisions.

Consider the policy issues raised when the judge assigned to the Google Book Search lawsuit analyzes whether Google Books excerpts constitute copyright infringement under existing law. 114 The judge is in the position of confronting a novel legal issue and analyzing whether copyright law and its fair use boundaries should change in response to Google's emerging technology. A judge encountering such an issue could, upon superficial analysis, conclude that little meaningful has changed from an IP public policy standpoint in this new technological context. The problem is that there is an inaccurate, but seemingly plausible, line of reasoning that suggests that the change brought about by the technology is one of degree rather than kind, and that existing laws are more or less operating as they have historically. 115

This line of reasoning might proceed as follows: (1) copyright's fair use doctrine has historically allowed excerpts when the portion

^{114.} See Campbell v. Acuff-Rose Music, Inc., 510 U.S. 569, 577–94 (1994) (discussing fair use factors and analysis).

^{115.} See, e.g., Memorandum of Law in Support of ReDigi Inc's Motion for Summary Judgment at 19–22, Capitol Records, LLC v. ReDigi Inc., 934 F. Supp. 2d 640 (S.D.N.Y 2013) (No. 12 Civ. 95) (arguing that the first sale doctrine is consistent between older analog and modern digital environments).

reproduced is small, 116 and the excerpts advance a very useful public purpose, such as scholarship or criticism, and there is minimal commercial impact; (2) similarly, Google Book Search limits the size of excerpts, and Google Book Search provides a very valuable public resource — the ability to search the full text of millions of previously inaccessible books; and (3) following this logic to the extreme, one might articulate that the fair use rule is simply continuing to allow an activity it is has always allowed — the display of limited excerpts for public purposes.

For an IP lawmaker without a framework for piercing this superficial argument, such a line of reasoning may seem plausible. This analysis is incomplete, however, because it ignores the Structural Constraints of the past that had played an implicit, but significant, scope-limiting role in maintaining a reasonable balance between control and use of IP in the context of paper excerpts. Google Book excerpts are, technologically, a very different type of excerpt than found in the paper based past. Thus, the policy considerations that historically animated the Excerpt Doctrine in a context in which excerpts were Structurally Constrained may no longer apply. Copyright legal rights, or the positive scope of the fair use rule, might need explicit rebalancing or re-architecting in light of a change in technology.

However, if one is not able to articulate cogently the nature of the change and provide a metric of comparison as to how the Excerpt Doctrine on its face operates quite differently in the context of Google Book Search than it did in its past, such a policy argument is difficult to make. After all, there has been no change in positive law during this time — both copyright law and the fair use Excerpt Doctrine remained unchanged — the fair use rule still permits, on its face, limited, socially useful excerpts. The change that occurred was exogenous to law: the Technological Cost of accessing, using, and displaying excerpts decreased, shifting the scope of the Excerpt Doctrine, even as positive law remained constant.

To be clear, my argument is *not* about whether or not Google Book Search should ultimately be considered fair use. Rather, the point is theoretical: scenarios such as Google Book Search should be understood as necessitating a completely novel policy analysis, rather than a continuation of the policy reasoning that animated past fair use rules. In the case of a significant departure from the past, in which activities are no longer Structurally Constrained, policymakers should recognize that a novel analysis may be required. As part of this novel analysis, policymakers should weigh the public benefits of the technology against the impact to copyright-holders' commercial market. After conducting such an analysis, lawmakers might indeed conclude

^{116.} See, e.g., New Era Publ'ns Int'l, ApS v. Carol Publ'g Grp., 904 F.2d 152, 158 (2d Cir. 1990) (finding copying eight percent of a work as fair use).

that Google Book Search is fair use given its benefits weighed against its costs. ¹¹⁷

Stepping back for a moment, this argument extends beyond the Google Book Search context. Anytime that there is a law that is premised upon unarticulated presumptions that some activity will be Technologically Costly (e.g., accessing embedded excerpts), and an external technological change lowers such Technological Cost, that law requires a deliberate re-examination by policymakers. To permit such a law to persist in its existing form following a relevant technological change, without a deliberate public policy analysis as to whether that law still meets IP policy goals, is a mistake. Such inaction is actually tantamount to allowing external technological change passively to shift the scope of positive law. As the legal realist scholars noted, *inaction* by lawmakers can be as significant in shaping law and policy as express lawmaker action. ¹¹⁸

The point is that a significant reduction in Technological Cost often generates a wholly novel IP context whose proper assessment may necessitate a new allocation of rights. However, the necessity of such a novel policy assessment may not be apparent when the shift involves changes of technological degree and the context superficially resembles existing, well-understood IP scenarios. In such a case, it is important to be able to (1) articulate that a meaningful change has occurred, (2) describe the nature of that change, and (3) assert that the technological change may mandate a novel re-assessment of rights and access from its historical baseline. This Article proposes focusing upon the Structural Constraints of the prior technological era that had an implicit, capacity-limiting effect.

There are thus three basic questions to ask following a technological change such as Google Book Search: (1) what activities used to be limited practically by background Structural Constraints prior to the change?; (2) to what extent was positive IP law dependent upon these implicit capacity-limiting effects?; and (3) in what ways have the scope-limiting effects of the past been diminished by technological change, and how has this impacted IP balances as compared to the prior period? These three questions highlight the way in which positive IP legal frameworks may have been implicitly dependent upon activities having a high Technological Cost.

^{117.} See, e.g., Authors Guild, Inc. v. Google Inc., No. 05 Civ. 8136(DC), 2013 WL 6017130 (S.D.N.Y. Nov. 14, 2013) (finding Google Books fair use).

^{118.} See, e.g., Robert L. Hale, Coercion and Distribution in a Supposedly Non-Coercive State, 38 Pol., Sci. Q. 470, 470–94 (1923).

D. Technological Shifts in Other IP Legal Domains

The phenomenon of Technologically Induced Shifts is prevalent across all the IP domains (i.e., copyright, patent, trade secret, and trademark). As Part IV will discuss, a major reason is that all IP legal regimes regulate goods that are, at their core, information. Technology has greatly increased the ability to aggregate, disseminate, transmit, search, and analyze information. Thus, information has been the locus of many of the most substantial shifts in technology of the last century. Thus, while not exclusive to IP, legal domains, like IP, that are closely connected to information have seen dramatic Technologically Induced Shifts. As examples given so far have primarily originated from copyright and patent law, this Section provides examples of shifts in Technological Cost from the remaining IP domains.

1. Trade Secret Law

Trade secret law gives legal protection over the unauthorized taking of secret commercial information, such as manufacturing processes, chemical formulas, or industrial designs. However, under one widely accepted rule, if formerly secret information becomes broadly known to the public, then trade secret protection for that information is no longer possible. Thus, the scope of a trade secret rule that grants protection only to information that is not widely known is implicitly dependent upon the Technological Cost of information diffusing to the wider world. If the Technological Cost of information joining the public sphere of knowledge decreases, some class of trade secrets will become more vulnerable to the loss of protection as technology changes.

This precise scenario occurred in *Religious Technology Center v. Lerma* in 1995.¹²⁴ In that case, The Church of Scientology had secret church documents that were posted on the Internet by a disgruntled former member for at least ten days. The court found that the information, once posted on the Internet, had entered the public sphere of

^{119.} Hui-Liang Tsai, Information Technology and Business Process Reengineering: New Perspectives and Strategies 120 (2003).

^{120.} Other areas of law that regulate information, for example privacy law, have also seen analogous issues of scope shift. See infra Part III.

^{121.} Ruckelshaus v. Monsanto Co., 467 U.S. 986, 1001 (1984).

^{122.} Id. at 1002 ("Information that is public knowledge or that is generally known in an industry cannot be a trade secret.").

^{123.} For a discussion of trade secret law in the digital era, see Victoria A. Cundiff, *Reasonable Measures To Protect Trade Secrets in a Digital Environment*, 49 IDEA 359 (2009). 124. 908 F. Supp. 1362 (E.D. Va. 1995).

knowledge, making the church documents "generally known" and therefore no longer eligible for trade secret protection. 125

The *Religious Technology* case, and the novel challenges for trade secret policy that arose from it, can be clarified through the lens of changing Technological Cost. Prior to the 1990s — in the era of paper documents and absence of Internet access — diffusing secret information widely enough into the public sphere so as to become generally known was Technologically Costly. The physical nature of paper effectively constrained the degree to which such secret information could spontaneously and easily enter the public domain.

The Technological Cost of quickly and widely diffusing information decreased significantly in the 1990s, thereby shifting the Effective Strength of the trade secret "widely known" bounding rule. The widespread adoption of the Internet beginning in the early 1990s allowed easy and widespread dissemination of information. While the diffusion of information previously would have been implicitly restricted by the Structural Constraints inherent to paper documents, the Internet made it feasible to disseminate information instantly worldwide with little effort.

Thus the scope of a trade secret rule that denied protection to information that became "generally known" was implicitly dependent upon the Technological Cost of disseminating information. The rule substantively shifted in Effective Strength when these costs decreased. Note that some parallel technological changes may have effectively strengthened trade secret law under some circumstances. For example, the ability to encrypt information acted as a countervailing force in potentially raising the Technological Cost of disseminating trade secret information. ¹²⁶

2. Trademark Law

A final example comes from trademark law. An infringement action under federal trademark law only encompasses an unauthorized use of a mark that is considered a "use in commerce." This limitation is intended to permit a set of unauthorized uses of a trademark for non-sales purposes (e.g., discussions about products). The scope of

^{125.} *Id.* at 1368 ("As other courts who have dealt with similar issues have observed, posting works to the Internet makes them 'generally known' at least to the relevant people interested in the news group." (internal quotation marks omitted)).

^{126.} See Cundiff, supra note 123, at 367.

^{127.} Rescuecom Corp. v. Google Inc., 562 F.3d 123, 127 (2d. Cir. 2009) ("[A] complaint fails to state a claim under the Lanham Act unless it alleges that the defendant has made 'use in commerce' of the plaintiff's trademark as the term 'use in commerce' is defined in 15 U.S.C. § 1127.").

^{128.} See generally Taubman Co. v. Webfeats, 319 F.3d 770 (6th Cir. 2002); see also Mark P. McKenna, The Normative Foundations of Trademark Law, 82 NOTRE DAME L. REV. 1839, 1892 (2007).

the standard "use in commerce" was implicitly dependent upon new commercial uses of trademarks that technological change might bring, and effectively enlarged when the Internet enabled novel uses that were previously infeasible.

In *Rescuecom Corp. v. Google Inc.*, the court found that when a user searches Google for a company name (i.e., mark), and Google shows an advertisement for a competitor near the search results, this act of association between search result and company mark constituted a potentially infringing "use in commerce." The court reasoned that Google profited from displaying these advertisements, even if Google was not directly selling the underlying product. A rule governing "uses" in commerce was capable of expansion as technology enabled novel modalities of using trademarks in a commercial business model.

The novel problem of Rescuecom for trademark policy can be usefully understood through the lens of changing Technological Cost. In the pre-digital world, associating marks with goods or services was Technologically Costly. In that era, endowing a product with a mark often had a physical dimension. In many cases association was formed by physically putting a mark on a product's packaging that indicated the source of the product. In other cases, association occurred through signs within stores that indicated the origin of the product or services nearby. Even when there was no physical product involved with association — as in an advertisement in a magazine referencing a product — such an advertisement in the past often required a physical image of the advertisement on a page or on film in the case of moving media. The physicality of access to a product and the limitations of printed media constrained the amount of association between products and services and the contexts in which such association could occur. This limitation constrained the degree to which intermediaries firms that only made associations, but did not actually sell the underlying products — could profit from such association.

With the advent of electronically mediated purchasing over the Internet, the Technological Cost of associating marks with products and services fell, and the contexts in which such association could occur enlarged. Unlike associating goods with marks in the past, which often had a limiting physical dimension, in electronic contexts — such as Google associating search results with relevant associations — it is now technologically less costly to associate with marks. Moreover, the ability to associate a mark with a product in

^{129.} Rescuecom, 562 F.3d at 127-28.

^{130.} *Id.* at 126 ("Rescuecom alleges that Google makes ninety-seven percent of its revenue from selling advertisements through its AdWords program. Google therefore has an economic incentive to increase the number of advertisements and links that appear for every term entered into its search engine.").

electronic contexts means that "uses in commerce" have novel properties that such uses did not have in the era of physical goods. Associations can be quickly and dynamically overlaid onto any part of the online experience. Thus, intermediary firms, like Google, are able to profit from possibly confusing electronic associations in search results in ways that were not feasible in the pre-digital age. Therefore, the policy assumptions that undergirded the positive trademark rules in the prior technological era may no longer be relevant, as the implicit limitations by the Structural Constraints of physical goods do not apply in this context.

In sum, this Part has described a general phenomenon throughout IP law. In the past, there was some activity that was Technologically Costly and Structurally Constrained. In that period, positive IP law was structured to reflect an expectation that this Structural Constraint would continue. In its previous constrained form, the activity did not pose a significant problem for the concerns that animate IP policy. An emerging technology reduced the capacity-limiting Structural Constraints of the past, rendering the activity significantly more capacious, or endowing it with novel properties that affected core IP concerns in ways that were not previously problematic. The Technological Cost framework provides a way of describing such Technologically Induced Shifts. It also provides a metric for characterizing the nature of the shift by reifving the scope-limiting effects of Structural Constraints of the past, the way in which positive IP law depended upon these constraints, and deliberately articulating the ways in which the novel technology permits the activity to be conducted in a new, unconstrained form.

III. TECHNOLOGICAL EROSION OF IMPLICIT IP VALUES

A. Values Implicitly Protected by Technological Cost

The Technological Cost framework highlights how activities can be implicitly constrained by technology in ways that matter to IP governance. Through this lens one can also understand how IP values may be embedded subtly in the technological limitations of the past. While some valued activities may be explicitly protected by positive law, others may only be implicitly protected by the technological infeasibility of interfering with them. From the latter arrangement, one may arguably infer the existence of implicit IP values. If such values exist (and they are contestable) they may be easy to overlook within IP policy discussions because they are not explicit. Such implicit val-

^{131.} See, e.g., Network Automation, Inc. v. Advanced Sys. Concepts, Inc., 638 F.3d 1137, 1141–43 (9th Cir. 2011) (discussing the purchasing of online advertisements as a use in commerce in trademark).

ues may also be vulnerable to erosion when technology changes. This Part presents a vocabulary for identifying implicit IP values that are potentially embedded in the technological limitations of the past.

Consider an example of an implicit IP value that is arguably embedded in past technological infeasibility. Purchasers of paper books (as opposed to electronic books) have the ability to lend these books to others in a relatively unconstrained fashion. Even if copyright holders wanted to restrict lending of paper books and require borrowers to purchase their own copies, there is little that a copyright holder can do to prevent this from a practical standpoint. It is technologically infeasible for a copyright holder to detect when a paper book is lent, and a copyright holder cannot technologically prevent a borrower from reading a paper book.

The ability to lend purchased paper books, without interference from copyright holders, is a valuable activity for certain groups in society (e.g., borrowers). One might plausibly argue that the ability to lend books is an IP social value that is implicitly embedded in the limitations of paper technology. In other words, one might contend that the ability to lend paper books is not simply a value-neutral artifact of a limited earlier technology, but rather may represent a latent IP social value (i.e., that purchased books *should be* freely lendable) that is fostered by the limitations of paper technology.

If the ability to lend books unimpeded is indeed an embedded IP value, it is important to note that it has historically been protected by the technological infeasibility of actually constraining lending, and not by an affirmative legal right to lend and borrow. We might term such a value a "Structural Value" because it is not explicitly enshrined in law, but rather is only implicitly embedded in the structural limitations of past technologies. Its unconstrained existence has been due to the technological infeasibility of others interfering with the valued activity.

This part develops the concept of such Structural Values. There may be a class of implicit IP values that are quite real and important to particular societal groups, but that policymakers may be overlooking because they are only implicit in the technological structures and limitations of the past. Because this pattern is so common in IP, policymakers should be in the habit of asking: if an activity important to IP governance was implicitly constrained by technological limitations of the past, was this constraint simply a value-neutral vestige of earlier technological processes, or was it actually performing a valuable, but implicit, functional role in protecting a value?

^{132.} See International Federation of Library Associations, supra note 28, at 7–

1. Explicit IP Values and Rights

It is best to understand implicit Structural Values by contrasting them against explicit legal values and rights. In this Article's usage, an explicit value is one that is expressly enshrined in a positive law source. For example, in real property law, the ability to exclude others "is a fundamental aspect of private property ownership." That property owners should be able to exclude others is a social value that is protected by an explicit legal right and remedy based in positive real property law. ¹³⁴

Thus, when I state that a legal right or value is *explicit*, I mean to emphasize two points. First, that the value or right is expressly articulated in some readily identifiable authoritative legal text, such as a statute or court opinion. Second, I mean to emphasize that the holder of a legal right can use the legal system to prevent others from interfering with the protected activity (e.g., possessing land). Thus, to the extent that the law can be used to constrain others from interfering with a particular activity, the law is providing an explicit legal right.

2. Implicit IP Structural Values

There is an analogy between the constraint provided by positive law and the constraint provided by technological infeasibility. The possessor of an explicit legal right can invoke a specific law to prevent others from interfering with some valued activity such as possessing land. It is the ability to rely upon the legal system to prevent others from interfering with one's performance of a valued activity that makes a legal right effective. Analogously, in the Structural Value scenario, parties are relying upon *technological infeasibility* to implicitly prevent others from interfering with some valued activity. Insofar as they do so, they may be reliant upon an implicit "Structural Right."

In other words, one can argue that there may be "shadow" IP Structural Values and Rights embedded in the technological limitations of the past. ¹³⁶ In the case of an explicit legal right, there is a pos-

^{133.} See People v. Tapia, 29 Cal. Rptr. 3d 158, 168 (Ct. App. 2005) (internal citation omitted). See also Kaiser Aetna v. U.S., 444 U.S. 164, 179–80 (1979); Restatement (First) of Property § 7 (1936).

^{134.} See, e.g., MD. CODE ANN., CRIM. LAW § 6-402 (West 2010) (articulating the Maryland limitations on the right to trespass).

^{135.} Wesley Newcomb Hohfeld, *Fundamental Legal Conceptions as Applied in Judicial Reasoning*, 26 YALE L.J. 710, 717–21 (1916) (discussing theoretical concepts of affirmative and negative legal rights).

^{136.} Scholars have previously made similar arguments but they have tended to focus upon how intentional design choices of technological systems (e.g., websites, software, the Internet) can foster or inhibit societal values. See, e.g., LESSIG, supra note 25, at 6 (arguing

itive law empowering one party to prevent others from interfering with a valued activity. By contrast, in certain IP contexts, it may only be technological infeasibility, and not law, that is preventing others from interfering with an activity valued by a societal group. Thus, one might plausibly posit the existence of a shadow Structural Right embedded in this arrangement, as technological feasibility may be, in some cases, performing a constraining function and substituting for positive law protection.

Thus, there is the possibility that technological infeasibility (i.e., high Technological Cost) may be implicitly protecting certain IP values. Using the earlier example, to the extent that the ability to lend books did represent a valued activity, it has historically only been protected implicitly by the practical fact that copyright holders could not technologically constrain what purchasers did with paper books. In such scenarios, one can draw analogies between explicit legal rights enshrined in positive law and implicit technological constraint. One party (a copyright holder) is being prevented from interfering with another party's valued activity (a borrower), except it is not law that is doing the constraining, but technological infeasibility. That arrangement arguably reflected an implicit value facilitated by the very structure and limitations of past technological environments.

The broader suggestion is that there may be similar non-obvious IP Structural Values embedded in the infeasibility of the past technological contexts. The interests of certain societal groups may have depended upon particular unwanted activities (e.g., restricting lending) being Technologically Costly and implicitly constrained. When a group's core interests depend upon unwanted activities being inhibited by high Technological Cost, we can think of such technological infeasibility as arguably implicitly "protecting" a Structural Value. 137 It may actually be important to a societal group's interests that certain activities that have historically been Technologically Costly continue to remain costly and constrained.

3. Issues with IP Structural Values

To the extent that IP Structural Values are embedded in this way, there are some unique issues worth emphasizing. First, because such values are implicit, they are by definition not affixed in any unambiguous and explicit positive law source. One reason for the lack of affixation is that if there is a valued activity (such as lending books) that is already adequately being protected by technological infeasibility (i.e., the technical inability to restrain paper book lending), also it is

that software code and design can effectively promote or inhibit values in electronically mediated environments, such as the Internet).

^{137.} See Surden, supra note 30, at 1613.

unlikely to become enshrined explicitly in positive law text. We imagine that lawmakers, with limited resources, do not bother enshrining values in positive law that are already being sufficiently safeguarded by technological infeasibility. To use the earlier example, even if there was a consensus that lending books is a valuable activity that should be protected, in the context of paper books, why would lawmakers have bothered creating an explicit legal rule to protect affirmatively lending when it was already technologically infeasible for others to interfere with this activity? An explicit legal rule would have been functionally superfluous. The end result is that such values remain only implicitly protected even if they reflect a genuine societal consensus.

The implicit nature of such IP Structural Values creates others issues. First, the very existence of an implicit value is contestable. Unlike a value that is affirmatively expressed in positive law, the existence of an implicit IP value can only be inferred from a historical technological arrangement. The presence of an inferred value is subject to much more ambiguity and contestability than an explicit value. In some cases, the fact that a certain activity of the past was Technologically Costly and constrained may have been a value-neutral artifact of some inefficient or underdeveloped process. Copyright holders may reasonably argue that the inability to constrain lending in the paper book context was simply a byproduct of primitive paper book technology and did not actually reflect an embedded societal value.

However, even if contestable, the possibility that such implicit IP Structural Values exist should not be dismissed out of hand simply because they are ambiguous. This Article's analysis suggests that such values may be very plausible and worthy of consideration. There may very well be scenarios in which the very Technological Costliness of an activity may reflect an embedded (but uncodified) social value whose protection is not enshrined in positive law. Given the natural tendency to observe the explicit over the implicit, there is the risk that policymakers may overlook the very existence of bona-fide, but implicit IP values.

Second, to the extent that IP Structural Values exist, they may be subject to subtle "Technological Erosion." Technological Erosion occurs when valuable activities that are only implicitly protected by technological limitations lose protection when new technologies emerge without the same limitations of the past. To the extent that societal groups relied upon technological limitations to prevent others implicitly from interfering with their interests, the emergence of new technologies that are unconstrained by earlier limitations may subtly

^{138.} Cf. ROBIN FELDMAN, RETHINKING PATENT LAW, 20 (2012) ("Developments in the world of science and technology can unfold in radically unpredictable ways"); see also supra Part II.A.

cause such interests to dissipate passively. Because the functional role of high Technological Cost is subtle, we might not fully understand that such technological infeasibility was implicitly protecting values until *after* those costs diminish, or in some cases, not at all.

B. Technological Erosion of Structural Values

1. Structural Values in Privacy as an Example

As I have written elsewhere, privacy law offers vivid examples of values embedded in the technological limits of the past. Such examples can illuminate analogous scenarios in IP law. Consider the privacy of sensitive information in public court documents. Today, many court records and documents of legal proceedings are digital and stored in electronic form. However, prior to the year 2000, most records of the documents and proceedings of a lawsuit were printed on paper and physically stored in files at a courthouse or some government archive. In that earlier physical era, it was not uncommon for parties to litigation to include sensitive private information such as social security numbers or income data in public court documents.

In that period, privacy was implicitly protected by technological infeasibility. Consider a litigant who did not want a social security number broadly revealed. Although sensitive information included in a court document was nominally public in the paper era (as court documents, if not under seal, are generally public), the privacy of the information was practically protected by the high Technological Cost of actually locating sensitive information in a public court filing. One would first have to navigate a bureaucracy, including the clerk of the court, to gain access to the physical docket file of a case. That file in turn might contain many folders, each itself likely containing multiple physical documents associated with that case. ¹⁴² Given that a typical case might have tens, if not hundreds, of separate documents (each multiple pages in turn), the task of locating specific portions of private information in a large stack of papers was formidable. In practical

^{139.} For a more comprehensive treatment of the way privacy values may be implicitly embedded in extant technological limitations, see Surden, *supra* note 30, at 1605–08.

^{140.} Amanda Conley et al., Sustaining Privacy and Open Justice in the Transition to Online Court Records: A Multidisciplinary Inquiry, 71 MD. L. REV. 772, 773–74 (2012).

^{141.} See, e.g., Jennifer Greene, Competing Interests Regarding Electronic Court Records: Privacy Versus Open Access in Arizona, 40 No. 3 JUDGES' J. 26, 28 (2001) (discussing the common use of social security numbers and other sensitive personal information in court documents).

^{142.} See Surden, supra note 30, at 1613 (describing how the Technological Cost of finding private information in public court records before and after the electronic era revealed that "Structural Constraints" rooted in technological limitations were implicitly protecting privacy); see also Nancy S. Marder, From "Practical Obscurity" to Web Disclosure: A New Understanding of Public Information, 59 SYRACUSE L. REV. 441, 444 (2009).

terms, the Technological Cost of finding sensitive information in a large paper docket file would have been prohibitive, requiring unreasonable amounts of time and resources.

2. Structural Values and Technological Erosion

The court records example illustrates a Structural Value embedded in prior technological infeasibility. In the era of paper documents, it was Technologically Costly, if not entirely infeasible, to locate particular sensitive information in public paper court documents. From this relationship of technological infeasibility, one may arguably infer a shadow Structural Value and Right. The interests of a certain societal group (litigants) depended upon others not being able to locate sensitive information. This interest was implicitly protected by the technological infeasibility of actually locating such information. As mentioned, lawmakers may be less likely to protect such an interest explicitly that is already adequately implicitly protected by technological infeasibility. However, to the extent that such an interest would have otherwise been explicitly protected by a positive legal right had technological infeasibility not adequately protected the interest, there is a strong argument that this technological relationship reflected not just a Structural Value, but a Structural Right embedded in the earlier technological structure. 143

To the extent that such implicit Structural Rights and Values exist, they may be vulnerable to subtle Technological Erosion when technology changes. In a familiar theme of this Article, in the case of court records, two trends occurred over time: (1) court documents were submitted in digital, rather than paper, form; and (2) these digitized court records were made accessible over the Internet. While the digitization and networked access of court records undoubtedly proved a boon to efficiency, it had the unintended side effect of making previously obscured private information suddenly accessible at low cost. Sensitive information that had previously been obscure the physical world became readily found.

^{143.} Cf. Gaia Bernstein, When New Technologies Are Still New: Windows of Opportunity for Privacy Protection, 51 VILL. L. REV. 921, 921–23 (2006) (discussing privacy regulation near the inception of a new technology).

^{144.} See Amanda Conley et al., supra note 140, at 773-74.

^{145.} Marder, supra note 142, at 444.

^{146.} See, e.g., Dwight R. Worley, The Gun Owner Next Door: What You Don't Know About the Weapons in Your Neighborhood, THE JOURNAL NEWS (Dec. 24, 2012), http://www.lohud.com/article/20121224/NEWS04/312240045/ (describing the creation of a map linking the addresses of people and public records indicating gun ownership).

^{147.} There are other examples from the privacy world, in which sensitive information which — nominally public in an earlier era — becomes exposed with the advent of technology that reduces the costs of aggregating previously distributed data. These include online maps linking the addresses of private individuals and information about those individuals — for example campaign contributions, the amount paid for their home, and whether they own

As a result of this technological change, Structural Values for privacy that had been embedded in the prior technological architecture subtly eroded. Litigants had depended upon limitations inherent to past technological environments to safeguard their privacy interests implicitly. In other words, rather than relying upon an explicit legal right to inhibit the privacy violating activities of others, litigants had relied upon technological infeasibility to constrain how others implicitly could locate their sensitive information. 148 However, when external technological changes rendered what was previously infeasible, feasible, the implicit protection for these Structural Values eroded. Others gained the ability to interfere with privacy interests in ways that had not previously been technologically possible. More generally, this point illustrated that when there is a Structural Value that is only implicitly protected by technological infeasibility; it may quietly dissipate when a new technology eliminates the Structural Constraints of the past that had been serving a functional role in safeguarding the interest. 149

In such a scenario, the emergence of technology is, in effect, subtly, and by default, creating public policy. We normally think of public policy as being consciously crafted and altered by lawmakers. However, in the context of Structural Values, it is the widespread emergence of a new technology that is, in effect, changing public policy. To the extent that societal groups relied upon limitations of past technological environments implicitly to safeguard their interests, and to the extent that the emergence of technology quietly removed these limitations, such a reduction in protection is tantamount to a passive shift in shadow values and rights. ¹⁵⁰ Following technological change, certain societal groups may gain the technological ability to interfere with the valued activities of other groups in ways that they previously could not. This is, in essence, a change in public policy. Such a policy change, however, is driven not by the conscious and active deliberation of lawmakers, but passively by the external emergence of technology.

a gun. While such information was nominally public, the information was often in dispersed locations (e.g., telephone company address database versus public deeds database) which made aggregating and linking the information practically difficult. See Evan Selinger, Why We Need New Rights to Privacy, SLATE (Nov. 2 2012), http://www.slate.com/articles/technology/future_tense/2012/11/harry_surden_suggests_rfid_and_other_tech_advances_necessitate_new_privacy.html.

^{148.} See Lynn M. LoPucki, Court-System Transparency, 94 IOWA L. REV. 481, 522–24 (2009) (discussing practical obscurity protecting paper court records).

^{149.} For a good illustration of this, see generally Scott R. Peppet, *Unraveling Privacy: The Personal Prospectus and the Threat of a Full-Disclosure Future*, 105 Nw. U. L. REV. 1153 (2011), for a discussion of how the lowering of Technological Cost of disclosing personal information can change dynamics by which actors can signal marketplace information.

^{150.} See id.

Importantly, following the emergence of a new technology, Structural Values may no longer be protected either by technological infeasibility or by positive law. One question is whether such implicit values should be explicitly preserved by positive law, or by some other mechanism (e.g., technology). However, there is reason to believe that the very existence (and erosion) of such Structural Values may tend to be overlooked in the first place because policymakers may not be accustomed to thinking of past costs or technological limitations as performing a functional role. Economic costs are often considered undesirable manifestations of some underlying inefficiency. 151 Similarly, high Technological Cost may, by default, be understood as simply a manifestation of an inefficient and underdeveloped state of technological advancement, and not as performing a functional role. Thus, it may be easy for policymakers to dismiss the high Technological Cost of activities in the past as mere byproducts of limited or inefficient processes.

Because the functional role of high Technological Cost is subtle, one might not fully understand that background technological limitations were implicitly protecting values until after those costs dissipate, or in some cases, not at all. However, one general lesson is that technological limitations and what others have elsewhere termed "friction" — may not simply be manifestations of inefficiency, but may be serving some non-obvious functional role in a larger governance framework. Here, we can understand high Technological Cost as potentially serving the functional role of implicitly protecting social values and abilities. Thus, policymakers may need priming to observe when technological infeasibility is implicitly protecting valued activities.

Problematically for those who depend on such values, the fact that the values were implicitly embedded in technological limits, rather than explicitly enshrined in law, poses a rhetorical and political disadvantage. Groups are put in the position of advocating for explicit protection for what may superficially appear to be a "new" legal right. In fact, the underlying values may have long existed, protected implicitly by technological infeasibility. Because such an implicit value was never positively enshrined in law, it is vulnerable to ambiguity as to whether it was truly an embedded social value, or simply a valueneutral byproduct of the way that technology happened to have progressed. When a value is implicit this counterargument always exists.

^{151.} See, Richard A. Posner, ECONOMIC ANALYSIS OF LAW 55-56 (6th ed. 2002).

^{152.} See, e.g., Jerry Kang, Information Privacy in Cyberspace Transactions, 50 STAN. L. REV. 1193, 1285–86 (1998); Kent Walker, Where Everybody Knows Your Name: A Pragmatic Look at the Costs of Privacy and the Benefits of Information Exchange, 2000 STAN. Tech. L. Rev. 2, 22 (2000).

^{153.} Surden, supra note 30, at 1605.

^{154.} See id. at 1613.

Many instances of high Technological Cost are simply manifestations of inefficiency and do not necessarily represent latent values. This is a significant ambiguity that is analytically difficult to entangle.

C. Technological Cost Protecting Values in IP

This same dynamic of embedded values exists in IP law. There are arguably multiple IP values that have historically been protected, not explicitly by positive law, but implicitly by high Technological Cost. As emerging technologies reduce these costs, values that have been important to particular groups have subtly eroded, possibly beneath the notice of lawmakers. Such groups are in the rhetorically difficult position of advocating for positive legal protection for interests that they may have had implicitly for many years.

Consider the example of IP "exhaustion" legal doctrines. In patent law, legal rights should "exhaust" after the first authorized sale of a product covered by a patent claim. ¹⁵⁵ This means that patent legal rights cannot be used to restrict subsequent resale of a product that embodies patented technology following an authorized sale. ¹⁵⁶ Copyright law has an analogous "first sale" doctrine that allows control over the initial sale of a creative work but not resale of that work in the aftermarket. ¹⁵⁷ Such exhaustion doctrines allow IP holders to profit from the *first* sale of a good but not to legally control subsequent resale by purchasers, thus permitting robust secondary markets for used IP goods (e.g., secondhand bookstores).

In the past, when IP goods were primarily non-electronic, IP owners could do little to detect or control use in the aftermarket once their legal rights were exhausted. Similar to the book lending scenario discussed earlier, copyright holders could not technologically detect when purchasers resold paper books, nor could they technologically constrain this activity. In patent law, the holder of patent rights similarly could not technologically constrain or control the use of a typical product embodying a patented invention once an authorized purchaser possessed the product. The typical purchaser of a patented product could thus resell that product without interference from the patent holder because it was technologically infeasible for the patent holder to constrain this activity.

^{155.} See, e.g., Intel Corp. v. ULSI Sys. Tech., Inc., 995 F.2d 1566, 1571 (Fed. Cir. 1993) (Plager, J., dissenting) ("The principle of 'first sale' . . . is that when a patent owner . . . sells to another a product which incorporates the patented invention, the other may convey the product to third parties free of any claim of patent infringement.").

^{157. 17} U.S.C. § 109(a) (2012); Vernor v. Autodesk, Inc., 555 F. Supp. 2d 1164, 1168 (W.D. Wash. 2008) ("Because a first sale exhausts the copyright holder's distribution right, future distributions of the copy do not implicate the Copyright Act.").

Embedded in this past technological infeasibility was arguably an implied Structural Value that the public should be able to resell copyrighted and patented goods without the interference of rights holders. However, as books and other creative works have shifted to digital form, and physical patented products increasingly contain embedded electronics capable of controlling the products from afar, this implicit value has subtly eroded. ¹⁵⁸ For example, copyright holders can now technologically constrain the resale of purchased digital music in ways that were previously infeasible. ¹⁵⁹ Similarly, patent holders can now technologically constrain how certain patented goods (those with embedded electronics) can be used after authorized purchasers possessed the goods. ¹⁶⁰ It is conceivable that a patent holder could disable the functionality of certain patented goods from afar if it is detected that an item is resold without the permission of the patent holder.

Thus, one can plausibly argue that the technological infeasibility of the past reflected an implicit Structural Value that copyright and patent owners should not have as much control over their works as technology now allows. If so, these implicitly protected values have subtly eroded with technological change. The limitation from the earlier technological era was arguably implicitly maintaining a desired IP policy balance between access to, and control over, IP goods. To the extent that such technological inability to control IP goods post-sale reflected an embedded, implicit value, this value has likely eroded since digital technology lowered the Technological Cost of post-sale control of IP goods. ¹⁶¹ One argument that users might raise is that this implicit Structural Value should now be explicitly preserved in positive law. ¹⁶²

In another example, a similar argument might be raised in the copyright fair use context. As discussed, copyright's fair use doctrine permits a class of unauthorized uses of copyrighted works. It has historically been Technologically Costly for copyright holders to detect when their creative works are being used for fair use purposes. Even if detected, it has also been Technologically Costly for copyright holders to interact with users and to do anything to constrain the

^{158.} See R. Anthony Reese, The First Sale Doctrine in the Era of Digital Networks, 44 B.C. L. REV. 577, 577–80 (2003) (discussing diminishing first sale rights in the digital age).

^{159.} See Aaron Perzanowski & Jason Schultz, Digital Exhaustion, 58 UCLA L. REV. 889 (2011)

^{160.} See, e.g., Static Control Components, Inc. v. Lexmark Intern., Inc., 697 F.3d 387, 396 (6th Cir. 2012) (describing patented printer cartridge with electronics that only permit use with printers authorized by patent holder).

^{161.} Cf. Gary Miller, On Federal Preemption of Contractual First Sale Waivers, 2010 B.C. INTELL. PROP. & TECH. F. 90802, *5–6 (2010) (describing increased post-sale technological control over copyrighted works).

^{162.} See Perzanowski & Schultz, supra, note 159.

^{163.} See James Boyle, The Second Enclosure Movement and the Construction of the Public Domain, 66 LAW & CONTEMP. PROBS., Winter/Spring 2003, at *33, *39–40 (2003) (describing a wide range of fair uses).

use. ¹⁶⁴ We can thus think of the high Technological Cost of detecting fair uses and interacting with users as implicitly protecting a class of unauthorized uses. In the analog world, certain users (e.g., a professor showing a short film clip in class) can engage in a series of fair uses in a relatively unconstrained fashion due to the technological infeasibility of detecting such a use.

With the transition to digital content, it is becoming easier for copyright holders to detect and constrain fair uses. Additionally, as I have argued elsewhere, certain Technological Costs of contracting are beginning to decrease due to a host of emerging contracting technologies. This decrease in the Technological Cost of detecting fair uses may erode a class of unconstrained fair uses that had previously been fostered by the technological infeasibility of constraining them. Some of these uses may represent values that societal groups had historically depended upon and deemed important. 166

In general, we can think of the high Technological Cost of the past as having protected, in certain cases, important but implicit IP values. It is crucial for policymakers to be cognizant of the fact that the technological infeasibility of the past may have subtly masked values that were important to core IP balances, and that these embedded values may passively erode over time as previously infeasible levels of control becomes technologically feasible.

Thus, the Technological Cost framework helps give a theoretical structure to the intuitive understanding that users of IP goods have lost certain abilities with technological change (e.g., lending books, reselling music). This framework provides a rhetorical structure for articulating that there may have been implicit, but genuine, values subtly embedded in the limitations of past technological environments, and whose passive diminishment policymakers should take seriously. In such a case, a user could plausibly argue that the addition of an explicit legal right (e.g., an affirmative right to lend) would not constitute the addition of a *new* IP right, but rather would be simply be preserving a *longstanding* Structural Right that had existed for many years implicitly embedded in the technological architectures of the past but which has eroded.

There are a few points to clarify. The first is that if we are examining Structural Values from the standpoint of users, it is important to note that decreases in Technological Cost can often benefit users by enabling new activities as they simultaneously erode certain implicit

^{164.} See Wendy J. Gordon, Fair Use as Market Failure: A Structural and Economic Analysis of the Betamax Case and its Predecessors, 82 COLUM. L. REV. 1600, 1616 (1982). 165. See Harry Surden, Computable Contracts, 46 U.C. DAVIS L. REV. 629, 629–30

^{166.} See Erickson & Mulligan, supra note 25, at 985; Parchomovsky & Weiser, supra note 21, at 91; Julie E. Cohen, Copyright and the Jurisprudence of Self-Help, 13 BERKELEY TECH. L.J. 1089, 1090 (1998).

values. For example, technology can now enable users to engage in more fair uses than they had historically, such as software tools that allow the editing of videos or music. Thus, this part has focused only upon how changes in Technological Cost can hurt users compared to a historical technological baseline, but to be clear, changes in certain types of Technological Cost can also help users.

Second, values are relative. From the perspective of a copyright holder, the ability to control books and other creative works may be a benefit, not a detriment. Thus, whether the erosion of a prior ability represents the dissipation of Structural Value depends upon the viewpoint taken. I do not mean to suggest that the implicit technological constraint of the past *necessarily* reflects embedded IP values, but rather that policymakers should take seriously the possibility that such latent values embedded in past technological infeasibility might have existed and may have passively eroded.

D. Replicating Implicit IP Values Explicitly

To the extent that Structural Values exist when technology changes, such implicit values may be left unprotected either by law or technology. The question then arises, should society continue to actively protect such values using an explicit means such as positive legal right, or some other mechanism of regulation (e.g., technological measures)? This is a question that is not, as a general matter, typically addressed today, as policymakers are not accustomed to observe the subtle process of Technological Erosion. However, the argument for promulgating an explicit legal right is the strongest when it is clear that some valued activity would have been protected by positive law had technological infeasibility not so effectively safeguarded it.

One line of thinking suggests preserving the historical status quo by continuing the balance of IP rights and duties that existed in the previous technological era. For example, if high Technological Cost traditionally inhibited post-sale control over patented or copyrighted goods, according to this view society should continue to limit post-sale control over goods using positive law, even after post-sale control becomes technologically feasible. In the domain of privacy, such a "status quo" preservation principle has been advocated by Helen Nissenbaum in dealing with analogous issues of technological change shifting longstanding, embedded privacy values. ¹⁶⁷

While a major point of this Article is that it is crucial to recognize when implicit rights have eroded, I do not think that the status quo preservation principle is necessarily apt in the IP context. Emerging technologies may lower costs and as a by-product erode rights that

^{167.} Helen Nissenbaum, *Privacy as Contextual Integrity*, 79 WASH. L. REV. 119, 145 (2004).

were only implicitly protected by costs. Yet emerging technologies can also enable novel welfare enhancing activities as well. A default preservation of historical allocations risks over-inclusiveness, quelling beneficial activities along with unwanted activities. Another problem is that the balance that had been rendered by the historical path of technological advancement might be, in part, arbitrary and not necessarily the allocation that would have been chosen with conscious forethought.

Rather, my suggested approach is process oriented, rather than normative. IP policymakers should actively pay attention to the way in which values may have been embedded in prior technological architectures, and the way activities that were valuable to earlier societal groups were implicitly protected by technological infeasibility. Following a significant technological change, lawmakers should return to basic IP principles for re-evaluation, determining whether IP incentives are still being adequately fostered, and uses of IP goods are still being adequately preserved. However, currently it appears that the potential existence of Structural Values tends to be overlooked because such values are implicit rather than explicit.

Problematically, the emergence of technology often ends up making default public policy allocations concerning IP values. For example, the emergence of digital books has effectively enabled copyright holders to technologically constrain lending post-sale. However, whether or not lending represents a valued activity that should be legally protected is a matter of public policy and should be decided actively through deliberation by lawmakers, not passively by technological emergence. Today, however, such IP public policy allocations are often rendered, by default, when a new technology emerges that permits increased control over IP goods as compared to the past. A better approach is a deliberate and considered weighing of the costs and balances of new technologies and whether certain valued activities of the past should or should not be protected. Allowing the emergence of technology to render default legal allocations is an arbitrary and passive form of policymaking.

IV. A THEORETICAL VIEW OF TECHNOLOGICAL COST IN IP

A. Implicit IP Regulation by Technological Cost

This Part explores in more depth how IP legal frameworks can be understood, from a theoretical perspective, to rely upon high Technological Cost to maintain balances that are central to IP governance. This understanding is different from the usual view of costs, which

are often understood as passive manifestations of inefficient processes and not as performing a functional role. 168

1. An Abstract View of Regulation and Regulatory Theory

Legal regulation involves influencing the behavior of individuals or organizations through threatened legal consequences or instruction. However, under an approach made prominent by Lawrence Lessig, lawmakers are encouraged to consider other factors, whether based in law or not, that are also capable of influencing the activities or behaviors of societal actors. According to scholars of this genre, we should understand law to be but one among many modalities that can incentivize or constrain the activities of societal actors. 171

There is thus a broader class of regulatory mechanisms, aside from law, that society can potentially use to promote or constrain particular activities. Under Lessig's typology, we can classify regulatory mechanisms into four broad categories: law, social norms, market pricing, and physical/technological architectures. To this list I would add: institutional design 173, "choice architectures" (or similar approaches based upon human cognitive tendencies) 174, enforcement procedures, and organizational or industry practices. These are all factors that have the effect of influencing the behavior of societal entities. "Non-Legal Regulators" are those mechanisms listed above, such as physical architectures, which are external to law in the sense that they do not themselves directly employ positive law or legal institutions as their means of influencing behavior. 175

^{168.} For articles discussing ways in which costs play functional roles, see Victor Fleischer, *Regulatory Arbitrage*, 89 TEX. L. REV. 227, 232–33 (2010) (discussing how "frictions" can be used as a tool to encourage tax compliance) and Jonathan S. Masur, *Costly Screens and Patent Examination*, 2 J. LEGAL ANALYSIS 687, 687 (2010) (discussing the way in which patent application costs functionally screen low-valued patents).

^{169.} See Pierre J. Schlag, Rules and Standards, 33 UCLA L. REV. 379, 381-82 (1985).

^{170.} Lessig, *supra* note 30, at 661.

^{171.} *Id.*; *cf.* Gary S. Becker, *Crime and Punishment: An Economic Approach*, 76 J. POL. ECON. 169, 176 (1968) (discussing deterrence of crime as a function of all expected costs and benefits).

^{172.} Lessig, supra note 30, at 661-63.

^{173.} See, e.g., Fleischer, supra note 168, at 283–84 (showing how institutional design affects regulatory arbitrage).

^{174.} For a discussion as to how the framing of legal and non-legal structures can influence decisions in light of knowledge about human cognitive processes, see On Amir & Orly Lobel, *Stumble, Predict, Nudge: How Behavioral Economics Informs Law and Policy*, 108 COLUM. L. REV. 2098, 2098 (2008), and see generally RICHARD H. THALER & CASS SUNSTEIN, NUDGE: IMPROVING DECISIONS ABOUT HEALTH, WEALTH, AND HAPPINESS (2009).

^{175.} Lessig notes that positive laws may regulate Non-Legal Regulators. Thus, for example, a law that imposes a tax on a good is a law (a legal regulator) altering a price (a Non-Legal Regulator). Therefore, the distinction between legal and Non-Legal Regulators is not always so discrete. Lessig, *supra* note 30, at 662–64.

This scholarship emphasizes the importance of considering Non-Legal Regulators in crafting legal policy. ¹⁷⁶ In some contexts it is not law but a factor external to law that is the predominant influence over an activity. In those contexts, the most significant considerations may involve Non-Legal Regulatory mechanisms. By tendency, lawmakers may focus principally on *legal* regulation through statute, case law, or administrative rule. However, effective policymaking requires considering the broader regulatory context in which the effects of Non-Legal Regulators (e.g., social norms) might dominate the effects of *legal* regulation. In other words, sound lawmaking cannot occur in a vacuum but must take into account other significant modalities affecting behavior, whether based in legal rules or not. ¹⁷⁷

One principle drawn from viewing "regulation" abstractly is that regulation is often achieved through imposing (or reducing) *costs* (metaphorically) along some dimension. ¹⁷⁸ Making some behavior or activity more difficult — physically, psychologically, technologically, legally, or economically — is a means of constraining behavior. Laws often regulate by imposing the threat of sanctions or other legal consequences; these are the "legal costs" of violating the law. Social norms impose social costs such as disapproval for those who violate them. Similarly, physical architectures, such as fences, can make it physically costly to go from one place to another. Cost has the effect of inhibiting behavior, and the general lesson is that we can think about just about anything that imposes costs as potentially playing a regulatory role.

2. Technological Cost Can Play an Implicit Regulatory Role

Using this abstract understanding of regulation as making an activity more or less difficult, we can understand Technological Cost as implicitly regulating IP goods. Just as law modulates the prevalence of activities by imposing legal costs, technological limitations regulate implicitly because certain activities will be technologically constrained given the state of technological development of an era. Core IP policy balances, reflected in the expression of positive IP laws, implicitly depend on an assumption that certain activities that are Technologically Costly will *remain* costly.

^{176.} See id. at 661.

^{177.} See THALER & SUNSTEIN, supra note 174, at 5-6.

^{178.} See Lessig, supra note 30, at 662; Cass R. Sunstein, Social Norms and Social Roles, 96 COLUM. L. REV. 903, 912 (1996).

B. Technological Cost and IP Governance Structures

1. Balance Is Crucial to IP Law

Implicit regulation by Technological Cost is best understood within the context of policy balances that are central to all IP legal regimes, such as the one described earlier in the sound recording and photocopying contexts. ¹⁷⁹ IP policymakers are thought to spend considerable effort crafting IP laws that strike deliberate balances between conflicting societal interests. The underlying justification for IP law is generally agreed to be utilitarian in nature. 180 Exclusive IP legal rights — whether in copyright, patent, trademark, or trade secret are justified only to the extent that the net benefits that they give to society outweigh the *net* costs that they impose. For example, patent law's exclusive rights over inventive ideas are justified in the belief that such rights promote the creation and commercialization of inventions and the disclosure of ideas that might not otherwise have occurred absent legal exclusivity. 181 Similarly, exclusive rights in copyright are thought to promote the creation of creative works that authors would not otherwise be incentivized to develop. 182 Thus, inherent in the notion of a utilitarian justification in law is a balancing of net social benefits against net social costs. 183

IP laws frequently trade off the legal rights of IP *owners* against the access and use rights of *non-owners* (i.e., the public). Because IP law gives private legal rights over intangible information that would otherwise be easily copied, distributed, and broadly used by the public, control over information is often a zero-sum game. For example, patent law is concerned with providing incentives for inventors to develop fundamental, pioneering inventions, such as the telegraph ¹⁸⁴ or DNA sequences for therapeutic targets. However, "upstream" incentives in the form of exclusive rights to control ideas may inhibit the ability of "downstream" researchers to develop, improve, and commercialize inventions beyond the extent developed by the original inventor. As discussed, copyright has similar concerns with exclu-

^{179.} See supra Part I and Part II.A.2.

^{180.} See Burk & Lemley, supra note 39, at 1597; Mazer v. Stein, 347 U.S. 201, 219 (1954) ("The economic philosophy behind the clause empowering Congress to grant patents and copyrights is the conviction that encouragement of individual effort by personal gain is the best way to advance public welfare....").

^{181.} Mazer, 347 U.S. at 219.

^{182.} WILLIAM M. LANDES & RICHARD A. POSNER, THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW 12–14 (2003).

^{183.} See generally William Hubbard, Competitive Patent Law, 65 FLA. L. REV. 341, 378, 391 (2013) (assessing the value of protectionist patent law and expedited examinations in industry areas based on a cost-benefit analysis).

^{184.} See, e.g., O'Reilly v. Morse, 56 U.S. 62 (1853).

^{185.} See, e.g., Ass'n for Molecular Pathology v. USPTO, 689 F.3d 1303 (Fed. Cir. 2012).

^{186.} See Lemley, supra note 31, at 990-91.

sive rights discouraging creative works that build upon earlier works, or inhibiting other values, such as free speech or scholarship. ¹⁸⁷

If IP laws strike the *wrong* balance there is the risk that IP laws will do more net harm than good, and thus will not serve the underlying utilitarian justification. IP rights that are too strong or too broad may inhibit the ability of non-holders to use abstract ideas, and may, on net, impose more costs than the benefits that they bring. For example, if DNA synthesis is merely the first step to a very costly and difficult research path of creating a useful medical therapy, then granting broad pioneering patent rights to those who merely identify initial DNA markers might unduly inhibit downstream research required to create a usable medical therapy. Similarly, copyright laws that are unduly strong might inhibit the ability of the public to access and transform creative works into new and socially beneficial products, and may result in less, rather than more creation.

On the contrary, IP regimes must not be so weak as to undermine fundamental economic incentive structures. IP incentives work when the holders of exclusive legal rights can appropriate the value of their works in the commercial marketplace backed by the threat of legal remedy against unauthorized users. If the ability to capture value in the commercial market is undermined, IP rights may not effectively incentivize creation. 189 For example, if a fair use rule allows unlimited duplications for research purposes, and the technological emergence of photocopying machines enables research departments to copy at such an extensive scale so as to undermine the commercial market for books and articles, policymakers might be concerned. Similarly, if patent laws did not permit firms to recoup their research investments, the creation of new technological knowledge might be underincentivized. Thus, IP policy represents, in theory at least, a series of carefully calibrated regulatory equilibria that attempt to balance sufficient incentives to invent, create, or invest in quality IP goods against the costs that exclusive legal rights impose on improvement, free speech, or other socially beneficial uses by non-owners.

2. IP Frameworks Depend Upon Technological Cost To Maintain Balances

The balancing of competing policy interests is thus crucial to the regulation of IP goods. IP legal frameworks sometimes depend upon Technological Cost to functionally preserve central regulatory balances. In this way, we can understand high Technological Cost to be playing an implicit, but crucial, regulatory role. When Technological

^{187.} See Morrissey v. Procter & Gamble Co., 379 F.2d 675, 678-79 (1st Cir. 1967).

^{188.} See In re Fisher, 421 F.3d 1365, 1378 (Fed. Cir. 2005)

^{189.} See LANDES & POSNER, supra note 182, at 13.

Costs decrease, the central governance equilibria upon which IP legal frameworks implicitly depend can be disrupted. Several earlier examples illustrate this point.

Recall the sound recording example from the introduction. ¹⁹⁰ Modern federal copyright law generally gives authors of creative works (e.g., books, paintings, and movies) exclusive legal rights to restrict copying of those works. ¹⁹¹ However, for much of the twentieth century, federal copyright law did not give the creators of sound recordings (e.g., music albums) the right to restrict others from making copies of sound recordings. Meanwhile, federal copyright law of that era did allow the authors of other types of creative works exclusive legal rights in their creations.

One reason why federal rights over sound recordings did not arrive until 1972 was that for many years high Technological Cost effectively limited the impact of unauthorized copies of sound recordings. 192 The general justification for exclusive legal rights over duplicating creative works is that, absent such control, authors will not be able to capture the value of their creations in the market, and will therefore not have incentive to produce books, movies, or the like in the first place. 193 Without exclusive rights to restrict copying others will "free ride" off the work and copy or sell the work at a lower price (i.e., marginal cost) than could be charged by the creator, ¹⁹⁴ who incurred up-front costs to create the product that copiers did not. In the early part of the twentieth century, Technological Cost, not law, effectively mitigated the commercial market problem. The Technological Cost of duplicating music albums in the early 1900s was high because it was practically infeasible to create albums given the limited access to sound recording duplicating methods of the era; the poor quality of the copies further deterred duplication. The constraint imposed by these Technological Costs preserved the economic incentives to create. 195

A similar story of Technological Cost as part of an integral IP balance occurred in the earlier scenario involving the Research Doctrine and photocopying described earlier. ¹⁹⁶ In the early twentieth century, the high Technological Cost of duplication allowed fair use rules

^{190.} See supra Part I.

^{191.} See generally 17 U.S.C. § 106 (2012).

^{192.} See, e.g., Harper & Row Publishers, Inc. v. Nation Enters., 471 U.S. 539, 553 (1985).

^{193.} Landes & Posner, *supra* note 31, at 330–31.

^{194.} *Id*.

^{195.} The limited state of duplication technology in the early twentieth century permitted a small amount of unauthorized, but valuable public uses of sound recordings. The duplication of sound recordings of orphaned works by jazz enthusiasts was one example. Glenn M. Reisman, *The War Against Record Piracy: An Uneasy Rivalry Between the Federal and State Governments*, 39 ALB. L. REV. 87, 89 (1974).

^{196.} Supra Part II.A.

to permit scholarly researchers to make unauthorized duplications of copyrighted work without explicit limitations in a way that did not threaten the core copyright balance. The natural constraints of early duplication technology — hand transcription and the "photostat machine" — inherently maintained an equilibrium between competing copyright goals. The Research Doctrine was structured upon unstated presumptions of high Technological Cost. Because the legal scope of the fair use rule was subtly linked to the external state of technological development, the doctrine underwent a shift in Effective Scope when the Technological Cost of copying decreased. The Research Doctrine had been framed in an era of background technological limitations that no longer applied.

Similarly, the Google Book Search example described earlier exemplifies the way in which high Technological Cost had previously maintained an implicit equilibrium between appropriation of value by IP creators and permission-free uses of IP goods by the public. ¹⁹⁷ In the era of paper documents, Embedded Excerpts fostered socially beneficial uses such as criticism or scholarship without diminishing the ability of copyright holders to capture the value of their books on the market. As described, the display of digital, online excerpts in the context of Google Books substitutes for some commercial functions of the original text. Thus, for certain purposes — such as citation checking — a mere glance at a snippet or excerpt is sufficient to achieve a purpose that previously required physical access to the book.

To summarize the argument: (1) under regulatory theory we can understand anything that imposes "costs" on an activity to be a regulatory factor; (2) certain activities central to IP equilibria have historically been functionally constrained by high Technological Cost; (3) we can understand Technological Cost to play an implicit regulatory role, alongside positive IP law, in constraining activities relevant to the governance of IP goods; (4) when innovation lowers the Technological Cost of these activities, policy balances at the core of positive IP legal structures may be disrupted.

3. Positive Law and Implicit Link to Technological Cost

The positive expression of IP laws — what courts or legislatures promulgate and commit to authoritative legal texts — often reflects unstated assumptions about Technological Cost. This relationship is demonstrated as much by what is included in the positive text as by what is conspicuously omitted. For example, the Research Doctrine, which permitted unauthorized duplications of written materials for

research purposes, contained no explicit restrictions in its early twentieth-century expression. The absence of such scope restrictions reflected an assumption that the Technological Cost of duplication was understood to be high and believed to remain high. Since the Technological Cost of copying was high, positive IP law did not need to include explicit restrictions on scope.

The important point is that positive IP law, both explicit legal rules as articulated, and omissions from positive IP law, develops in the shadow of prevailing Technological Cost. The conspicuous omission of copyright protection for sound recording exemplifies a similar dynamic. Positive IP legal frameworks' inclusions (legal categories chosen) or omissions (scope limitations) implicitly reflect assumptions about technological feasibility. The activities that are regulated are those that do not appear, at the time, to be capable of changes in Technological Cost or feasibility. However, later technological advancement reveals this to be, in fact, inaccurate.

C. Identify and Predict

Lawmakers should thus be concerned about IP legal frameworks that implicitly depend upon high Technological Cost to regulate. In such an arrangement, carefully crafted regulatory balances can become destabilized and susceptible to shifts when technology changes. Lawmakers should aim to actively identify, ex-ante, current IP regulatory arrangements that are implicitly dependent upon high Technological Cost. In service of this goal, this next Part suggests analytical approaches to identify current technological dependencies in IP law. In general, the method is to identify activities that are currently Technologically Costly but are likely to see a decrease in Technological Cost in the near term, impacting the scope of IP law.

1. Cost and Constraint Focused Analysis

The first approach to identifying hidden dependencies of law upon Technological Cost is to focus upon existing Structural Constraints. One method is to imagine a hypothetical world of zero constraints. What activities regulated by IP laws are implicitly technologically constrained today? What would change in IP law if limitations inherent to today's technologies were to suddenly disappear? For instance, as of the writing of this Article, data bandwidth limitations prevent certain video copyright activities from occurring on a broad scale. Some IP regulatory structures may actually, but implicitly, depend upon the high Technological Cost manifested by today's bandwidth limitations. Thus, the imaginary lens of zero constraints approximates what emerging technologies have tended to do to past

Structural Constraints. They have, as a primary or side effect, broadly reduced Technological Cost levels, making activities that were previously difficult and constrained, less so.

We can use this thought experiment to identify existing IP legal structures that subtly depend upon high Technological Cost. For example, what would change in patent, copyright, trade secret, or trademark law, if bandwidth became unlimited and data transmission instantaneous? Or, how would it fundamentally shift the current IP legal regimes if data that is today stored separately in disconnected data centers suddenly became centralized and costless to aggregate and analyze? If physical objects that are today costly to produce were instead costless to create, how would this shift IP equilibria? This thought experiment reveals hidden dependencies that emerging technologies will likely disrupt, reducing constraints that pervade the current system. Thus, to understand where IP laws might be vulnerable is to envision a world without the Structural Constraints that exist today. This process helps to reveal presumptions of high Technological Cost that are embedded in the structure of current IP laws.

2. Technology Focused Analysis

The second approach is to focus upon technologies that will emerge in the near term. This approach, unlike the one above, is technology focused, rather than constraint focused. This technique should be used in tandem with the one above for identifying current technological dependencies in IP law. By examining emerging technologies, we have a guide to the types of costs that might be dissipating in the near future. Part V takes this approach by examining how three-dimensional printing technology is reducing the Technological Cost of manufacturing complex physical objects, as well as how certain patent and copyright laws may be premised upon unarticulated presumptions that the Technological Cost of manufacturing goods is high. This is an example of focusing upon an emerging technology as a guide to Technological Costs that might be reduced in the near future and predicting the impact on law.

3. Principles for Identifying Technological Dependencies

It is possible to come up with general principles by which activities appear to decrease in Technological Cost. These principles can help illuminate the way in which current laws may subtly depend upon high Technological Cost by giving a guide to the dimensions along which activities have tended to shift with technological change. We

^{198.} See infra Part V.A (applying the technology focused technique, alongside the cost-focused technique, with respect to three-dimensional printing).

can examine current IP law along these dimensions to understand the way in which they might shift with future technological change.

One common theme from the earlier examples has concerned technology decentralizing the production and duplication of IP goods. The creation of records, for example, has historically required expensive equipment that could only be operated economically by professional firms with centralized operations. Technology has tended to lower the costs of producing and replicating IP products, allowing broad classes of non-professionals to produce these goods in physically dispersed venues with low-cost equipment. Personal printers, photocopiers, and word-processing technology illustrate this trend. Part V discusses how three-dimensional printing continues this trend in the context of physical goods.

Technology has also tended to reduce the quality gap between consumer and professional output. Consumer equipment has often crossed a threshold in which the goods produced have become sufficiently suitable for many purposes, even if not matching the quality of professional tools. Technology has often eliminated quality deficiencies that limited the commercial impact of unauthorized uses of IP goods made by non-industrial grade equipment, as was discussed earlier in the context of copying sound recordings.

Technology has also undermined those IP laws linked to physical location. ²⁰² Certain laws are structured upon the assumption that regulated goods, actors, or activities will be anchored to certain physical locations — so called "locus-based" presumptions. ²⁰³ Historically, copyright infringers have required physical U.S. operations to produce or import products impacting the domestic commercial market. ²⁰⁴ However, the advent of the Internet has permitted infringers to have the majority of their operations physically outside U.S. jurisdictions, while still able to impact the domestic market. ²⁰⁵ Similarly, copyright law has historically regulated creative works that were physically possessed by an end user, and which were embodied in a single object

^{199.} Supra Part I, Part II.B.2.

^{200.} Note, supra note 9, at 44.

^{201.} The quality of MP3 and other lossy music compression technology is not as good as professional lossless audio, but has turned out to be sufficient for many purposes. Eric Berger, *The Legal Problems of the MP3*, 18 TEMP. ENVTL. L. & TECH. J. 1, 1–4 (1999).

^{202.} See generally Timothy R. Holbrook, Territoriality Waning? Patent Infringement for Offering in the United States To Sell an Invention Abroad, 37 U.C. DAVIS L. REV. 701 (2004).

^{203.} See, e.g., Allarcom Pay Television, Ltd. v. Gen. Instrument Corp., 69 F.3d 381, 387 (9th Cir. 1995) (discussing the difficulties in determining the "locus" or location where copyright infringement actually occurred).

^{204.} See generally Jane C. Ginsburg, Copyright Legislation for the "Digital Millennium," 23 COLUM.-VLA J.L. & ARTS 137, 163 (1999) (discussing difficulties with foreign infringers and the Internet).

^{205.} Tom W. Bell, Pirates in the Family Room: How Performances from Abroad, to U.S. Consumers, Might Evade Copyright Law, 18 SW. J. INT'L L. 245, 248–50 (2011).

found in a specific location (e.g., a paper book). However, technology has enabled copyrighted works to be disaggregated and divided into distinct subcomponents in physically dispersed locations to be reaggregated electronically upon demand. As information has moved away from specific locations and toward "cloud-based" network services, physical possession of IP products is no longer necessary, nor must all the components of an IP product be physically located in one place. Technology has thus undermined historical presumptions tying IP activities to specific physical locations.

Additionally, technological change has brought about shifts in speed of analysis, miniaturization, and monitoring. Things that previously used to require manual analysis, or for which computerized analysis was expensive and slow, may become meaningfully faster or instantaneous to analyze. Certain IP laws may be structured upon the assumption that analysis that has historically been slow will continue to be slow, but increases in the speed of analysis may lead to differences of kind rather than degree.

Furthermore, physical objects that have historically been non-electronic in nature are appearing in fully electronic form. Others are having electronics partially embedded within them. This inclusion of remotely accessible and controllable electronics in objects that have historically been non-electronic may bring about shifts. For example, sensors are allowing the ability to monitor and remotely control physical devices in ways that were not technologically possible in the past when everyday objects did not contain electronic, networked components. Such technological trends have tended to grant IP owners increased control over the use of products embodying IP. For example, copyright holders can control the use and disposal of electronic books in ways that were not technologically possible in the era of physical books. Similarly, physical products increasingly contain electronic sensors that may allow patent holders to remotely control or monitor how distant purchasers actually use their products.

^{206.} See, e.g., Hard Drive Prods., Inc. v. Does 1–188, 809 F. Supp. 2d 1150, 1151 (N.D. Cal. 2011) (discussing BitTorrent and the decentralized and subcomponent nature of distributing data).

^{207.} See Edward Lee, Warming up to User-Generated Content, 2008 U. ILL. L. REV. 1459, 1500-01 (2008).

^{208.} See, e.g., Alice Roberts, The Fruit Fly: Our Ancestor of 800 Million Years, THE OBSERVER, Aug. 18, 2013, at 22. ("In the 1970s, geneticists began to sequence genes, laboriously at first, then with increasing speed as more of the process was automated.").

^{209.} See, e.g., Mohana Ravindranath, Building the "Internet of Things," WASH. POST (Aug. 30, 2013), http://www.washingtonpost.com/business/on-small-business/building-the-internet-of-things/2013/08/29/e3fbc1ae-1024-11e3-85b6-d27422650fd5_story.html (describing how everyday products will increasingly contain embedded electronics that allow them to be controlled remotely); Dan Sorensen, The Future Is Now: Building a Better World with the Internet of Things, UTAH BUSINESS (October 8, 2013), http://www.utahbusiness.com/articles/view/the_future_is_now.

Information that has historically been difficult to access is increasingly becoming accessible due to technology. Moreover, a number of societal activities are occurring through electronically mediated contexts (i.e., through computer systems) that used to take place in physical forums or involving tangible objects with inherent physical constraints. The Google Books Search project illustrates this point. To the extent that additional goods existing today only in physical or analog form can in the future become digitized, this is another likely dimension of change.

These principles, along with the methods discussed above, can help identify existing laws likely to contain technological dependencies. To the extent that laws exhibit some of the themes above (i.e., rely upon premises that technological emergence has tended to undermine) they may be vulnerable to technological shift.

V. APPLYING THE TECHNOLOGICAL COST MODEL

This part will demonstrate how applying the Technological Cost framework to contemporary IP topics can clarify certain issues. To recap, the framework posits that IP laws are often premised upon unstated assumptions that certain activities will be Technologically Costly and thereby will be implicitly constrained by limitations inherent to contemporary technologies. When the Technological Cost of these activities fall, and existing Structural Constraints dissipate, there can be shifts in the impact of IP legal structures.

A. Technological Cost as a Predictive Framework

The Technological Cost framework can be used for prediction. This part will first examine how an emerging technology — three-dimensional ("3-D") printing — is reducing the Technological Cost of producing and transmitting physical objects. It will then illustrate how one can identify current IP legal structures that are premised upon unstated presumptions of high Technological Cost. Current patent and copyright laws, for example, are structured upon the premise that the production of physical objects will be implicitly constrained by technological limitations common today. We can observe how laws framed in an earlier technological context are likely to undergo substantive shifts as 3-D printing undermines the presumptions of Technological Costliness upon which these were based. Viewing this change through the lens of Technological Cost allows us to predict and understand upcoming changes in the law, such as an increasing importance of secondary liability in copyright and patent law.

1. 3-D Printing and Changes in Technological Cost

Let us examine how 3-D printing is reducing the Technological Cost of creating complex physical objects. 3-D printing is an emerging technology that allows for the rapid production of physical objects from electronic designs. Unlike traditional printers that produce two-dimensional output on paper, 3-D printers can produce three-dimensional physical objects such as parts for machines. NASA, for example, has used 3-D printing technology to produce components for rocket engines. The technology is also widely used in rapid prototyping, enabling firms to print early-stage product samples with the physical shape of end products.

In a typical design process, a user first creates a three-dimensional computer model of the object to be printed using computer aided design ("CAD") software. The software then translates the on-screen representation of the object into a set of precise, physical attributes which are stored in an electronic computer file. ²¹⁴ A 3-D printer can read such a specification file to produce an accurate, physical version of the electronically designed object using a prototyping material such as plastic or metal. ²¹⁵ Although there are different 3-D printing techniques, in the typical "additive" process, the 3-D printer abstractly divides a 3-D design into very thin horizontal layers. ²¹⁶ The printer produces the physical object by precisely "printing" or adding one thin layer on top of another, with each layer conforming to the particular physical measurements specified in the design file. The ultimate result is a physical object — such as a plastic machine part — that matches the exact dimensions specified.

Recent changes in 3-D printing technology are increasingly allowing non-professionals to create complex physical objects that would have previously required complex manufacturing facilities. First, while 3-D printers were previously relegated to professional machine departments due to cost and size, low-cost, high-quality, small-footprint "personal" 3-D printers, situated in the price range of ordinary consumers, are starting to emerge. ²¹⁷ Large numbers of non-

 $^{210.\} Rendow$ Yee, Architectural Drawing: A Visual Compendium of Types and Methods 96 (2012).

^{211.} BRIAN EVANS, PRACTICAL 3D PRINTERS: THE SCIENCE AND ART OF 3D PRINTING XXIII (2012).

^{212.} Larry Greenemeier, NASA Plans for 3-D Printing Rocket Engine Parts Could Boost Larger Manufacturing Trend, SCI. AM. (Nov. 9, 2012), http://www.scientificamerican.com/article.cfm?id=nasa-3-d-printing-sls-rocket-engine.

^{213.} See Kenneth Cooper, Rapid Prototyping Technology: Selection and Application § 1.1 (2001).

^{214.} ANDERSON, *supra* note 37, at 90–91.

^{215.} Id.

^{216.} Id. at 91.

^{217.} This technology has historically been relegated to centralized machine departments because of the expense of the equipment. See id. at 92–95; EVANS, supra note 211, at xxiii.

professional users are increasingly able to produce physical objects that conform to precise physical specifications. Second, it has become increasingly easy to send electronic specifications of objects to distant recipients. One can transmit a particular specification to tens of thousands of 3-D printer owners simultaneously, in dispersed locations around the world, at very little cost. In principle, each recipient should be able to make a precise, physical duplication of the object specified. The ability to quickly and simultaneously disseminate and reproduce exact replicas of physical objects, at a distance and on a mass scale, is a previously infeasible activity enabled by 3-D printing technology.

The emergence of 3-D printing technology may thus significantly reduce the Technological Cost of creating complex physical objects in the near future. Historically, the manufacturing of complex products is an activity that has been Technologically Costly — Structurally Constrained by technological limitations that tended to relegate this activity to sophisticated manufacturing facilities such as factories.²²⁰

2. Presumptions of Technological Cost in Current IP Law

Applying this Article's lens, we can understand that current IP legal structures are premised upon the Technological Costliness of producing, duplicating, and disseminating complex physical objects. This part demonstrates how it is possible to recognize these legal-technological dependencies ex ante, before a technology, such as 3-D printing, has fully emerged.

One significant source of existing dependencies is the incentive structure of both patent and copyright law. Patent law is architected so that the creators of inventions can appropriate the value of their inventive contributions in the market. ²²¹ Inventions are often costly to develop, but relatively easy to copy once developed. ²²² The concern is that inventors, absent patent law, will not be able to recoup their research costs in the market. Copying competitors will be able to sell the product at near marginal cost and will be at an advantage to the

^{218.} See EVANS, supra note 211, at xxiii.

^{219.} See, e.g., HOD LIPSON & MELBA KURMAN, FABRICATED: THE NEW WORLD OF 3D PRINTING 18–19 (2013).

^{220.} Id. at 46.

^{221.} See, e.g., Rebecca S. Eisenberg, Patents and the Progress of Science: Exclusive Rights and Experimental Use, 56 U. CHI. L. REV. 1017, 1024–25 (1989) ("The incentive to invent theory holds that too few inventions will be made in the absence of patent protection because inventions once made are easily appropriated by competitors of the original inventor who have not shared in the costs of invention.").

^{222.} See id.

original inventor because they will not have borne the research and development costs. ²²³

For example, consider a firm that has spent considerable amounts of research, development, and clinical testing funds to create a medical device. Once that device has been designed and tested, competitors seeking to copy the device can often reverse engineer the design at relatively low cost. While the inventing firm needs to recoup its development costs, a copying firm would not incur these development costs and thus be able to sell the same device at a lower price. Patent law aims to prevent such free riding through legal exclusivity. The inventing firm can use patent rights to exclude free-riding competitors from selling products that are covered by their claims, thus allowing the firm to capture the value of their invention in the marketplace.

Embedded in patent law's economic model is an underlying premise about the Technological Costliness of manufacturing products that is revealed if we imagine the cost of decentralized manufacturing falling to zero. To manufacture a sophisticated product such as a medical device generally requires the resources of a firm with advanced manufacturing, production, distribution, and selling capabilities. Such production abilities are, for most advanced products, typically outside the range of non-professional individuals. Often creating complex products necessitates sophisticated and centralized production facilities and other resources.

The high Technological Cost of manufacturing complex products has an effect of implicit constraint that is crucial to the patent legal model. The number of entities who have the technical (and logistical) sophistication to produce complex infringing products on a scale disruptive enough to affect the economics of the market is often implicitly limited to those that can invest in the necessary manufacturing equipment. This, in turn, means that the pool of potential defendants to consider in a patent infringement lawsuit is often relatively constrained. This relatively limited pool of potential defendants is crucial to the effectiveness of exclusive patent rights. A firm can often identify and sue the most important patent infringers — those firms with the factories and distribution capacity to actually disrupt the commercial market — and thereby use the legal system to constrain these defendants. In other words, patent holders today may have a reasonable

^{223.} See id. at 1025 ("If successful inventions are quickly imitated by free riders, competition will drive prices down to a point where the inventor receives no return on the original investment in research and development.").

^{224.} See C. Scott Hemphill, Paying for Delay: Pharmaceutical Patent Settlement as a Regulatory Design Problem, 81 N.Y.U. L. REV. 1553, 1564 n.36 (2006) (noting clinical trial costs in the hundreds of millions in the closely related field of pharmaceutical drugs).

^{225.} ANDRES DIAZ LANTADA, HANDBOOK OF ACTIVE MATERIALS FOR MEDICAL DEVICES: ADVANCES AND APPLICATIONS 3 (2011) (describing the complexity of manufacturing many medical devices).

chance of detecting infringement and pursuing meaningful legal action when the universe of entities that can pose an economically serious threat by infringing a patent is implicitly constrained due to the high Technological Cost of manufacturing and distributing complex physical products.

The high Technological Cost of manufacturing products performs an implicit substantive role in the current patent legal framework. The current structure of patent law is dependent upon relationships of implicit constraint by existing technological limitations. The amount of resources currently required to produce many sophisticated physical objects often has the side effect of constraining the number of significant defendants to a reasonably manageable level. However — if the Technological Cost of manufacturing complex products decreased significantly — there may be practical issues with the patent legal system as a means to appropriate the value of inventions. 3-D printing technology will potentially lower the Technological Cost of consumers, or small firms, producing complex physical objects and thereby undermine a core premise that is currently embedded in the structure of patent law. If the ability to create physical objects becomes decentralized and available to non-professional individuals in ways not technologically feasible today, the class of putative defendants may enlarge so as to make patent legal action ineffective.

Multiple individuals possessing 3-D printers may be able to create useable reproductions of sophisticated patented objects, such as medical devices, in decentralized locations such as private homes. Moreover, certain products that today require physical shipping and importation across borders may be replaced by the electronic transmission of object specification files to end-user 3-D printers at distant locations. Such decentralized patent infringement may be difficult to monitor, and even if detected the financial calculus of suing multiple small firms or individuals may not prove viable. Thus, for certain types of inventions, current patent incentive structures may no longer function once 3-D printing technology broadly reduces the Technological Cost of producing goods.

In sum, we observed some activity that is today being implicitly constrained by technological limitations: producing complex physical objects. We observed some functional activity that this implicit constraint is performing in a larger patent legal structure: limiting the set of putative defendants making patent infringement detection and restriction operational. We can predict an upcoming issue as the Technological Cost decreases due to 3-D printing: the inability to monitor and address infringement in a way that had not historically been problematic.

Copyright has a very similar economic issue concerning physical objects. Copyright law grants to creators of sculptures, figurines, and

other non-functional three-dimensional artistic objects, the exclusive right to reproduce these objects, and their designs and likenesses. The development of such creative works often requires time and resources. Creators are often (but not always) incentivized to create these works only by the knowledge that copyright exclusivity will allow them to capture the monetary value of these works in the market. In other words, copyright economics depends upon being able to prevent others from creating these objects without permission so that those who want reproductions will have to purchase them from the creator. The creators of films, for example, often monetize their investment through the sale of figurines, dolls, or other physical manifestations of characters or objects associated with the film. Copyright law often secures this monetization.

Already, early adopting non-professional owners of 3-D printers are able to generate, based upon designs, high-quality figurines and replicas of film characters or objects. In the past only firms with relatively sophisticated equipment typically produced such products. Thus, home printed 3-D reproductions of copyrighted objects may begin to commercially substitute for purchases that in the past accrued to the copyright holder. The model thus allows us to predict that the decentralization of production may make legal actions for direct copyright infringement less effective for certain types of creative works by effectively dispersing defendants.

3. Predicting Changes in Law by Applying the Framework

The recognition that current IP laws depends upon high Technological Cost allows one to make predictions about upcoming changes in the law. Current IP laws are premised upon the Technological Costliness of producing copyrighted or patented objects. 3-D printing lowers the production costs for certain types of objects and allows for decentralization. When decentralization makes the class of direct infringers unmanageably large, a typical legal response has been an in-

^{226. 17} U.S.C. \S 113 (2012). Copyright holders can also create physical derivative works (e.g., figurines) based upon book or movie characters. *See* 17 U.S.C \S 106 (2012) (delineating the exclusive rights to reproduce products).

^{227.} Landes & Posner, *supra* note 31, at 326. ("While the cost of creating a work subject to copyright protection... is often high, the cost of reproducing the work... is often low.... If the copies made by the creator of the work are priced at... marginal cost... the creator's total revenues may not be sufficient to cover the costs of creating the work.").

^{228.} See generally id.

^{229.} Derek E. Bambauer, *Faulty Math: The Economics of Legalizing the Grey Album*, 59 ALA. L. REV. 345, 363 (2008) (discussing the value of merchandising based upon derivative rights of films).

^{230.} Steve Henn, *As 3-D Printing Becomes More Accessible, Copyright Questions Arise*, NAT'L PUB. RADIO (Feb. 19, 2013), http://www.npr.org/blogs/alltechconsidered/2013/02/19/171912826/as-3-d-printing-become-more-accessible-copyright-questions-arise.

^{231.} See ANDERSON, supra note 37, at 68-69.

creased focus upon secondary (or indirect) infringement liability. In theories of secondary liability, defendants are liable if they help others to directly infringe, even if the secondary defendants themselves do not directly infringe (e.g., produce infringing objects).²³²

Copyright law has seen similar examples in decentralization before. New reproduction technologies (e.g., sound recordings and digitization) have enabled the duplication of copyrighted works by private individuals that had previously required expensive professional equipment. As Stacey Dogan has observed, a common strategic reaction to such decentralization is to focus secondary liability upon the firms that provide the equipment or "tools" that enable others to directly infringe. Thus, after home video emerged, copyright holders sued Sony, the manufacturer of VCR machines (the equipment that assisted individual infringement), under theories of secondary liability rather than suing the dispersed set of directly infringing individual users. Similarly, once 3-D printing enables direct infringement by dispersed and hard-to-detect private individuals, IP holders may shift their attention to the makers of 3-D printers under theories of secondary liability.

The 3-D printing analysis was meant to be illustrative of a more general approach in which subtle legal dependencies upon high Technological Cost in IP law can be observed ex ante — before a particular Technological Cost decreasing innovation emerges widely. The example demonstrates the way in which this Article's framework can be predictive of current susceptibilities in IP law to Technologically Induced Shifts in Scope. We can focus upon the Structural Constraints that exist today, and the way in which they implicitly limit the scope of certain activities. This, in turn, can illuminate the way in which IP legal frameworks may depend upon these implicit limitations and allows us to predict, ex ante, the way in which IP structures may be disrupted by future technological change once these constraints dissipate.

^{232.} See Lemley & Reese, supra note 21, at 1347 n.8.

^{233.} Stacey L. Dogan, Code Versus the Common Law, 2 J. TELECOMM. & HIGH TECH. L. 73, 85 (2003).

^{234.} See generally Sony Corp. of Am. v. Universal City Studios, Inc., 464 U.S. 417 (1984)

^{235.} As discussed earlier, this is not to suggest that we should necessarily replicate the constraints of the current technological state with law. To do so would be overinclusive, and would ignore the welfare enhancing benefits unlocked by 3-D printing technology. The better approach would be to consider ways in which the incentive structure of the existing system might be preserved going forward. One approach, for example, might be to use technology to make the class of putative infringers more manageable under the legal system — lowering the transaction costs of detecting and enforcing legal rights in a manner proportional to the diffusion. Others might focus upon alternative economic structures or taxes to insure that inventors are suitably compensated proportionally to the value of their inventive contribution, in an era where the production of physical objects becomes decentralized and dispersed. See, e.g., Neil Weinstock Netanel, Impose a Noncommercial Use Levy to Allow Free Peer-to-Peer File Sharing, 17 HARV. J.L. & TECH. 1, 36-42 (2003).

B. Technological Cost as a Policy Lever in IP

This Article's framework also reveals a new class of policy levers based upon Technological Cost. The "policy lever" metaphor was popularized by Dan Burk and Mark Lemley. They used the term to reference the way in which courts could choose among multiple patent doctrines, and flexibly apply these doctrines, to contextually take into account material differences among patents from industries with different characteristics. They make generally, it is useful to think of IP law as containing a broader series of "policy levers" that policymakers can independently calibrate in order to the meet various IP goals. We can think of IP policymakers as having the ability to elect from among the numerous IP doctrines, processes, or structures that can be used to achieve policy goals in somewhat different ways.

For instance, if business method patents²³⁹ are exceptionally problematic as a category of invention, one approach might be to categorically exclude them under the patentable subject matter rule.²⁴⁰ However, there may be other patent policy levers that might be more fruitfully employed to achieve the same end. For instance, the courts may combat problematic business method patents more subtly by selectively, but informally applying a lower obviousness standard to these inventions.²⁴¹ Or, policymakers might devote resources to increasing the length of patent examination for business method patents. The major point of the policy lever metaphor is that there are often multiple strategies by which IP lawmakers can address issues, some with advantages over others. Policymakers can try "pushing" or "pulling" various policy levers to adaptively meet various policy ends.

If we consider "policy levers" to broadly mean the various avenues by which IP policymakers can address IP problems, this Article's framework suggests one novel avenue: strategically reducing the Technological Cost of selected activities. For example, recall from Part II that patent law's novelty doctrine prohibits the patenting of

^{236.} Burk & Lemley, *supra* note 39, at 1579. Burk and Lemley primarily discussed this in the context of courts and flexible judicial doctrines, but we can think of this more broadly in terms of calibration points throughout IP law.

^{237.} Id.

^{238.} This Article uses the term "policy lever" in this broader sense, and not limited to court doctrines.

^{239.} A business method patent is a patent on a means of running some aspect of a business. See Robert P. Merges, As Many as Six Impossible Patents Before Breakfast: Property Rights for Business Concepts and Patent System Reform, 14 BERKELEY TECH. L.J. 577, 578–79 (1999).

^{240. 35} U.S.C. § 101 (2006 & Supp. V 2011); see also Bilski v. Kappos, 130 S. Ct. 3218, 3235–36 (2010) (Stevens, J., concurring) (advocating for a patentable subject matter based approach to dealing with problematic patents).

^{241.} See, e.g., DAN BURK & MARK LEMLEY, THE PATENT CRISIS AND HOW THE COURTS CAN SOLVE IT 196 (2009).

inventions that had been invented previously.²⁴² Recall further that, as a practical matter, the way that a patent examiner actually rejects a patent as non-novel (e.g., previously invented) is by finding invalidating prior art documents.²⁴³ Many patents are considered problematic because they should have been rejected by the patent office during patent examination. However, patent examiners are not always able to find invalidating prior art documents, given the limited time to search through an enormous universe of potentially relevant documents.²⁴⁴

This problem suggests an approach based upon Technological Cost. The novelty doctrine is dependent on the Technological Cost of actually finding invalidating prior art documents. It can therefore shift if the Technological Cost of this activity decreases. Thus, policymakers might devote resources to deliberately reducing the Technological Cost of finding relevant, invalidating prior art. For example, rather than changing the novelty doctrine, lawmakers might instead devote resources developing advanced technological tools that reduce the Structural Constraints that today inhibit the finding of relevant prior art. Numerous machine learning and data mining techniques have developed out of the computer science domain in the last ten years that can be usefully deployed on this problem. ²⁴⁵ Thus a technological system that automates the process of finding obscure and remote prior art, incorporating modern search and analytics technologies to improve the capacity to find relevant, invalidating prior art documents in ways not feasible today, is another avenue to address the issue of invalid but issued patents. This is an observation that is highlighted by viewing the problem through the lens of Technological Cost.

The previous example was meant to be more generally illustrative as to how an IP policy goal might be achieved by reducing Technological Cost. Technological Cost provides an additional dimension that policymakers might consider when addressing policy problems. Among the pantheon of policy levers, the most promising lever to address a problematic IP issue might be technological, and not doctrinal, in nature. The recognition that IP doctrines depend upon Technological Cost helps to reveal this strategy, and reduction of Technological Cost should be considered as an additional tool or lever in general IP regulatory approaches.

VI. CONCLUSION

This Article argued that many observed disruptions in IP law can be usefully explained through the lens of changing Technological

^{242. 35} U.S.C. § 102.

^{243.} *Id*.

^{244.} Burk & Lemley, supra note 39, at 1614 n.124.

^{245.} See RUSSELL & NORVIG, supra, note 41, at 867.

Cost. IP laws, or legal frameworks, are often structured upon the unstated premise that activities that have historically been infeasible and difficult to do will continue to be constrained. Emerging technologies tend to reduce the capacity-limiting effects of Structural Constraints of the past. When this occurs, positive IP laws can undergo meaningful shifts in Effective Scope or Strength, and long prevailing but implicit equilibria can be disrupted.

Such disruptions are common in IP law, but are often difficult to characterize. This Article provided the Technological Cost framework and a vocabulary for describing observed shifts. It also provides a metric for characterizing the nature of a legal shift following a technological change. We observe which Structural Constraints had an implicit, scope-limiting effect on activities in the prior technological era, and we examine to what extent particular IP laws, or overall IP structures, depended upon this implicit restriction. We can describe the change by articulating precisely what used to be limited, what impact this limitation had upon IP law, and how the novel technology under consideration effectively diminishes the restrictive effect of earlier Structural Constraints. This Article suggested that this type of argument should enter broader IP policymaking to understand the nature of such Technologically Induced Shifts in legal scope.

This Article also provided numerous examples of IP legal frameworks from across the various IP domains that depended upon the Technological Costliness of activities in order to preserve balances that are central to IP policy goals. When technology reduced the costs of these activities, IP regulatory equilibria shifted as well. This Article further described a method for revealing unrecognized technological dependencies in existing IP laws, and applied this method to illustrate how recognizing technological dependencies ex ante can be used to predict issues in IP law that are likely to occur with near-term technological change.

Finally, this Article argued that high Technological Cost can be understood as implicitly protecting important IP values. Values that are protected primarily by Technological Cost, and not by positive law, are vulnerable to erosion as technologies emerge. In such instances, it may not be apparent that costs were functioning to protect social values until *after* those costs are gone. This Article discussed this dynamic of implicit protection by costs, and subsequent Technological Erosion, in the specific context of IP law. The function of costs in implicitly maintaining social values may have broader implications for legal theory generally. These applications are beyond the scope of this Article but will hopefully be the subject of future inquiry by other scholars.