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Digital Patent Infringement in an Era of 3D Printing

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The digital revolution has now moved beyond music and video files. A person can now translate three-dimensional objects into digital files and, at the press of a button, recreate those items via a 3D printer or similar device. Just as digitization placed pressure on the copyright system, so will these digital computer-aided design ("CAD") files stress the patent system. Patents directed to physical objects can now have their value appropriated not only by the transfer of physical embodiments but also by the transferring of CAD files designed to print the invention. We term this phenomenon digital patent infringement.

In this Article, we explore the ways the patent system can respond to protect patent owners against the appropriation of their inventions via these digital files. First, we explore whether indirect infringement doctrines sufficiently protect patent holders against these CAD files. Given the nature of likely accused indirect infringers, we conclude, contrary to earlier literature, that these doctrines likely are not up to the task.

Second, we offer novel theories of direct "digital" patent infringement based on the CAD files alone. We consider whether offers to sell and sales of these files should constitute direct patent infringement. Because such commercial activity is an appropriation of the economic value of the patented invention, we believe the law should recognize such an infringement theory. Next, rejecting the prior assumptions of the literature, we explore whether the CAD files alone should be viewed as infringement for making the patented device, given the de minimis *effort it takes to create the item via a 3D printer or related device. As a*

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technological matter, the line between the digital and the tangible has eroded to the point where the file and the item are viewed as interchangeable. Under this view, the files alone should be infringing. As a legal and policy matter, however, such expansion of patent infringement liability could have significant chilling effects on other actors and incentives, giving us pause in extending liability in this context.

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INTRODUCTION

It is hard to believe that the first iPod was released in 2001, a mere fourteen years ago.[1] We quickly moved from bulky Sony Walkmans, to the click-wheel iPods with mini-hard drives, to now having flash memory. CDs, the previously disruptive technology that sent vinyl albums into the dustbin of history, were quickly displaced by digital music files and portable music players. This transition in our culture from a physical to a digital world has occurred at an impressive, if not dizzying, pace. From smartphone apps to digital music streaming services, our world has replaced the tangible and the analog with the digital.

Since the 1990s, the ability to make and share multiple copies of two-dimensional pictures and movies with negligible cost has brought benefits, such as increased access to information and cultural innovation. Yet the facility with which one can make and share digital copies has brought tremendous pressure on the copyright regime from unauthorized digital books, movies, images, and songs. The terms Napster, Grokster, and BitTorrent instantly call to mind the impact digitization has had on the entertainment and music industries. But the process is not over yet, and the digital world and the physical world continue to intertwine and merge. The line between hardware and software has effectively eroded.[2] For example, most of our buttons on smart phones are now "virtual" — icons on a screen — rather than physical, mechanical objects.

New technologies now are adding a (literal) third dimension to the commingling of the physical and digital worlds, allowing people to create complex, tangible objects directly from digital files. For example, three-dimensional printers, scanners, and computer-aided design ("CAD") programs allow people to translate physical objects into digital files and, more ominously for patent holders, to then translate the digital files back into physical objects.[3] With these 3D printers, we can now move, almost seamlessly, between the physical

[1] *Apple Press Info*, APPLE, https://www.apple.com/pr/products/ipodhistory/ (last visited Aug. 11, 2014).

[2] *See* Eolas Techs., Inc. v. Microsoft Corp., 399 F.3d 1325, 1339-40 (Fed. Cir. 2005) ("[P]rocess and product — software and hardware — are practically interchangeable in the field of computer technology. On a functioning computer, software morphs into hardware and vice versa at the touch of a button." (citation omitted)). *See generally* Mike Bacidore, *Software Replaces Machine Hardware, but Mechanical Solutions Still Have Their Places*, CONTROL DESIGN (Oct. 8, 2009), http://www.controldesign.com/articles/2009/mechanicalsolutions0910 (providing examples of software overtaking hardware with respect to electronic device controls).

[3] *See* discussion *infra* Part I.

and the digital worlds. Additionally, advances in chemistry and biology allow scientists to digitally design DNA and other chemicals and to feed digital files to a machine that will directly manufacture the molecules.[4] Collectively, we term these technologies digital manufacturing technology ("DMT").

Like previous digitization technologies, these new technologies bring both excitement and stress. In particular, DMT places pressure on all aspects of the intellectual property regime.[5] One respected research firm predicts that by 2018, intellectual property theft due to 3D printing alone will create losses of $100 billion per year.[6] The focus of this Article is the impact DMT is having[7] and will have on the patent system.[8]

Historically, someone could only infringe a patent if there was a physical embodiment of the invention claimed in the patent.[9] To infringe, someone had to build the "better mousetrap," complete with springs and levers, not simply design it on paper. Even patents on processes or methods are typically infringed when there is a *machine* or other device that performs the process.[10] If we create a new method

[4] *See infra* notes 46–47 and accompanying text.

[5] *See* Lucas S. Osborn, *Intellectual Property's Digital Future*, *in* RESEARCH HANDBOOK ON DIGITAL TRANSFORMATIONS (F. Xavier Olleros & Majlinda Zhegu eds., forthcoming 2016) (manuscript at 1), *available at* http://papers.ssrn.com/abstract=2533673; Lucas S. Osborn, *Regulating Three-Dimensional Printing: The Converging Worlds of Bits and Atoms*, 51 SAN DIEGO L. REV. 553, 582-92 (2014) [hereinafter *Regulating 3D Printing*].

[6] *Gartner Says Uses of 3D Printing Will Ignite Major Debate on Ethics and Regulation*, GARTNER (Jan. 29, 2014), http://www.gartner.com/newsroom/id/2658315.

[7] *See* Heesun Wee, *The 'Gold Rush' for 3-D Printing Patents*, CNBC (Aug. 15, 2013, 10:48 AM), http://www.cnbc.com/id/100942655 (documenting fervent patent activity related to 3D printing).

[8] Intellectual property regimes in other countries also will have to wrestle with the impact of 3D printing. *See, e.g.*, Pedro Malaquias, The 3D Printing Revolution: An Intellectual Property Analysis (Aug. 8, 2014) (unpublished manuscript), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2495416 (discussing impact of 3D printing on UK intellectual property law).

[9] *See* Timothy R. Holbrook, *Liability for the "Threat of a Sale": Assessing Patent Infringement for Offering to Sell an Invention and Implications for the On-Sale Patentability Bar and Other Forms of Infringement*, 43 SANTA CLARA L. REV. 751, 755 (2003) [hereinafter *Threat of a Sale*] ("Historically, for there to be infringement, the allegedly infringing device had to be in a physically complete form."); Katherine J. Strandburg, *What If There Were a Business Method Use Exemption to Patent Infringement?*, 2008 MICH. ST. L. REV. 245, 254-57 (discussing patent law's adjustments to intangible business method and software patents).

[10] *See, e.g.*, Hughes Aircraft Co. v. United States, 640 F.2d 1193, 1196-97 (Ct. Cl. 1980) (explaining that a method of controlling satellites was infringed by the particular system in question); Acme Steel Co. v. E. Venetian Blind Co., 130 F. Supp.

of making aspirin, we will infringe only when a plant is built, and we begin to use the method.

This historical anchoring to the physical, however, has its roots in the industrial age, when most innovation actually did relate to tangible things.[11] In the digital era, it is at best unclear whether we should retain the vestiges of an earlier era when assessing the scope of patent infringement. While courts have confronted these issues on the front end — assessing whether patents should cover intangible inventions like software or methods of doing business[12] — they have yet to wrestle with these issues on the backend when assessing infringement based on DMT technologies.

At first blush, digital patent infringement might seem preposterous. After all, creating blueprints for a patented device does not infringe a claim directed to the device.[13] But a dismissive reaction ignores the potential impact on the economic value of a patent. Even now, a person who possesses a digital file of a wrench or a fuel injector is a 3D printer and one push of a button away from having the physical item itself. As quality 3D printers make their way into the average person's home, the difference between having a CAD file and having the physical object will become increasingly inconsequential. Moreover, people can print the physical object in the privacy of their office or home without the need to purchase the physical device from a mass-produced source. Hence, DMT decentralizes and partially anonymizes the manufacture of tangible objects, inviting comparisons

459, 465-68 (D. Md. 1955) (comparing the claimed method to the machine accused of performing the method to find no infringement); *cf.* Richard S. Gruner, *Intangible Inventions: Patentable Subject Matter for an Information Age*, 35 LOY. L.A. L. REV. 355, 355-57, 360 (2002).

[11] *See* Gruner, *supra* note 10, at 360.

[12] *See, e.g.*, Alice Corp. v. CLS Bank Int'l, 134 S. Ct. 2347, 2352 (2014) (holding that a method of intermediated settlement was not patent eligible even if computer implemented); Bilski v. Kappos, 561 U.S. 593, 611-12 (2010) (ruling that a method of hedging against risk of commodity price fluctuations was ineligible for patent protection); DDR Holdings, LLC v. Hotels.com, LP, No. 2013-1505, 2014 WL 6845152, at *1, *12 (Fed. Cir. Dec. 5, 2014) (holding that "systems and methods of generating a composite web page" were eligible for patent protection).

[13] Niks v. Marinette Paper Co., 11 F.R.D. 384, 385 (N.D.N.Y. 1951) (indicating that blueprints of a physical device alone are not sufficient to find patent infringement); Luten v. Camp, 221 F. 424, 429 (E.D. Pa. 1915) ("The substantial issue is whether the defendants have infringed the plaintiff's patents. The materiality and relevancy of the contract and blueprints is dependent upon the plaintiff establishing (1) that they infringe, and (2) that they were produced by or under the direction of any of the defendants leading up to the contract, or are part of a contract entered into between any of the defendants.").

to file-sharing technologies that brought consternation to the media industries.[14] If we can make our own patented wrenches in the privacy of our own homes, why bother to purchase them from the patent owner?[15]

If these digital files undermine the economic value of a patented invention, then they risk undermining the incentives that the patent system is meant to create.[16] Unless the patentee can exert a measure of control over the CAD files that will manufacture her patented invention, her incentive to engage in innovative activity will be dampened.

Because the line between the tangible and intangible is increasingly blurred, the patent system will have to react. In short, is there (and should there be) a difference between an infringing, tangible item and a digital file that effortlessly allows the creation of that same tangible item?[17] If so, what are the appropriate infringement scenarios that will adequately protect patent owners without creating undue costs on competitors and other innovators?

We confront this situation directly, offering a doctrinal and normative assessment of such "digital" patent infringement. In so doing, we fill a gap in the literature on what constitutes infringement relating to digital technologies. To date, commentators have assumed without much analysis that digital files do not infringe patent claims directed to a physical device.[18] We challenge that assumption and, for

[14] *See* Ben Depoorter, *Intellectual Property Infringements & 3D Printing: Decentralized Piracy*, 65 HASTINGS L.J. 1483, 1493-1502 (2014) (comparing 3D printing and file sharing); Justin Hughes, *On the Logic of Suing One's Customers and the Dilemma of Infringement-Based Business Models*, 22 CARDOZO ARTS & ENT. L.J. 725, 726-28 (2005) (describing peer-to-peer filesharing and the recording industry's reaction to it).

[15] Or, for that matter, to purchase parts to repair items we already own. *See* Kelsey B. Wilbanks, *The Challenges of 3D Printing to the Repair-Reconstruction Doctrine in Patent Law*, 20 GEORGE MASON L. REV. 1147, 1147-48 (2013).

[16] *See generally, e.g.*, William Hubbard, *Inventing Norms*, 44 CONN. L. REV. 369, 374-76 (2011) (describing the incentive theory through which inventors can recoup research and development costs).

[17] *Cf.* Simon Bradshaw, Adrian Bowyer & Patrick Haufe, *The Intellectual Property Implications of Low-Cost 3D Printing*, 7 SCRIPTED 5, 26-27 (2010) (discussing potential theories of infringement for files under the United Kingdom's patent laws), *available at* http://www2.law.ed.ac.uk/ahrc/script-ed/vol7-1/bradshaw.asp.

[18] *See, e.g.*, MICHAEL WEINBERG, PUB. KNOWLEDGE, IT WILL BE AWESOME IF THEY DON'T SCREW IT UP 12 (2010), *available at* https://www.publicknowledge.org/files/docs/3DPrintingPaperPublicKnowledge.pdf [hereinafter IT WILL BE AWESOME] ("Unlike with copyright infringement, the mere possession or downloading of a file is not enough to create infringement liability."); Daniel Harris Brean, *Asserting Patents to Combat Infringement via 3D Printing: It's No "Use,"* 23 FORDHAM INTELL. PROP. MEDIA &

the first time in the literature, explore whether the patent system should recognize infringement based on these digital files alone.

Specifically, we explore whether and when digital files that can directly print operable physical objects might infringe a patent claim directed to the underlying physical object.[19] For example, imagine a patent containing a claim directed to an improved rocket fuel injector, but containing no claim to a CAD file capable of printing it. We explore whether a person might infringe the claim by the unauthorized creation or distribution of a CAD file that would print — with no extra assembly required — the exact claimed fuel injector.[20] We refer to this sort of infringement as digital patent infringement.

ENT. L.J. 771, 790 (2013) [hereinafter *Asserting Patents*] ("If a patent claims a physical product, that physical product is what must be sold or offered for sale in order to satisfy §271(a)."); Nicole A. Syzdek, *Five Stages of Patent Grief to Achieve 3D Printing Acceptance*, 49 U.S.F. L. REV. (forthcoming 2015) (manuscript at 13), *available at* http://ssrn.com/abstract=2423571 ("A user's actions fail to trigger direct infringement under § 271(a) unless the physical patented product is in fact printed."); Sam Dillon, Note, *Infringement by Blueprint: Protecting Patent Rights in a World of Low-Cost 3D Printing*, 42 AIPLA Q.J. 425, 443 (2014) ("But direct infringement of a patent covering an object would not occur when someone creates . . . a [CAD file] of that object."); Davis Doherty, Note, *Downloading Infringement: Patent Law as a Roadblock to the 3D Printing Revolution*, 26 HARV. J. LAW & TECH. 353, 360 (2012) (assuming that a user would not be "liable for uploading the CAD file, though she may be liable for any copies of the object that she printed in the process of developing her design"); Charles W. Finocchiaro, Note, *Personal Factory or Catalyst for Piracy? The Hype, Hysteria, and Hard Realities of Consumer 3-D Printing*, 31 CARDOZO ARTS & ENT. L.J. 473, 498 (2013). These commentators have focused their infringement analyses on indirect infringement.

[19] One might draft a patent claim directed to the digital file itself. *See* Daniel Harris Brean, *Patenting Physibles: A Fresh Perspective for Claiming 3D-Printable Products*, 55 SANTA CLARA L. REV. (forthcoming 2015) (manuscript at 13-26), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2560816 (discussing strategies to claim CAD files themselves); Osborn, *Regulating 3D Printing*, *supra* note 5, at 587 n.206; Dillon, *supra* note 18, at 452-55. But that strategy is not our focus. Whether such a claim would constitute patentable subject matter is not clear. *See infra* notes 297–301 and accompanying text. We note, however, that whether claims to CAD files for inventions should constitute patentable subject matter is relevant to our discussion in Parts III and IV of whether courts should recognize claims for digital patent infringement. Generally, if the law *should* allow claims for digital infringement, it *should* allow claims to CAD files stored on a medium. But the law is not always so clean and symmetrical. Even if such a claim would work, before 3D printing is fully mature, patentees may not know they need to draft claims covering CAD files, leaving a potential gap in protection.

[20] NASA has used 3D printed rocket fuel injectors. *See* Press Release, Rachel Kraft, NASA, NASA Tests Limits of 3-D Printing with Powerful Rocket Engine Check (Aug. 27, 2013), *available at* http://www.nasa.gov/press/2013/august/nasa-tests-limits-of-3-d-

Expansion of the patent system to include forms of digital infringement, however, may generate undesirable costs. For example, one of the laudable aspects of the system is encouraging subsequent innovators to "design around" a patented invention — making changes to their product to avoid infringing a patent. Efforts to design around a patent may in fact further the progress in the relevant technological field.[21] One way that someone may be able to design around effectively is to create various computer models and designs and test them through virtual modeling. Overly robust protection of DMT could chill this aspect of the patent system.

As patent law confronts digital patent infringement, lawmakers can look to its sister system — the copyright system — for comparison. Copyright has been addressing issues of digitization for quite some time, with illegal downloading and sharing of music challenging traditional business models for creating music and other forms of entertainment.

There are important differences, however, between patent law and copyright law. Copyright law requires actual copying of a work, whereas patent law merely requires that the item be made, used, sold, offered to sell, or imported.[22] Copying is not required. Further, copyright law protects a work even if copied in different media.[23] The courts made clear early that a copy of software in computer memory constitutes a "copy" for infringement purposes because it is in a fixed, tangible medium.[24] Patent law, as one of the most powerful forms of strict liability, does not have a clear rule that the digital version of a

printing-with-powerful-rocket-engine-check/#.U9EvJlbF9g0.

[21] *See, e.g.*, State Indus., Inc. v. A.O. Smith Corp., 751 F.2d 1226, 1236 (Fed. Cir. 1985) ("One of the benefits of a patent system is its so-called 'negative incentive' to 'design around' a competitor's products, even when they are patented, thus bringing a steady flow of innovations to the marketplace.").

[22] *See, e.g.*, Oskar Liivak & Eduardo M. Peñalver, *The Right Not to Use in Property and Patent Law*, 98 CORNELL L. REV. 1437, 1444 (2013) ("Unlike copyright, patent does not protect independent inventors from infringement liability.").

[23] *See* 17 U.S.C. § 101 (2012) (defining copies in part as "material objects . . . in which a work is fixed by any method now known or later developed").

[24] *See* MAI v. Peak, 991 F.2d 511, 519 (9th Cir. 1993) (finding that a copy in a computer's RAM memory "creates a copy under the Copyright Act"); *see also* NAT'L COMM'N ON NEW TECHNOLOGICAL USES OF COPYRIGHTED WORKS, FINAL REPORT OF THE NATIONAL COMMISSION ON THE NEW TECHNOLOGICAL USES OF COPYRIGHTED WORKS 13 (1978) ("[T]he placement of a work into a computer is the preparation of a copy . . . ."). The copyright statue expressly allows an owner of a software copy (e.g., a CD) to make an additional copy in the computer's RAM, which is necessary to use the software. *See* 17 U.S.C. § 117(a) (2012).

physical object is in fact an embodiment of the patented invention.[25] The question is whether we should treat digital files in the patent context in a manner akin to those in copyright.

This Article proceeds as follows. Part I briefly introduces 3D printing and biochemical molecular manufacturing as examples of DMT. Part II turns to patent law's indirect infringement regime, namely induced and contributory infringement. Because scholarly commentary thus far has focused on the exposure of creators and distributors of CAD files under patent law's indirect infringement regime, Part II reviews the existing commentary and highlights the flaws in current conceptualizations of indirect infringement. We offer a novel analysis of indirect infringement's specific intent requirement that takes account of a unique phenomenon with DMT: laypeople as massive indirect infringers. After more than 100 years of indirect infringement by increasingly sophisticated companies, infringement will come full circle to its nineteenth-century paradigm of laypeople as indirect infringers. Having unsophisticated actors contributing to patent infringement raises novel questions regarding when liability should attach and whether the inquiry should be objective or subjective. In addition, Part II recognizes two potentially gaping holes in the contributory infringement paradigm that stem from the paradigm's requirement that an accused infringer sell or offer to sell (or import) a component of the patented invention.[26] First, many accused infringers will not sell or offer CAD files for sale; they will give them away, thus potentially escaping liability.[27] Second, CAD files may not constitute "components" of the patented invention, offering an additional means to avoid liability.

The difficulty of capturing CAD file distributors under indirect infringement theories risks rendering patentees helpless to redress the real economic harms they incur. As such, Part III confronts the potential for there to be direct patent infringement based on the digital files themselves alone, even absent the actual creation of the object through a 3D printer. Our analysis contravenes the present assumption that that making, selling, and offering to sell CAD files does not constitute direct infringement of a patent claim directed to the underlying physical object.[28] We first explore whether efforts to commercialize CAD files could and should constitute direct

[25] *See* Osborn, *Regulating 3D Printing*, *supra* note 5, at 586-87.

[26] *See* 35 U.S.C. § 271(c) (2012).

[27] We find support in this assertion by analogy to the myriad infringing music and movie files that have been "shared" around the internet without charging a fee.

[28] *See supra* note 18.

infringement for selling or offering to sell the claimed invention. Because such commercial activity is an appropriation of the economic value of the patented invention, we believe the law would and should recognize such an infringement theory.

What about acts other than selling and offering to sell the invention? In the future, physical instantiations of complex mechanical and chemical objects will be a mere press of a button away. Does it make sense to conclude that someone has not "made" the invention if they have created a digital file? We take this next, logical step in Part III and provide a novel exploration of this potential. On this point, we offer a new analysis that previous literature has not considered. As mentioned, commentators have all taken as a given that making the invention requires a physical instantiation of the invention. We deconstruct and evaluate that assumption and explore why one could view CAD files as direct infringement for "making" the claimed invention. Such a rule would be an extension of current law, with commensurate potential costs that give us pause.[29] Part III then concludes with an analysis of direct digital infringement under the doctrine of equivalents and shows how a novel, but in one sense minor, extension of existing doctrine could allow patentees to capture CAD files as equivalents of physical devices.

In Part IV, we step back to consider the consequences of allowing direct digital patent infringement theories. Even if as a technological matter there is little difference between digital files and tangible objects, there very well may be important policy considerations that counsel against such an expansion of patent law. The convergence of the digital and physical worlds also alters some of the basic presumptions of the patent law regime. As a result, an analysis of digital patent infringement under current law is an incomplete inquiry; one must also ask whether digital patent infringement is desirable in light of the overarching goal to promote the progress of the useful arts. Part IV begins the critical conversation that must take place if patent law is to absorb DMT optimally. DMT must be analyzed in terms of its effects on innovation incentives, follow-on innovation,[30] and laypeople and intermediaries. Finally, Part IV highlights the need to appropriately cabin any doctrinal extensions that arise from DMT to prevent spillover into other technology areas.

[29] *See infra* Part IV.

[30] Follow-on innovation includes innovations that build on earlier innovations.

I. DIGITAL MANUFACTURING TECHNOLOGY

DMT continues to evolve and change, but the public has become aware of, if not infatuated with, the quintessential DMT: 3D printing. 3D printing, also called "additive manufacturing," reverses the normal, "subtractive" way most objects have traditionally been built. In subtractive processes, one starts with a solid block and then removes the undesirable material to yield the desired shape.[31] Take sculptures as an example: a sculptor starts with a block of marble and begins to chip and cut away the stone, ultimately yielding David. Another traditional manufacturing method is the use of hollow molds, such as where a malleable substance is injected into a mold until the substance solidifies.[32] The mold is then removed to yield the desired end product.[33] In contrast to these traditional approaches, 3D printing builds objects up layer-by-layer, using a print head that emits a solid or molten material to print each layer.[34] After a first layer is printed, the print head moves up (or the base moves down) and a second layer is placed on top of the first layer. The process continues until the object is complete.

To three-dimensionally print, the printer must have instructions.[35] These come from a computer file, which for convenience we refer generically to as a CAD file.[36] Someone can create a CAD file from scratch using a computer program or, alternatively, by scanning an existing physical object with a scanner that generates a corresponding CAD file.[37] Under either scenario, the CAD file is a digital representation of the physical object that can be readily printed.

3D printing is rapidly becoming a mainstream technology and has received attention both in the popular press[38] and among legal

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[31] *See* Osborn, *Regulating 3D Printing*, *supra* note 5, at 558-59.

[32] *See generally, e.g.*, Barr Rubber Prods. Co. v. Sun Rubber Co., 277 F. Supp. 484, 486-87 (S.D.N.Y. 1967) (discussing patented hollow molding process), *aff'd in part, rev'd in part*, 425 F.2d 1114 (2d. Cir. 1970).

[33] *Id.*

[34] *See* Osborn, *Regulating 3D Printing*, *supra* note 5, at 559. 3D printers can use a variety of materials, including plastics, metals, ceramics, and more. *Id.*; Peter Jensen-Haxel, Comment, *3D Printers, Obsolete Firearm Supply Controls, and the Right to Build Self-Defense Weapons Under* Heller, 42 GOLDEN GATE U. L. REV. 447, 451 (2012).

[35] *See* Osborn, *Regulating 3D Printing*, *supra* note 5, at 559.

[36] Various file formats exist, and currently the most dominant file for 3D printing purposes is the STL file. *Id.* at 559-60.

[37] *Id.*

[38] *See, e.g.*, *The Search for Creative Destruction*, GOLDMAN SACHS (Mar. 24, 2014), http://www.goldmansachs.com/investor-relations/financials/current/annual-reports/2013-annual-report-files/search.pdf (describing 3D printing as a disruptive

academics.[39] 3D printers can already make numerous products, including shoes,[40] human body parts,[41] and a working gun.[42] 3D printing even took center stage, figuratively and literally, on the TV show *Project Runway*, when one contestant printed various accessories to his fashion designs.[43] The technology has and will continue to develop rapidly,[44] allowing the user to print objects made of multiple materials in one pass, such as working circuits.[45]

3D printing, however, is not the only form of DMT. Another DMT of interest is chemical and biological molecular manufacturing. In these processes, a user builds molecules from constituent atoms or molecules.[46] The concept is similar to 3D printing (and can be

technology); *The Third Industrial Revolution*, ECONOMIST (Apr. 21, 2012), http://www.economist.com/node/21553017 (exploring the future of 3D printing).

[39] *See, e.g.*, Deven R. Desai & Gerard N. Magliocca, *Patents, Meet Napster: 3D Printing and the Digitization of Things*, 102 GEO. L.J. 1691 (2014) (discussing the potential impacts of 3D printing on the future of patent, copyright, and trademark law); Nora Freeman Engstrom, *3-D Printing and Product Liability: Identifying the Obstacles*, 162 U. PA. L. REV. ONLINE 35 (2013) (discussing the possible impact of 3D printing on the future of products liability law); Lucas S. Osborn, *Of PhDs, Pirates, and the Public: Three-Dimensional Printing Technology and the Arts*, 1 TEX. A&M L. REV. 811 (2014) [hereinafter *Art and 3D Printing*] (discussing 3D printing and its implications on laws prohibiting piracy); Osborn, *Regulating 3D Printing*, *supra* note 5 (discussing the impact of 3D printing on products liability, contract, criminal, intellectual property, and environmental law).

[40] *See* Michael Fitzgerald, *With 3-D Printing, the Shoe Really Fits*, MIT SLOAN MGMT. REV. (May 15, 2013), http://sloanreview.mit.edu/article/with-3-d-printing-the-shoe-really-fits.

[41] *See* Dan Solmon, *Listening to the Future with a 3D-Printed Ear*, TECHCRUNCH (May 27, 2013), http://techcrunch.com/2013/05/27/listening-to-the-future-with-a-3d-printed-ear.

[42] *See* Alexis Kleinman, *The First 3D-Printed Gun Has Been Fired*, HUFFINGTON POST (May 6, 2013, 10:48 AM), http://www.huffingtonpost.com/2013/05/06/3d-printed-gun-fired_n_3222669.html.

[43] *See* Michael Molitch-Hou & Danielle Matich, *3DPI Interview with Project Runway Finalist Justin LeBlanc*, 3D PRINTING INDUS. (Nov. 26, 2013), http://3dprintingindustry.com/2013/11/26/3dpi-interview-project-runway-finalist-justin-leblanc. As an interesting (to us) aside, LeBlanc teaches at NC State University, the undergraduate alma mater of one of us and just down the road from the law school of the other.

[44] *See* HOD LIPSON & MELBA KURMAN, FABRICATED: THE NEW WORLD OF 3D PRINTING 84 (2013).

[45] *See* Amit Joe Lopes et al., *Integrating Stereolithography and Direct Print Technologies for 3D Structural Electronics Fabrication*, 18 RAPID PROTOTYPING J. 129, 129-33 (2012).

[46] *See* J.P. Renault et al., *Fabricating Arrays of Single Protein Molecules on Glass Using Microcontact Printing*, 107 J. PHYSICAL CHEM. B 703, 703-04 (2003) (describing a microcontact printing method for printing proteins and protein arrays); Press Release,

considered a subset of 3D printing) though the scale and print materials differ. Although the technology is in its infancy, the goal is to manufacture molecules, cells, and systems from digital files akin to the CAD files used with 3D printing.[47]

Much of the attention paid to DMT technologies has focused on the printers themselves.[48] As their costs fall,[49] printers increasingly will be available to everyday users in the same way laser printers went from being high-end products to common items found on nearly everyone's desktop.[50] What is underappreciated, however, is the CAD files' crucial role in DMT. A CAD file is not merely an impotent blueprint of the physical device. Rather, it is a powerful tool that, in a world of ubiquitous 3D printers, renders the possessor of the file just as satisfied as if he possessed the physical object itself. The physical object is merely a button press (and a bit of time and print material) away. Such simplicity differs significantly from a blueprint, which requires skill to build the described structure.

By way of analogy, consider a calculator. In years past, a calculator connoted a physical object one kept on a desk or in a backpack. Today, calculators are simple apps residing on a person's smart phone. Ask someone with a smart phone if she has a calculator, and she says, "yes," even though she only has a file that when loaded into the

Nat'l Sci. Found., Drag-and-Drop DNA (Dec. 4, 2012), *available at* http://www.nsf.gov/news/news_summ.jsp?cntn_id=125990 (describing technology that allows one to "'print,' molecule by molecule, exactly the [desired] compound" and "to rapidly, and precisely, specify the placement of every atom in a compound").

47 *See generally* Priscilla E.M. Purnick & Ron Weiss, *The Second Wave of Synthetic Biology: From Modules to Systems*, 10 NATURE REVS. MOLECULAR CELL BIOLOGY 410, 412-15 (2009) (describing efforts to combine basic biomodules into systems-level circuitry); *Bioprinting: Printing a Bit of Me*, ECONOMIST (Mar. 8, 2014), http://www.economist.com/news/technology-quarterly/21598322-bioprinting-building-living-tissue-3d-printer-becoming-new-business (describing computer-controlled 3D printers that print live cells); Roff Smith, *Just Press Print*, NAT'L GEOG., Dec. 2014, at 112, 126 (noting use of 3D printing to print blood vessels); Kyle Maxey, *3D Printing Martian DNA?*, ENGINEERING.COM (Oct. 09, 2013), http://www.engineering.com/3DPrinting/3DPrintingArticles/ArticleID/6443/3D-Printing-Martian-DNA.aspx (discussing potential to 3D print synthetic DNA).

48 *See, e.g.*, Depoorter, *supra* note 14 (discussing impact of 3D printers on all intellectual property); Desai & Magliocca, *supra* note 39 (focusing on impact of 3D printers).

49 *See* Agam Shah, *3D Printer Price Drops Could Lure Home Users*, PCWORLD (April 4, 2014, 4:10 PM), http://www.pcworld.com/article/2140360/3d-printer-price-drops-could-lure-home-users.html.

50 *See* George Cox, *Laser Printer Costs Drop*, THE SPECTRUM (Sept. 22, 2014, 5:55 PM), http://www.thespectrum.com/story/life/features/mesquite/2014/09/22/laser-printer-costs-drop/16077397/.

phone's RAM gives her the functions of a calculator. It is largely the same for one who possesses a CAD file of a physical object: assuming you have the print material, a press of the "print" button produces the physical object.

Like MP3 files before them, the impact of CAD files multiplies exponentially because of their reproducibility and transferability.[51] Like any other file, they can be copied, emailed, posted online, and downloaded from the Internet. The upshot is that one can essentially multiply and share physical objects across the globe. This is great news for the remote village that can print a replacement part for a broken water pump.[52] But it is worrisome for the patent holder that fears widespread, decentralized creation of her patented invention. Just like the digitization of music allowed massive and largely anonymous copyright infringement, the digitization of things will be of considerable concern to patent holders.

II. THE OBVIOUS POLICY LEVER: INDIRECT INFRINGEMENT

The most basic form of infringement under the Patent Act is found in 35 U.S.C. § 271(a), which defines infringement as arising when someone without authorization makes, uses, sells, offers to sell, or imports the patented invention.[53] Anyone who uses a 3D printer or equivalent to print a patented device would be directly infringing because she has made the device without authorization. In theory, the patent owner could sue such people for patent infringement.

But such a strategy may be rather impractical. First, given how diffuse the printers may be, it may be difficult for the patent owner to identify who these infringers are. Second, even if the patent owner identifies the infringers — who are probably geographically dispersed — the owner may have to sue each infringer separately, either because

[51] *Cf.* Metro-Goldwin-Mayer Studios Inc. v. Grokster, Ltd., 545 U.S. 913, 913 (2005) (noting that "billions of files" were shared on peer-to-peer networks each month); Deven R. Desai, *The New Steam: On Digitization, Decentralization, and Disruption*, 65 HASTINGS L.J. 1469, 1471-73, 1475 (2014) (illustrating implications of new technology, such as 3D printing, using peer-to-peer MP3 file sharing and noting how disruptive MP3 files were to the music industry).

[52] *See* J.M. Pearce et al., *3-D Printing of Open Source Appropriate Technologies for Self-Directed Sustainable Development*, 3 J. SUSTAINABLE DEV. 17, 18 (2010) (describing the possibilities for 3D printers to assist people in developing countries).

[53] 35 U.S.C. § 271(a) (2012). There are other forms of direct infringement as well. *See generally* Timothy R. Holbrook, *The Potential Extraterritorial Consequences of* Akamai, 26 EMORY INT'L L. REV. 499, 502 n.20 (2012) [hereinafter *Consequences of* Akamai] (discussing § 271(e)–(g)).

of joinder rules[54] or personal jurisdiction requirements.[55] Finally, the patent owner would ultimately be suing a potential customer, someone who may want to buy the patented item. The music industry faced this scenario when illegal digital music downloads began.[56] Ultimately, the industry did sue illegal downloaders, or at least those engaged in massive downloads, to set an example.[57] Such a strategy, however, may not be effective, and it risks alienating future customers and creating a public relations nightmare.[58]

To combat some of these problems, patent law affords protection to patent owners against indirect infringement, which arises when a third party is held liable for the acts of others who are directly infringing the patent.[59] Holding such indirect infringers liable helps to protect patent owners when the direct infringers may be large in number, diffuse, and perhaps unable to pay.[60] The Patent Act provides two forms of indirect infringement: active inducement of infringement under § 271(b) and contributory infringement under § 271(c).[61] Active inducement is vaguely defined in the statute, though it is clear Congress intended to codify the common law that had developed prior to the adoption of the 1952 Patent Act.[62] With respect to DMT, one could consider the printer to be the genesis of the potential indirect liability, since it ultimately produces the patented invention.[63] Thus,

[54] *See* 35 U.S.C. § 299 (2012). For an excellent discussion of the new joinder provisions, see generally David O. Taylor, *Patent Misjoinder*, 88 N.Y.U. L. REV. 652 (2013).

[55] For a leading case interpreting personal jurisdiction, see Int'l Shoe Co. v. Washington, 326 U.S. 310 (1945).

[56] *See* Hughes, *supra* note 14, at 725-29.

[57] Copyright owners had the subpoena power under the Digital Millennium Copyright Act ("DMCA") that allowed them easily to identify downloaders via their ISP address. *See* 17 U.S.C. § 512(h) (2012). This power is specific to copyright owners and would not be available to patent owners, further complicating the ability of a patent owner to sue persons printing their invention directly. In addition, courts have read § 512(h) such that it does not apply to files located on peer-to-peer networks. *See* Recording Indus. Ass'n of Am., Inc. v. Verizon Internet Servs., 351 F.3d 1229, 1233 (D.C. Cir. 2003).

[58] *See* RIAA v. The People: *Five Years Later*, ELEC. FRONTIER FOUND. (Sept. 30, 2008), https://www.eff.org/wp/riaa-v-people-five-years-later.

[59] *Id.* at 401.

[60] *See* Timothy R. Holbrook, *The Intent Element of Induced Infringement*, 22 SANTA CLARA HIGH TECH. L.J. 399, 400-01 (2006) [hereinafter *Induced Infringement*].

[61] *See* 35 U.S.C. § 271(b), (c) (2012).

[62] *See* Charles W. Adams, *A Brief History of Indirect Liability for Patent Infringement*, 22 SANTA CLARA COMPUTER & HIGH TECH. L.J. 369, 370 (2006).

[63] *See* Depoorter, *supra* note 14, at 1496 (discussing indirect liability based on 3D printers).

patent owners may want to go after the manufacturers of the printers as indirect infringers. This avenue, however, would not bear fruit for patent owners. Both forms of indirect infringement require knowledge of the relevant patent. Because 3D printers are generic — they print whatever the CAD file tells them to print — it is highly unlikely the manufacturers of the printers would ever be liable for indirect infringement.

The CAD files, however, are quite different. These files are specific to a particular item and thus potentially to a specific patented invention. Indirect infringement theories are the most obvious avenue for patentees under current law because they do not turn on the difficult question of whether the CAD file itself infringes the patent covering the physical invention. Instead, liability arises for a party when she facilitates the infringement of someone else, such as when a third party makes an infringing item from the CAD file.[64] Webpages already exist where people can buy CAD files or download them for free.[65] Just as in the digital music context, people can use peer-to-peer networks to share files[66] that they have either purchased or created on their own.[67]

It is thus unsurprising that the majority of commentators to analyze whether digital files can infringe patent claims have focused almost exclusively on indirect infringement theories. Indeed, these commentators simply assume without discussion that direct infringement lawsuits based on the CAD files alone are not viable.[68] In this section, we too address the possibility for indirect infringement based on CAD files. Our analysis reveals complexities not yet discussed in the literature. As we explain, patent holders likely will be dissatisfied with indirect infringement claims against digital files. Nevertheless, as we address in Part III, we do not join those previous

[64] *See* Holbrook, *Induced Infringement*, *supra* note 60, at 400 ("Liability for active inducement of infringement and contributory infringement are variations of third-party liability, where one party is held liable for the directly infringing acts of others.").

[65] *See, e.g.*, 3D BURRITO, http://3dburrito.com (last visited Aug. 1, 2014); THINGIVERSE, http://www.thingiverse.com (last visited Aug. 1, 2014).

[66] Ernesto, *Pirate Bay Takes over Distribution of Censored 3D Printable Gun*, TORRENTFREAK (May 10, 2013), https://torrentfreak.com/pirate-bay-takes-over-distribution-of-censored-3d-printable-gun-130510.

[67] This is another significant difference from the copyright context. Where most of the music and movie files had to be copied from the original copyrighted work, people can sometimes generate CAD files by scanning an object, and they may not be aware that the object is patented or part of a patented item.

[68] *See supra* note 18.

commentators who have rejected the possibility of direct infringement claims based on the CAD files themselves.

Claims for indirect infringement could arise in at least two common scenarios. First, an individual could create[69] or otherwise obtain a digital file and transfer that file directly or indirectly to someone who prints the infringing physical object. Second, a website, peer-to-peer network, or other network could host a digital file, allowing others to access the file and print the infringing object. We explore these scenarios as we discuss patent law's two forms of indirect infringement: active inducement of infringement and contributory infringement.

A. Active Inducement of Infringement Under § 271(b)

A person is liable as an indirect infringer when she "actively induces infringement."[70] To prove active inducement, a patent holder must demonstrate the following elements: (1) direct infringement; (2) specific intent to induce a third party to infringe; and (3) an affirmative act by the inducer.[71]

As will be shown, digital infringement creates unique problems for a patent holder's ability to enforce its patent through active inducement.

First, the patentee must prove that the alleged inducement actually led to an act of direct infringement.[72] In the context of 3D printing, for example, the patentee would have to show by direct or circumstantial evidence that the accused inducer provided access to a CAD file that

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[69] Either by scanning an object or designing it from scratch on a computer.

[70] *See* 35 U.S.C. §271(b) (2012).

[71] *See* KIMBERLY A. MOORE, TIMOTHY R. HOLBROOK & JOHN F. MURPHY, PATENT LITIGATION AND STRATEGY 452 (West 4th ed. 2013).

[72] *See* Limelight Networks, Inc. v. Akamai Techs., Inc., 134 S. Ct. 2111, 2115 (2014) ("This case presents the question whether a defendant may be liable for inducing infringement of a patent under 35 U.S.C. § 271(b) when no one has directly infringed the patent under § 271(a) or any other statutory provision. The statutory text and structure and our prior case law require that we answer this question in the negative."); Aro Mfg. Co. v. Convertible Top Replacement Co., 365 U.S. 336, 341-42 (1961) ("[T]here can be no contributory infringement in the absence of a direct infringement."); i4i Ltd. P'ship. v. Microsoft Corp., 598 F.3d 831, 850 (Fed. Cir. 2010) ("To succeed on a theory of contributory or induced infringement, [the patent owner] was required to show direct infringement of the . . . patent."), *aff'd*, 131 S. Ct. 2238 (2011); Epcon Gas Sys., Inc. v. Bauer Compressors, Inc., 279 F.3d 1022, 1033 (Fed. Cir. 2002) ("Upon a failure of proof of direct infringement, any claim of inducement of infringement also fails. A finding of contributory infringement likewise requires underlying proof of direct infringement." (citation omitted)); Joy Techs., Inc. v. Flakt, Inc., 6 F.3d 770, 774 (Fed. Cir. 1993).

another person downloaded and printed.[73] Proving this kind of direct infringement can be difficult because of the relative anonymity of the internet. Discovering who has downloaded a file often requires a difficult and lengthy discovery process, as shown by digital music litigation.[74] Moreover, in copyright law, the mere act of downloading the song is an act of infringement. Under current understanding of patent law,[75] the act of direct infringement would be the printing of the patented item, constituting an infringing "making" of the patented invention.[76] As such, the patentee must prove that the downloader actually printed the object. Although obtaining such proof is not impossible, it certainly can be difficult and costly.[77] The patentee's burden may be lightened somewhat because it can prove the underlying direct infringement with circumstantial evidence.[78] What

[73] *But see* Finnsugar Bioproducts, Inc. v. Raytheon Eng'rs & Constructors, Inc., No. 97 C 8746, 1998 U.S. Dist. LEXIS 15965, at *10-11 (N.D. Ill. 1998) (holding that claims for contributory infringement based on an offer to sell need not show that the actual sale has occurred and that the patentee meets the "direct infringement pleading requirement by pleading that a sale will occur sometime in the future"). Without directly citing *Finnsugar*, the Federal Circuit has abrogated it. *See In re* Bill of Lading Transmission & Processing Sys. Patent Litig., 681 F.3d 1323, 1332-33 (Fed. Cir. 2012) ("[Plaintiff] is incorrect that a party could be liable for contributory infringement even if no one has yet directly infringed the patent in question.").

[74] *See* Sean B. Karunaratne, Note, *The Case Against Combating BitTorrent Piracy Through Mass John Doe Copyright Infringement Lawsuits*, 111 MICH. L. REV. 283, 286-88 (2012) (describing the process of obtaining IP addresses, filing "John Doe" lawsuits on the basis of the addresses, and then seeking subpoenas to discover the person behind the IP address).

[75] An understanding that we challenge below.

[76] *See* 35 U.S.C. § 271(a) (2012).

[77] One way to determine the identity would be for the patentee to determine an IP address that was used to download a file. *See* Karunaratne, *supra* note 74, at 286-88. Using that IP address, the patentee would file a John Doe lawsuit to determine the true identity of the downloader. *See id.* at 287. Then the patentee would need to somehow prove that the person who downloaded the file actually printed it, either through an admission or some other avenue, thereby making the invention pursuant to 35 U.S.C. § 271(a).

[78] Linear Tech. Corp. v. Impala Linear Corp., 379 F.3d 1311, 1326-27 (Fed. Cir. 2004) (vacating summary judgment in part based on circumstantial evidence of direct infringement); Moleculon Research Corp. v. CBS, Inc., 793 F.2d 1261, 1272 (Fed. Cir. 1986) (finding no clear error in the district court's finding that the patentee "had met its burden of showing infringement under section 271(b) with circumstantial evidence of extensive puzzle sales, dissemination of an instruction sheet teaching the method of restoring the preselected pattern with each puzzle, and the availability of a solution booklet on how to solve the puzzle").

constitutes sufficient circumstantial evidence, however, is uncertain,[79] especially in the uncharted arena of CAD files.

Second, the accused inducer must also have the requisite mental state — the intent to induce acts of infringement.[80] This intent element requires actual knowledge of the patent or willful blindness of the patent's existence.[81] Assuming the patentee can prove the underlying act of direct infringement, she also must prove the accused inducer actively encouraged the direct infringer with "knowledge that

[79] The courts have struggled with how to prove infringement through circumstantial evidence, particularly with respect to software-implemented inventions. For example, in *Lucent Technologies, Inc. v. Gateway, Inc.*, the Federal Circuit affirmed the holding of no direct infringement where the accused software method was only used by the media player when the primary, non-infringing method failed. 543 F.3d 710, 723 (Fed. Cir. 2008). The patentee "did not show specific instances of direct infringement" where the infringing software method had actually run, but instead relied on expert testimony that the failure of the non-infringing method was "very common." *Id.* Similarly, in *ACCO Brands, Inc. v. ABA Locks Manufacturing Co.*, the court confronted the situation where the accused device could be operated in either of two modes, one infringing and one not. 501 F.3d 1307, 1313 (Fed. Cir. 2007). The court found no infringement, reasoning "to prove direct infringement, a patentee must either point to specific instances of direct infringement or show that the accused device necessarily infringes the patent in suit." *Id.*

In contrast, the Federal Circuit affirmed a judgment of direct infringement in *Lucent Technologies, Inc. v. Gateway, Inc. See* 580 F.3d 1301 (Fed. Cir. 2009), *cert. denied sub nom.* Microsoft Corp. v. Lucent Techs., Inc., 130 S. Ct. 3324 (2010). In *Lucent*, the accused software method required a user of a computer program, such as Microsoft Office, to utilize the patented date-picker function instead of the non-patented typing method. *Id.* Despite no specific evidence of an individual act of infringement, the court affirmed the holding of infringement because "circumstantial evidence was just adequate to permit a jury to find that at least one other person within the United States during the relevant time period, other than the expert, had performed the claimed method," noting that the accused indirect infringer included instructions to customers regarding how to use both the infringing and non-infringing methods. *Id.*

Because CAD files may have uses other than merely printing, these cases suggest courts may require evidence of specific acts of direct infringement. Undeniably, issues of what evidence, particularly circumstantial evidence, is sufficient to prove direct infringement will arise in litigation.

[80] *See* Global-Tech Appliances, Inc. v. SEB S.A., 131 S. Ct. 2060, 2068 (2011) ("Accordingly, we now hold that induced infringement under § 271(b) requires knowledge that the induced acts constitute patent infringement."); *see also* DSU Med. Corp. v. JMS Co., 471 F.3d 1293, 1304-06 (Fed. Cir. 2006) (en banc in relevant part) ("[I]nducement requires evidence of culpable conduct, directed to encouraging another's infringement, not merely that the inducer had knowledge of the direct infringer's activities.").

[81] *Global-Tech*, 131 S. Ct. at 2068-69. To show willful blindness, a patentee must demonstrate "(1) the defendant must subjectively believe that there is a high probability that a fact exists and (2) the defendant must take deliberate actions to avoid learning of that fact." *Id.* at 2070.

the induced acts constitute[d] patent infringement."[82] This necessarily means that the accused inducer has knowledge of the patent.

This scienter requirement significantly limits the ability of patent owners to sue actors for active inducement. For instance, CAD file creators may be unsophisticated actors, unfamiliar with patents and patent law.[83] Patent law, thus far, has not had to wrestle much with laypeople as accused inducers. Before DMT, the quintessential inducer was a relatively wealthy company that had access to sophisticated legal counsel.[84] Now, accused inducers will include passive websites hosting CAD files and numerous individuals who transfer files to others.[85] In essence, indirect infringement will enter an era of unsophisticated (in a patent law sense) inducers, which raises significant new legal and policy issues.

The copyright system, of course, has encountered some of this dynamic with infringing digital downloads. The Supreme Court even imported active inducement from patent law into the copyright system in *Metro-Goldwin-Mayer Studios Inc. v. Grokster, Ltd.*[86] But, in *Grokster*, the requisite intent was apparent. As the Supreme Court noted, each of the defendant's entire existence was about facilitating the peer-to-peer transfer of copyrighted works.[87] Indeed, the Court concluded, "[t]he unlawful objective is unmistakable."[88] The result is not surprising given that everyone effectively knows music is subject to copyright.

The situation differs significantly in the patent context because people often have little to no appreciation that objects are patented. The strict knowledge requirement will make it difficult for patentees

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[82] *See id.* at 2068.

[83] The actual manufacturers of 3D printers and scanners likely are sophisticated actors, but they also likely would not satisfy the knowledge requirement given that, in theory, every patent that involves a material object could arguably be created by a 3D printer. It is unlikely they would be viewed as even being willfully ignorant in that context. Willful ignorance, which is a form of knowledge, is more particularized than general knowledge that a patent out there, somewhere, may cover the produced item. *See id.* at 2070.

[84] Jason A. Rantanen, *An Objective View of Fault in Patent Infringement*, 60 AM. U. L. REV. 1575, 1580 (2011) ("Accused inducers of infringement are not individuals and small companies but giant, multi-national corporations.").

[85] For an example of a website that hosts user-generated content for others to share, see THINGIVERSE, *supra* note 65.

[86] *See* MGM Studios Inc. v. Grokster, Ltd., 545 U.S. 913, 936-37 (2005); *see also* Holbrook, *Induced Infringement*, *supra* note 60, at 402-04 (discussing *Grokster* and its relationship to patent law).

[87] *Grokster*, 545 U.S. at 937-40.

[88] *Id.* at 940.

to hold inducers liable.[89] If the accused inducer independently created the infringing object and did not know of the patent, there will obviously be no knowledge on the part of the accused inducer. Even if the accused inducer copies an object that is marked with a patent number product, the mere marking of a product — unnoticed by the inducer — is not sufficient to impute knowledge.[90] At a minimum, patent owners will need to police activities more rigorously and likely send various notice letters to trigger the requisite knowledge on the part of many lay infringers.[91]

Even after an accused inducer has actual notice of a patent, her "good faith" belief that the patent is invalid or that the printed item does not infringe the patent negates the requisite intent, immunizing them from liability[92] (at least for past infringement).[93] Thus, sending

[89] Some accused inducers might plausibly argue that although they transferred the CAD file, they did not intend for it to be printed, thus negating the intent to infringe.

[90] This is true even when the accused is a business rather than an individual. *See* Mendenhall v. Astec Indus., Inc., 14 U.S.P.Q.2d 1134, 1137 (E.D. Tenn. 1988) ("While [the patentee] argued vigorously . . . that the word 'knowingly' as used in [Section 271(c)] included constructive knowledge of the patent, it was unable to produce any case law to support that position."), *aff'd per curium*, 891 F.2d 299 (Fed. Cir. 1989); Celotex Corp. v. V.E. Power Door Corp., 204 U.S.P.Q. 636, 639 (E.D.N.Y. 1979) (rejecting an argument that constructive knowledge of a patent is sufficient and stating that, under *Aro Manufacturing Co. v. Convertible Top Replacement Co.*, 377 U.S. 476 (1964), and stating "there can be no question that . . . actual knowledge is required under § 271(c)"). *Contra* Brean, *Asserting Patents*, *supra* note 18, at 796 (assuming that "any deliberate copying, rendering, or 3D scanning of a product marked with a United States patent number should suffice" to show scienter).

[91] *See* Aro Mfg. Co. v. Convertible Top Replacement Co., 377 U.S. 476, 488-90 (1964) (stating that receipt of letter from patentee alleging infringement was sufficient to impute knowledge of the patent and infringement).

[92] Commil USA, LLC v. Cisco Sys., Inc., 720 F.3d 1361, 1368 (Fed. Cir. 2013) ("We now hold that evidence of an accused inducer's good-faith belief of [patent] invalidity may negate the requisite intent for induced infringement."). The Supreme Court has granted certiorari in this case on the question of whether a defendant's belief that a patent is invalid is a defense to induced infringement under 35 U.S.C. § 271(b). *See* Commil USA, LLC v. Cisco Sys., Inc., 135 S. Ct. 752, 752 (2014); *see also* Ecolab, Inc. v. FMC Corp., 569 F.3d 1335, 1351 (Fed. Cir. 2009) (finding that a reasonable belief of non-infringement supported a jury verdict that the defendant lacked the intent required for induced infringement); DSU Med. Corp. v. JMS Co., 471 F.3d 1293, 1307 (Fed. Cir. 2006) (finding a demonstrated belief of non-infringement sufficient to support a jury verdict that the defendant did not induce infringement).

[93] Arguably, during litigation, if the patent is found not invalid and infringed, then that belief has been negated. The accused inducer should be enjoined from inducing ongoing infringing activity, or to pay an ongoing royalty rate. *See* Holbrook, *Induced Infringement*, *supra* note 60, at 406 ("The shield from liability would only be retrospective, however. The indirect infringer should not be immunized from prospective relief if her belief is later shown to be unfounded at trial."); *see also*

notice letters may result in the accused obtaining such an opinion of counsel, further complicating enforcement. A legitimate opinion of counsel opining that the patent is invalid or not infringed would certainly provide "good faith" sufficient to avoid inducement.[94] But opinions of counsel are expensive, and laypeople may not even know they need one or how to get one. Thus, the question remains, what is the scope of good faith in the absence of legal counsel?

Suppose that a layperson with actual notice of a patent studies it closely but erroneously concludes without advice of counsel that it is invalid or not infringed. Is "good faith" purely a subjective inquiry into the mind of the accused, or is there an objective element?[95] Does the answer differ depending on whether the infringer is a layperson or a business?[96] Before 3D printing and other DMT, the vast majority of

Rantanen, *supra* note 84, at 1603 n.162.

[94] *See* Bettcher Indus. v. Bunzl USA, Inc., 661 F.3d 629, 649 (Fed. Cir. 2011) (finding opinion of counsel regarding non-infringement "admissible, at least with respect to [defendant]'s state of mind and its bearing on indirect infringement").

[95] Professor Rantanen, in his excellent exploration of fault in the indirect infringement context, points to *Water Technologies Corp. v. Calco, Ltd.*, 850 F.2d 660 (Fed. Cir. 1988), as suggesting that the Federal Circuit applies an objective component to the intent to induce inquiry. Rantanen, *supra* note 84, at 1621. He states, "the Federal Circuit concluded that despite a letter evidencing the accused indirect infringer's subjective belief that his composition did not infringe the patent, the objective evidence . . . supported the [judge's] conclusion that such a belief was *objectively* unreasonable." *Id.* (emphasis added).

Professor Rantanen overstates his point slightly. The court did not clearly adopt an objective component for intent; it was reviewing a lower decision for clear error. It is an equally fair reading of the case that the court allowed the district court to use "all of the circumstances" — including objective evidence — to decide whether it believed the defendant as to asserted subjective belief. *See Water Techs.*, 850 F.2d at 668-69 (stating that the defendant's evidence was "not such clear evidence of intent that the district court could not make a contrary finding" and "[t]he requisite intent to induce infringement may be inferred from all of the circumstances").

[96] Support for such a distinction can be found in the original version of Article 1 of the U.C.C., which embraced a distinction between sophisticated actors ("merchants" under U.C.C. § 2-104(1) (2000)) and mere laypeople (non-merchants) regarding what constitutes good faith. Good faith for non-merchants meant only subjective good faith. *See* U.C.C. § 1-201(19) (2000) (defining good faith for non-merchants as "honesty in fact in the conduct or transaction concerned"). Good faith for merchants required subjective and objective good faith. *Id.* § 2-103(1)(b) (2001) (defining good faith for merchants as "honesty in fact and the observance of reasonable commercial standards of fair dealing in the trade"). The revised Article 1 of the U.C.C. abolished the subjective-only test for non-merchants. *See id.* § 1-201(b)(20) (2001). However, many states either have not adopted revised Article 1 or have adopted it without that particular change. Keith A. Rowley, *UCC Legislative Update*, UCC LAW (Mar. 2, 2010, 5:00 PM), http://ucclaw.blogspot.com/2010/03/ucc-legislative-update.html ("Of the 37 enacting states, 26 have adopted the uniform

inducing infringers were large companies,[97] but DMT potentially will expose numerous individuals to accusations of inducement. A purely subjective test would render enforcement exceedingly difficult because patent law is so esoteric and specialized that a layperson could innocently misunderstand — or plausibly assert that he misunderstood — the law any number of ways.[98] Even if the test has an objective element, if it is tied to what a reasonable *layperson* might understand, patent law's complexity could effectively insulate many laypeople from inducement.[99]

Although there is some uncertainty as to whether the test for actual knowledge of infringement will be objective or subjective (though we believe it is subjective), it is clear that where willful blindness is used to show knowledge, a subjective test is used. The Supreme Court has recently stated that willful blindness requires a threshold finding that the accused inducer first *subjectively* believes there is a high probability of infringement.[100] Proving such a mindset will be difficult.

Moreover, the Federal Circuit, in the comparable context of willful infringement, has suggested that a layperson's subjective views will not negate intent.[101] When someone knows of a patent and infringes

definition, while 11 have retained the pre-revised definition.").

97 *See* Rantanen, *supra* note 84, at 1580.

98 *See* Mark D. Janis & Timothy R. Holbrook, *Patent Law's Audience*, 97 MINN. L. REV. 72, 119 (2012) ("[T]he only parties that are liable for inducing such infringement are those that have actively engaged in the patent system and have awareness of the patent *and* a belief that the activity they are inducing is infringing. Such actors must be quite familiar with the patent system and law to form such an intent." (emphasis added)). Indirect infringement focuses on the actor's appreciation of the *legal* (as opposed to factual) consequences of a given act. *See* Rantanen, *supra* note 84, at 1617-20. And a layperson will be virtually helpless to make those determinations accurately. Determining the merit of a claim for patent infringement is generally much more difficult in the patent context than the copyright context. The accused inducer must wrestle with claim construction, the doctrine of equivalents, and obviousness, among other difficult areas of patent law. What chance does a layperson have of construing claims correctly if district courts cannot do so a large percentage of the time? *See, e.g.*, Kimberly A. Moore, Markman *Eight Years Later: Is Claim Construction More Predictable?*, 9 LEWIS & CLARK L. REV. 231, 233 (2005) (reporting the reversal rate for appealed claim terms from 1996 to 2003 was 34.5%).

99 *See* Rantanen, *supra* note 84, at 1615 ("But the only way to actually know that conduct infringes a patent is to interpret the claims and conduct in an infringement analysis. Even then, one cannot be 'practically certain' that conduct infringes a patent — the only way to know for sure is to have a court make a final determination.").

100 Global-Tech Appliances, Inc. v. SEB S.A., 131 S. Ct. 2060, 2070 (2011).

101 *See generally In re* Seagate Tech., LLC, 497 F.3d 1360, 1371 (Fed. Cir. 2007) (en banc) ("The state of mind of the accused infringer is not relevant to this objective inquiry.").

anyway, she may be viewed as a willful patent infringer.[102] When infringement is willful, a court can enhance damages up to treble the compensatory amount.[103] To prove willful infringement, the patent owner must demonstrate: (1) "that the infringer acted despite an objectively high likelihood that its actions constituted infringement of a valid patent"; and (2) "that this objectively-defined risk (determined by the record developed in the infringement proceeding) was either known or so obvious that it should have been known to the accused infringer."[104] The second prong of the willfulness test contains an objective requirement, namely, that the infringer "should have known" of the risk. Thus, for willful infringement, a mere subjective belief of non-infringement will not negate intent. If the infringer has a good faith belief that the patent claim is invalid or not infringed, then generally there is no willful infringement.[105] This belief negates the required scienter for willful infringement just as it does for induced

[102] *See generally id.* (creating an "objective recklessness" standard for willful infringement, in which a reckless person is one who knows of an unjustifiably high risk of harm and acts anyway).

[103] 35 U.S.C. § 284 (2012) ("[T]he court may increase the damages up to three times the amount found or assessed.").

[104] *Seagate*, 497 F.3d at 1371. The continued vitality of this test for willfulness is in doubt. The Supreme Court recently rejected the Federal Circuit's test for fee-shifting when a case is "exceptional" under 35 U.S.C. § 285. *See* Octane Fitness, LLC v. ICON Health & Fitness, Inc., 134 S. Ct. 1749, 1756-58 (2014); *see also* Highmark Inc. v. Allcare Health Mgmt. Sys., Inc., 134 S. Ct. 1744, 1748-49 (2014) (rejecting de novo review of exceptional case determination in light of new standard). Given the link between fee-shifting in § 285 and the enhancement of damages under § 284, two Federal Circuit judges have called for the court to reconsider *Seagate*. *See* Halo Elecs., Inc. v. Pulse Elecs., Inc., 769 F.3d 1371, 1383-86 (Fed. Cir. 2014) (O'Malley, J., concurring, joined by Hughes, J.). The Federal Circuit or the Supreme Court, therefore, may change the *Seagate* standard.

[105] *See, e.g.*, Finisar Corp. v. DirecTV Group, Inc., 523 F.3d 1323, 1339 (Fed. Cir. 2008) ("Thus a competent opinion of counsel concluding either that DirecTV did not infringe the '505 patent or that it was invalid would provide a sufficient basis for DirecTV to proceed without engaging in objectively reckless behavior."); Wechsler v. Macke Int'l Trade, Inc., 486 F.3d 1286, 1292 (Fed. Cir. 2007) ("A primary consideration for willful infringement, on the other hand, is whether the infringer had a good faith belief that the patent was invalid and/or not infringed."); Jurgens v. CBK, Ltd., 80 F.3d 1566, 1571 (Fed. Cir. 1996) ("[W]here one continues his infringing activity, and fails to investigate and determine, in good faith, that he possesses reasonable defenses to an accusation of patent infringement, the infringement is in bad faith. Such conduct occurs when an infringer merely copies a patented invention, or where he obtains incompetent, conclusory opinions of counsel only to use as a shield against a later charge of willful infringement, rather than in a good faith attempt to avoid infringing another's patent.").

infringement.[106] But this belief must be based on a competent opinion of counsel, suggesting that there is an objective aspect to this inquiry.[107] If the Federal Circuit follows the willfulness doctrine's objective requirement, it will require lay inducers to seek sophisticated opinions of counsel.[108]

Finally, the third element for inducement requires that the accused inducer *actively induced* infringement.[109] The Supreme Court has stated that "[t]he term 'induce' means '[t]o lead on; to influence; to prevail on; to move by persuasion or influence.' The addition of the adverb 'actively' suggests that the inducement must involve the taking of affirmative steps to bring about the desired result."[110]

It seems clear that the inducer needs to have transferred or hosted the CAD file with the specific intent that it be printed,[111] but it is not

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[106] *See* Holbrook, *Induced Infringement*, *supra* note 60, at 405-06 (comparing willfulness and inducement); Mark A. Lemley, *Inducing Patent Infringement*, 39 UC DAVIS L. REV. 225, 240 n.70 (2005) [hereinafter *Inducing Patent Infringement*].

[107] *See* Acumed LLC v. Stryker Corp., 483 F.3d 800, 810 (Fed. Cir. 2007) (noting that willfulness can still be found when opinion of counsel is incompetent). For example, the Federal Circuit offered the following explanation in *Golden Blount, Inc. v. Robert H. Peterson Co.*, 438 F.3d 1354, 1369-70 (Fed. Cir. 2006):

> The district court did not clearly err in dismissing Peterson's asserted good-faith belief in non-infringement, and thus in finding willfulness. Peterson made little-to-no effort to assess whether it infringed or whether the patent was invalid after receiving notice of the patent. The district court did not clearly err in according little weight to the first two oral opinions rendered by McLaughlin in light of the fact that McLaughlin did not have, and therefore could not have considered, the prosecution history or the accused device when the opinions were given . . . . Finally, the district court did not clearly err in inferring that Peterson demonstrated a cavalier attitude toward Golden Blount's patent rights from the facts that Peterson did not respond substantively to Golden Blount's notice letters and that it only sought a thorough opinion of counsel after suit was filed, and then only out of a concern to avoid a willfulness finding and a possible judgment for attorney fees.

[108] That said, the standard for willfulness differs somewhat from the inducement context. To prove willfulness, the patent owner must show "that the infringer acted despite an objectively high likelihood that its actions constituted infringement of a valid patent" and that "that this objectively-defined risk (determined by the record developed in the infringement proceeding) was either known or so obvious that it should have been known to the accused infringer." *Seagate*, 497 F.3d at 1371.

[109] *See* MOORE, HOLBROOK & MURPHY, *supra* note 71, at 452.

[110] Global-Tech Appliances, Inc. v. SEB S.A., 131 S. Ct. 2060, 2065 (2011).

[111] DSU Med. Corp. v. JMS Co., 471 F.3d 1293, 1306 (Fed. Cir. 2006) (en banc as to Section III.B of the opinion) (holding en banc that inducement requires that the alleged infringer knowingly induced infringement and possessed "specific intent" to encourage another's infringement).

clear what is required to show the specific intent. For example, must the inducer have taken an "affirmative step" beyond merely uploading or transferring the file, such as urging that the file be printed? Although a person often hosts or transfers a CAD file so that it can be printed, that may not be true every time. Someone might share a file simply so others could view the digital version, or so that people in countries where the object is not patented could print it. What if someone posts a CAD file with a large disclaimer reading: "Do not print in any country where printing will infringe a patent!"? Will such a disclaimer protect the accused inducer from liability? Or, instead, would the negative command actually suggest to the direct infringer that they *should* print.[112] In other words, metaphorically, does a sign saying "don't push the button" actually lead people to push the button?

Due to these various legal and practical limitations, patent owners will have considerable difficulty using active inducement of patent infringement under § 271(b) to stop or prevent the distribution of CAD files. Although active inducement is designed to protect patent owners in the context of diffuse infringement, we believe that patent owners likely will need to pursue some other avenue.

B. Contributory Infringement Under § 271(c)

Active inducement under § 271(b) is not the only form of indirect infringement under the patent statute. When Congress adopted § 271(b) and (c), it codified common law that had developed. Section 271(c) represented the most common form of indirect infringement[113]

[112] *Cf.* Cross Med. Prods., Inc. v. Medtronic Sofamor Danek, Inc., 424 F.3d 1293, 1312-14 (Fed. Cir. 2005) (finding a genuine issue of material fact around the accused inducer's specific intent because defendant's "field bulletins" instructed users to configure the device in a non-infringing manner, but an employee of the defendant testified that he instructed users to configure the device however "they feel comfortable," which might involve an infringing configuration); Lifescan, Inc. v. Can-Am Care Corp., 859 F. Supp. 392, 396 (N.D. Cal. 1994) (finding a genuine issue of material fact existed regarding inducement because the "fact that [the accused] provides the warning [against configuring in an infringing manner] to consumers does not equate with the fact that the consumers, in fact, understand and heed the warning").

[113] *See Global-Tech*, 131 S. Ct. at 2066 ("Cases in the latter category — i.e., cases in which a party sold an item that was not itself covered by the claims of a patent but that enabled another party to make or use a patented machine, process, or combination — were more common."); Hewlett-Packard Co. v. Bausch & Lomb Inc., 909 F.2d 1464, 1469 (Fed. Cir. 1990) ("The most common pre-1952 contributory infringement cases dealt with the situation where a seller would sell a component which was not itself technically covered by the claims of a product or process patent

and § 271(b) covered all other forms.[114] Thus, the two provisions, though distinct, are related.[115]

A person is liable for contributory infringement when the following conditions are satisfied: (1) someone offers to sell, sells, or imports into the United States (2) a component of a patented device (3) knowing the component to be especially adapted for use in an infringement of a patent with no substantial non-infringing uses (4) resulting in an act of direct infringement.[116]

Unlike active inducement under § 271(b), there is no requirement that the infringer have an "intent to cause infringement." Instead, the law requires knowledge of the patent and knowledge that the component is especially adapted for the patent.[117] Because the accused contributory infringer is aware of the patent and that the component has no substantial non-infringing uses, intent is presumed — what other use could the component have except to infringe?[118] Thus, the two provisions differ because one can be an active inducer of infringement even if some acts could be non-infringing, as was the case in the analogous copyright scenario in *Grokster*.[119]

The first requirement — that someone sell, offer to sell, or import a component — bears further exploration. Commentators discussing § 271(c) in the context of CAD files have focused their attention on whether the CAD file is a "component."[120] But an additional,

but which had no other use except with the claimed product or process.").

[114] *Hewlett-Packard*, 909 F.2d at 1469 ("Section 271(b) codified the prohibition against all other types of activity which, prior to 1952, had constituted 'contributory infringement.'"); *see* Adams, *supra* note 62, at 370; Lemley, *Inducing Patent Infringement*, *supra* note 106, at 227.

[115] *See Global-Tech*, 131 S. Ct. at 2065-68 (using § 271(c) precedent to interpret § 271(b)).

[116] *See* 35 U.S.C. § 271(c) (2012). In addition, the component must be a material part of the invention, and not a staple article or commodity of commerce suitable for substantial noninfringing use. *Id.*

[117] Aro Mfg. Co. v. Convertible Top Replacement Co., 377 U.S. 476, 488 (1964) ("On this question a majority of the Court is of the view that [§] 271(c) does require a showing that the alleged contributory infringer knew that the combination for which his component was especially designed was both patented and infringing.").

[118] *See* Holbrook, *Induced Infringement*, *supra* note 60, at 408.

[119] MGM Studios Inc. v. Grokster, Ltd., 545 U.S. 913, 941 (2005).

[120] *See, e.g.*, Brean, *Asserting Patents*, *supra* note 18, at 796-800 (arguing that CAD files are not "components" under § 271(c)); *cf.* William R. Thornewell II, Note, *Patent Infringement Prevention and the Advancement of Technology: Application of 35 U.S.C. § 271(f) to Software and "Virtual Components,"* 73 FORDHAM L. REV. 2815, 2833-43 (2005) (analyzing the potential judicial treatment of CAD files as "components" under 35 U.S.C. § 271(f)).

unexplored question is how to interpret the requirement that the infringer "sells" or "offers to sell" the component. The Federal Circuit has interpreted "offer to sell" under § 271(a) "according to the norms of traditional contractual analysis,"[121] meaning that an offer must constitute a "manifestation of willingness to enter into a bargain, so made as to justify another person in understanding that his assent to that bargain is invited and will conclude it."[122] The Federal Circuit's contract-law definition for an "offer" has been criticized.[123] Part of the criticism relates to the definition's exclusion of most advertisements and solicitations,[124] which can cause harm to the patentee in the form of price erosion.[125]

Importantly, the Federal Circuit has held that the term "sale" excludes at least some transactions where the infringing item is donated or otherwise given away for free.[126] Although this interpretation may be correct as a matter of plain meaning, the fact

[121] Rotec Indus., Inc. v. Mitsubishi Corp., 215 F.3d 1246, 1254-55 (Fed. Cir. 2000).

[122] *Id.* at 1257 (quoting RESTATEMENT (SECOND) OF CONTRACTS § 24 (1979)).

[123] *See, e.g.*, Holbrook, *Threat of a Sale*, *supra* note 9, at 791-92 (criticizing the Federal Circuit's contract-law offer standard for, among other things, failing to account for price erosion from advertisements of infringing products); Lucas S. Osborn, *The Leaky Common Law: An "Offer to Sell" as a Policy Tool in Patent Law and Beyond*, 53 SANTA CLARA L. REV. 143, 169-91, 196-99 (2013) [hereinafter *Offer to Sell*] (criticizing the Federal Circuit's contract-law offer standard for failing to account for price erosion and for failing to properly interpret the statutory language and relevant Supreme Court case law).

[124] *See* Holbrook, *Threat of a Sale*, *supra* note 9, at 798-99; Osborn, *Offer to Sell*, *supra* note 123, at 150.

[125] *See* Holbrook, *Threat of a Sale*, *supra* note 9, at 791-92 (indicating that the damage to the patentee is the lost profit caused by the drop in price because but for the infringing offer to sell, the patentee could have sold the item at a higher price); *cf.* Transocean Offshore Deepwater Drilling, Inc. v. Maersk Contractors USA, Inc., 617 F.3d 1296, 1308-09 (Fed. Cir. 2010) (noting that "the damages that would flow from an unaccepted offer to sell and an actual sale would likely be quite different" (citing Holbrook, *Threat of a Sale*, *supra* note 9, at 791-92)). Price erosion refers to the downward price pressure on patented goods when a competitor signals to the market that it will offer a competing (often infringing) good, since the market expects the patentee to lower its price to compete with the infringer. *See* Osborn, *Offer to Sell*, *supra* note 123, at 174-76.

[126] HollyAnne Corp. v. TFT, Inc., 199 F.3d 1304, 1309 (Fed. Cir. 1999) (holding, in the personal jurisdiction context, that "a mere offer to donate, where a donation is never made, cannot be an offer for sale" under § 271(a)); *see also* Holbrook, *Threat of a Sale*, *supra* note 9, at 766. That said, some efforts to give something away for "free" may nevertheless be a "sale" because some sort of consideration is exchanged. *Cf.* LifeScan Scot., Ltd. v. Shasta Techs., LLC, 734 F.3d 1361, 1374-77 (Fed. Cir. 2013) (finding patent rights exhausted under "first sale" doctrine even though item was distributed for free).

that non-commercial transfers of CAD files may not be actionable as "sales" creates a barrier to lawsuits based on contributory infringement. Because generating CAD files can be inexpensive, CAD file creators may be willing to transfer them without charging money. Similarly, websites will be willing to host the CAD files without charging for them. Yet the availability of the CAD files can harm the patentee in the form of lost sales[127] and price erosion. Under current interpretation, these harms cannot be rectified because transferring CAD files for free would not constitute a sale or offer to sell under § 271(c).[128]

The second requirement — that the sale or offer to sell must be for a "component" of the patented invention — adds additional complexity to the issue. In the end, we conclude that a CAD file that will print the finished product is not a component of the finished product. But we explore the counterargument in the remainder of this section. At the outset, it should be noted that attempting to pigeonhole a CAD file as a "component" of the underlying physical device differs from the normal contributory infringement case. In the majority of early contributory infringement cases, the alleged "component" was a physical piece of the larger patented whole. For example, for a patented blender comprising a motor-driven base and a container, the container would represent a component of the patented blender. Even in this era of intangible inventions, contributory infringement continues to play an important role. For example, many software-related inventions are claimed as methods, and courts consider the software functionality — such as an XML editor — to be a component of the method of editing an XML document.[129]

But if a CAD file is a "component" of the patented physical device, it certainly relates to the physical device in a manner distinct from prior cases. Unlike the container that is physically part of the blender invention, the CAD file is not part of the physical device. In fact, it is a

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[127] Of course, not every CAD file that is obtained for free would have been the subject of a sale — many people who are willing to obtain the CAD file for free would be unwilling to pay the market price for the CAD file.

[128] *See HollyAnne*, 199 F.3d at 1309 n.7 ("Arguably, even numerous offers to donate could not be considered an infringing act under section 271(a) because Congress made offers to sell infringing acts and not offers to donate, despite the obvious commercial uses of a donation.").

[129] *See* i4i Ltd. P'ship. v. Microsoft Corp., 598 F.3d 831, 848-49 (Fed. Cir. 2010), *aff'd*, 131 S. Ct. 2238 (2011); Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1320-21 (Fed. Cir. 2009) (holding that various software products, including Microsoft Outlook, contributorily infringed a patented method concerning a calendar date-picker function).

digital representation of the *entire* device, not merely a part. Additionally, once the CAD file is printed, the file continues to exist separate and apart from the physical device, and the physical device no longer needs the CAD file for its existence. We do not, for instance, call the assembly line from which traditional devices are manufactured "components" of the device. More naturally, we might call the CAD file a precursor to the physical object or analogize it to a mold from which the object is formed.

Yet analogies to traditional manufacturing techniques, in which the manufacturer was a big company with deep pockets, are not entirely helpful in a digital manufacturing era. The doctrine of contributory infringement arose to protect patentees from the harm done to them when another party commercializes the patentee's technology.[130] In the past, we think the law did not consider a mold or an assembly line to be a "component" of the patented device because doing so was unnecessary to protect the patentee's interest. The company using the mold was likely a large, centralized business committing massive infringement with assets to pay a large infringement judgment.[131] In contrast, the entities using the CAD files are likely to be decentralized, individualized actors who might be guilty of a single act of infringement when they print the item. Suing each of them is not practical or cost effective.[132] Hence, whereas a plain meaning of "component" does not encompass a CAD file, a purposive interpretation of the term very well might.

Courts addressing CAD files would not be writing on an entirely clean slate, however. In *Microsoft Corp. v. AT&T Corp.*,[133] the Supreme Court analyzed the term "component" in § 271(f) of the Patent Act,[134] which is written to parallel active inducement and contributory infringement.[135] Thus, the interpretation afforded to "component" in

130 *See* Wallace v. Holmes, 29 F. Cas. 74, 80 (C.C.D. Conn. 1871) (finding contributory infringement where the defendant made and sold the burner of a patented burner/chimney combination "for the express purpose of assisting, and making profit by assisting, in a gross infringement of the complainants' patent").

131 *See* Rantanen, *supra* note 84, at 1580.

132 *See Wallace*, 29 F. Cas. at 80 (noting that without contributory infringement, "the complainants would be driven to the task of searching out the individual purchasers for use who actually place the chimney on the burner and use it — a consequence which, considering the small value of each separate lamp, and the trouble and expense of prosecution, would make the complainants helpless and remediless").

133 550 U.S. 437 (2007).

134 *See id.* (discussing whether software qualifies as a "component" under § 271(f)).

135 Michael Silhasek, Comment, *Closing One Loophole and Opening Another: Why*

the context of § 271(f) should also inform that term's meaning in § 271(c). Section 271(f)(1) and (2) track the language of § 271(b) and (c).[136] Infringement under § 271(f)(1) arises when a party "actively induce[s] the combination" of the invention's components outside of the United States "in a manner that would infringe the patent if such combination occurred within the United States."[137] A party infringes under § 271(f)(2) when:

> [She] supplies or causes to be supplied . . . any component of a patented invention that is especially made or especially adapted for use in the invention and not a staple article or commodity of commerce suitable for substantial noninfringing use . . . knowing that such component is so made or adapted and intending that such component will be combined outside of the United States in a manner that would infringe the patent if such combination occurred within the United States.[138]

An obvious difference between § 271(b) and (c), on the one hand, and §271(f), on the other, is that §271(f) is an extraterritorial provision that concerns the exportation of either the unassembled components of a claimed invention or components that have no substantial non-infringing uses.[139] Nevertheless, the language of § 271(f) should be interpreted consistently with § 271(c), given that the same language is used.

In *Microsoft*, the arguable "component" was software that was sent overseas to be loaded onto computers there.[140] AT&T's patent covered a computer/software combination for digitally encoding and compressing recorded speech.[141] Because the patent claim required the

§ 271(f) Patent Infringement Should Apply to Method Patents After Cardiac Pacemakers, 48 SAN DIEGO L. REV. 677, 700 (2011) ("[T]he application of § 271(f) should parallel the application of the inducement and contributory infringement statutes."); *see* Limelight Networks, Inc. v. Akamai Techs., Inc., 134 S. Ct. 2111, 2118 (2014) (using § 271(f)(1) to inform analysis of § 271(b)); Cardiac Pacemakers, Inc. v. St. Jude Med., Inc., 576 F.3d 1348, 1363-64 (Fed. Cir. 2009) (en banc in relevant part) (interpreting § 271(f)(2) in light of § 271(c)). *But see* Promega Corp. v. Life Techs. Corp., 773 F.3d 1338, 1353 (Fed. Cir. 2014) (comparing § 271(b) and § 271(f)(1), but noting "because § 271(f)(1) lacks such a strict liability companion statute, comparisons to § 271(b) are of limited value").

136 Zoltek Corp. v. United States, 672 F.3d 1309, 1334 n.6 (Fed. Cir. 2012) (Dyk, J., dissenting) ("The language of section 271(f) itself mimics the language of the indirect infringement provisions of sections 271(b) and (c).").

137 35 U.S.C. § 271(f)(1) (2012).

138 *Id.* § 271(f)(2).

139 *See id.* § 271(f)(1)–(2).

140 Microsoft Corp. v. AT&T Corp., 550 U.S. 437, 441 (2007).

141 *Id.* at 441-42.

combination of computer and software, neither a computer standing alone nor the software standing alone (e.g., on a compact disk or other pure storage medium) directly infringed the claims. Instead, direct infringement only occurred when the software was loaded onto the computer.[142] Microsoft transported its enabling software out of the United States to a foreign country where it was then copied, and the copy was then combined with a computer.[143]

The Court's analysis first focused on § 271(f)'s language concerning "components" that are "combined" as supporting a tangible meaning for the term "component."[144] Thus, software "in the abstract" is not a component under § 271(f), but software encoded on a medium can be.[145] The *Microsoft* Court's important distinction between software "in the abstract" — which cannot be a component — and software encoded "on a medium"[146] — which can be a component — shows that a CAD file stored on a tangible medium can sometimes be a component.[147]

Yet, some commentators have suggested that the decision holds that software stored in a medium is not a "component" under § 271(f).[148] This view misapprehends the reasoning in *Microsoft*. The Court was clear that only software *in the abstract* could not be a component, but software in a medium could be.[149] Thus, a CAD *file* (i.e., software) on a medium (i.e., memory) could be a component.

In a well-written article considering the *Microsoft* decision's importance for CAD files under § 271(c), Daniel Brean avoids this

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[142] *Id.* at 446.

[143] *Id.* at 442.

[144] *Id.* at 449.

[145] *Id.* at 449-51.

[146] A "medium" includes CDs and any other form of storage, including a server or the memory on a computer. *See id.* at 448-49.

[147] The Court ultimately found there was no infringement because the components had not been combined to form the patented invention, as is required under § 271(f). On this point the majority employed a very literal interpretation of the statute and decided that the component *actually combined* to make the infringing device was not the *master file* sent from the United States, but rather *the copy* of the master file. *See id.* at 453-54. Because the copy used for combination was not "supplied from the United States" as required by § 271(f), but instead was created in a foreign country, Microsoft was not liable for the copies. *Id.*

[148] *See, e.g.*, Robert A. McFarlane & Timothy V. Fisher, *Software Patents Under 35 U.S.C. § 271(f): Should Congress Amend § 271 to Harmonize Protection Between Tangible and Intangible Inventions?*, 2 HASTINGS SCI. & TECH. L.J. 183, 184 (2010) ("Specifically, the Supreme Court held in Microsoft v. AT&T that a software 'master disk' is not a 'component' for purposes of § 271(f).").

[149] *See Microsoft*, 550 U.S. at 449-52.

mistake, but unfortunately appears to commit a related non sequitur.[150] Mr. Brean correctly notes the Court's distinction between software in the abstract and software encoded on a medium, but then suggests that since "abstract instructions" are not components, "CAD files should not be considered 'components' of subsequently printed objects."[151] To the extent that Mr. Brean suggests CAD files cannot be components at all, *Microsoft* clearly suggests the opposite — that CAD files can be "components" as long as they are encoded on a medium.[152] Because the CAD files of interest in an infringement action would be encoded on a medium, they could qualify as "components" under § 271.

On the other hand, for reasons other than those that commentators have noted, the thrust of the *Microsoft* decision hints that it might be difficult to capture CAD file distributors under § 271(c). Specifically, the Court drew a firm distinction between the parts of the invention actually covered by the claims and the things used to make those parts.[153] Thus, while the *copy* of the software was required by the claims, the *master disk* was merely used to make the copy.[154] By analogy, the Court might distinguish between the physical device required by a patent claim and the CAD file used to make it.

Yet the *Microsoft* opinion does not contain any language addressing whether a software file that embodies the *entire* invention might constitute a component under § 271.[155] Rather, *Microsoft* states that a software file that makes a *component* of an invention is not itself a component of the invention. This point is made clearer by considering the Court's dicta in which it used a non-software example:

> A machine for making sprockets might be used by a manufacturer to produce tens of thousands of sprockets an hour. That does not make the machine a "component" of the tens of thousands of devices in which the sprockets are incorporated, at least not under any ordinary understanding of the term "component." Congress, of course, might have

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[150] *See* Brean, *Asserting Patents*, *supra* note 18, at 798.

[151] *Id.* at 800. The basis for Mr. Brean's conclusion is not entirely clear. To the extent that he means that CAD files *in the abstract* (not stored in computer memory) are not components, the *Microsoft* opinion supports him.

[152] *See Microsoft*, 550 U.S. at 449-51.

[153] *Id.* at 453 ("Under this formulation, the very components supplied from the United States, and not copies thereof, trigger § 271(f) liability when combined abroad to form the patented invention at issue.").

[154] *Id.* at 453-54.

[155] *See generally id.* (discussing whether software can be considered a component when its combination with a computer creates an infringement).

> included within § 271(f)'s compass, for example, not only combinable "components" of a patented invention, but also "information, instructions, or tools from which those components readily may be generated."[156]

This dictum is not on all fours with a patented device made from a CAD file. The Court is suggesting that a machine would not be a component if it makes components (i.e., sprockets) of a patented invention.[157] But in the CAD file scenario, the "machine" in the analogy would be the 3D printer, and the thing made by the 3D printer is not a component of the patented item, but rather is the entire patented item. Thus, *Microsoft* does not directly tell us how to treat CAD files even under § 271(f), though its direction does not provide encouragement to those seeking to construe CAD files as components under § 271(c).

The *Microsoft* decision focused on § 271(f), and the Court took a narrow approach to interpreting that provision in light of the presumption against the extraterritorial extension of U.S. patent law.[158] As a result, courts may be willing to take a fresh, broader look at the issue of whether CAD files are components of printed items under § 271(c).[159] If a court were willing to differentiate between § 271(f) and (c) for CAD files, it would require a very narrow parsing of each section's language. For a CAD file distributor to be liable under § 271(c), a court would have to interpret the CAD file to be a "component of the patented machine."[160] But the court would also have to say that CAD files are not "components" that "will be

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[156] *Id.* at 451.

[157] *See id.* at 450-51 (analogizing software in the abstract to a physical blueprint and stating, "[a] blueprint may contain precise instructions for the construction and combination of the components of a patented device, but it is not itself a combinable component of that device").

[158] *See id.* at 442. *See generally* Timothy R. Holbrook, *Extraterritoriality in U.S. Patent Law*, 49 WM. & MARY L. REV. 2119, 2123-28 (2008) [hereinafter *Extraterritoriality*] (discussing the principle against extraterritorial application of U.S. law in the context of patent law).

[159] An additional element of the case's context suggests a narrow reading. *Microsoft* can be read as a decision to treat U.S. software companies on the same footing as traditional industry because in traditional industry a company that designs a product in the United States can export that design (i.e., information) to manufacture components abroad without facing § 271(f) liability. *See* Brief for the United States as Amicus Curiae Supporting Petitioner at 40-41, *Microsoft*, 550 U.S. 437 (No. 05-1056), 2006 WL 3693464.

[160] *See* 35 U.S.C. § 271(c) (2012) ("Whoever offers to sell or sells within the United States . . . a component of a patented machine . . . .").

combined outside of the United States in a manner that would infringe the patent."[161] To hold both interpretations at the same time would mean that a CAD file that prints an entire patented device is a "component" of the device, but that a CAD file that merely prints a component of a patented invention is not a "component" of the final combination.[162] While such an interpretation is not a logical impossibility, it is not the most intuitive reading of the statute. Nevertheless, there might be good policy reasons to interpret § 271(c) in this manner, such as to allow the patentee to sue the party that represents the root cause of the infringement.[163]

The foregoing discussion shows that patentees seeking to control CAD files will find weak allies in § 271(b) and § 271(c). Indirect infringement theories may allow patentees to capture the most brazen infringers, but not much more. Moreover, a patent holder relying on a strategy of suing end users who physically print the object will encounter several problems, including: (1) detection (people printing in their homes are hard to catch); (2) diffusion (even if the patentee ce, the Federal Circuit and even the Supreme Court increasingly suing one's customers.[164] Thus, traditional and obvious avenues for legal protection will usually leave patent holders floundering. The next Part explores an avenue through which patent holders can gain protection against DMT infringement threats.

III. DIRECT DIGITAL INFRINGEMENT

Claims of direct infringement against those who actually "print" the device and indirect infringement against CAD file distributors would provide only minimal protection for patentees. They would be much better protected if they had a claim for direct infringement based on the CAD file itself. The majority of commentators who have analyzed whether digital files can directly infringe patent claims directed to physical objects simply dismiss this potential based on the view that the law requires a physical embodiment of the invention.[165] In this

161 *See id.* § 271(f)(2).

162 In essence, it would require saying that a component (the CAD file) of a component (the physical piece) is not a component of the final combination.

163 *Cf.* Thornewell, *supra* note 120, at 2833-43 (analyzing the potential judicial treatment of CAD files as "components" under 35 U.S.C. § 271(f)). Many of Mr. Thornewell's arguments apply with equal force to § 271(c).

164 *See supra* notes 55–58 and accompanying text.

165 *See supra* notes 13–15 and accompanying text; *see, e.g.*, Brean, *Asserting Patents*, *supra* note 18, at 789-90 ("It would be better from the patentee's perspective to proceed on a theory of infringement that finds the seller of the CAD files liable, but

Part, we challenge this view and demonstrate why CAD files themselves could directly infringe patent claims in the absence of a physical embodiment.

Direct infringement in its classic form[166] arises when someone makes, uses, sells, offers to sell, or imports the patented invention without authorization from the patent owner.[167] Historically, infringement generally was tied to physical instantiations of inventions.[168] Infringement of methods or processes typically involved some device that would perform the process.[169] Over time, Congress has eroded this tangibility requirement in other versions of infringement under § 271.[170] But such a shift is occurring under § 271(a) as well.

In a previous article, one of us offered a bifurcated approach to the acts of infringement under § 271(a).[171] Infringement by making, using, or importing the invention necessarily contemplates a tangible version of the invention because what is being appropriated is the physical item itself.[172] In contrast, for infringing sales and offers to sell the invention, it is the economic value of the invention being appropriated, not the physical item.[173] As such, there should be no requirement for a physical instantiation of the invention with sales of, and offers to sell, the claimed invention.[174]

The advent of 3D printing and other technologies that utilize CAD files provides the occasion to reconsider this bias towards tangibility for patent infringement not only for sales and offers to sell the claimed

the distributors of the CAD files do not 'make' the product."); Depoorter, *supra* note 14, at 1487 (assuming direct patent infringement would only arise once CAD file is used to print the object).

166 There are newer forms of direct infringement that have been added to the Patent Act. *See generally* Holbrook, *Consequences of* Akamai, *supra* note 53, at 502 n.20 (delineating the newer forms of direct infringement). For purposes of this article, we will focus on 35 U.S.C. § 271(a).

167 35 U.S.C. § 271(a) (2012).

168 *See* Holbrook, *Threat of a Sale*, *supra* note 9, at 755.

169 *See, e.g.*, Hughes Aircraft Co. v. United States, 640 F.2d 1193 (Ct. Cl. 1980) (discussing patent infringement claim concerning satellite control system); Acme Steel Co. v. E. Venetian Blind Co., 130 F. Supp. 459 (D. Md. 1955) (holding one-stage machine method did not infringe on plaintiff's patent).

170 *See* Holbrook, *Threat of a Sale*, *supra* note 9, at 815-20 (discussing how infringement under ANDA litigation and § 271(f) no longer require tangible items for infringement).

171 *Id.* at 805-15.

172 *Id.* at 813-15.

173 *Id.* at 805-13.

174 *Id.* at 805.

invention but also for making, using, and importing it. When a physical instantiation of the device is a mere button press away, does it really make sense to view only the tangible embodiment of the invention as infringing? In the software context, the tangible-intangible divide has already been erased, with software now able to perform functions that hardware would have done in the past.[175] Do we think the patent system should also erase that divide? We are the first to explore this potential.

There are no perfect tangible-era analogies to CAD files as manufacturing tools, but two commonly suggested comparisons are to blueprints and molds.[176] Under patent law doctrine in the tangible era, "making" or "using" a mold or blueprints for a patented device would not constitute direct infringement.[177] In the age of digital manufacturing, however, lawmakers will need to study closely whether CAD files should be treated as identical to the tangible item. While the idea may sound foreign to our tangible-tuned ears, it may sound perfectly natural to digital manufacturing natives one day.[178] For example, in the digital era of movies and books, lay people do not distinguish between having a digital copy of a song or book: if you have the file, you have the book. [179] Once 3D printing is ubiquitous and inexpensive, perhaps laypeople will feel the same way about CAD files — having the file is the same as having the object. This section

[175] *See supra* note 2.

[176] *See* Thornewell, *supra* note 120, at 2833-42.

[177] *See* United States v. C.M. Lane Lifeboat Co., 118 F.2d 793, 795-96 (2d. Cir. 1941) (discussing blueprints for lifeboats, and noting the produced boats "finally proved to infringe claims of the patent"); Niks v. Marinette Paper Co., 11 F.R.D. 384, 385 (N.D.N.Y. 1951) (requiring defendant to produce blueprints of device alleged to infringe on plaintiff's patent, but not ordering physical inspection of actual device); Luten v. Camp, 221 F. 424, 429 (E.D. Pa. 1915) (discussing a dispute over discovery of blueprints, not to prove infringement via blueprints alone, but instead as relevant to show infringement pertaining to a reinforced concrete bridge that had been constructed).

[178] Recall that it may be possible for patentees to draft claims covering digital versions of their inventions. *See supra* note 19. If such claims constitute patentable subject matter, they would be the easiest route to protect CAD files in the digital age. Such claims would not, however, protect patentees whose patents have already issued.

[180] *See* Katie Arnold-Ratliff, *Soft Target: Have Reports of the Paperback's Death Been Greatly Exaggerated?*, SLATE (June 20, 2013, 7:53 PM), http://www.slate.com/articles/technology/technology/2013/06/declining_sales_of_paperbacks_are_e_readers_killing_the_softcover.html (discussing potential disruption of resale and paperback books in light of ebooks, showing that the two are fungible (though with different collateral market effects)).

explores the potential for direct infringement based on the CAD files themselves.

A. Selling or Offering to Sell the Claimed Invention via a CAD File

The simplicity of converting a CAD file to the actual object should lead us to ask whether someone selling or offering to sell the CAD file has effectively sold the item itself. Given that the line between the intangible CAD file and the tangible item now is so thin, one could easily argue that the sale of the file should be effectively an infringing sale of the item itself. The interest in the purchaser is not the CAD file itself, but instead in the item to be produced by the CAD file. We think such sales and offers to sell are attempts to appropriate the economic value of the item, harming the patent owner pecuniarily.

Historically, however, the law has required tangible embodiments of the invention, even for infringing sales.[180] This is unsurprising for two reasons. First, during the industrial age, most technology was incorporated into some sort of physical form.[181] Second, the courts were somewhat hostile to patents because of the seemingly anticompetitive nature of their exclusive rights.[182] The Supreme Court in *Deepsouth Packing Co. v. Laitram Corp.* interpreted § 271(a) narrowly in part by considering "this Nation's historical antipathy to monopoly and of repeated congressional efforts to preserve and foster competition."[183]

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[180] *See, e.g.*, Ecodyne Corp. v. Croll-Reynolds Eng'g Co., 491 F. Supp. 194, 197 (D. Conn. 1979) ("When the thing in question is an apparatus and the issue is patent infringement by sale, partial delivery will not suffice; in order for there to have been a sale within the meaning of 35 U.S.C. § 271(a), the entire apparatus must have been constructed and ready for use."). *See generally* Holbrook, *Threat of a Sale*, *supra* note 9, at 801-03 (discussing state of the law requiring a physical embodiment of the invention for infringement).

[181] *See* Miriam Bitton, *Patenting Abstractions*, 15 N.C. J.L. & TECH. 153, 157-58 (2014).

[182] *See, e.g.*, Dawson Chem. Co. v. Rohm & Haas Co., 448 U.S. 176, 223 (1980) (White, J., dissenting) ("For decades this Court has denied relief from contributory infringement to patent holders who attempt to extend their patent monopolies to unpatented materials used in connection with patented inventions."); Ductmate Indus., Inc. v. Lockformer Co., No. 84 C 5152, 1985 WL 2179, at *2 (N.D. Ill. Feb. 12, 1985) ("Requiring a direct infringement in the United States balances the patentee's right to the exclusive control over his patent against the historical antipathy to monopoly in order to assure that the patentee not over-extend the reach of his limited patent monopoly.").

[183] *See* Deepsouth Packing Co. v. Laitram Corp., 406 U.S. 518, 530 (1972).

Although the Supreme Court might continue to harbor such concerns about the anticompetitive aspects of patents,[184] Congress clearly does not share that viewpoint any longer.[185] Congress has expanded the scope of infringement numerous times over the last forty years.[186] In general, Congress views patents favorably.[187]

Unlike the Supreme Court, the Federal Circuit has been more willing to reconsider whether something tangible must exist for there to be infringement by selling or offering to sell the invention.[188] As one of us previously articulated, infringing sales and offers to sell an invention are "an appropriation of the economic value of the invention, as opposed to its physical incarnation" such that a physical embodiment should not be required.[189]

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184 *See* Tim Holbrook, *Is the Supreme Court About to Rule that Software is Ineligible for Patent Protection?*, FORBES (Mar. 16, 2014, 11:44 AM), http://www.forbes.com/sites/realspin/2014/03/16/is-the-supreme-court-about-to-rule-that-software-is-ineligible-for-patent-protection; *see also* Timothy R. Holbrook, *Explaining the Supreme Court's Interest in Patent Law*, 3 IP THEORY 62, 63-65 (2013).

185 *See* Holbrook, *Threat of a Sale*, *supra* note 9, at 764 ("The history of § 271 demonstrates that, contrary to the Supreme Court's historical antipathy to patents, Congress has taken an expansive view of them, enlarging the class of activities covered by the patent statute's forms of infringement.").

186 *See* Timothy R. Holbrook, *Territoriality Waning? Patent Infringement for Offering in the United States to Sell an Invention Abroad*, 37 UC DAVIS L. REV. 701, 719-23 (2004) [hereinafter *Territoriality Waning*] (discussing amendments to § 271); *see also* Timothy R. Holbrook, *The Treaty Power and the Patent Clause: Are There Limits on the United States' Ability to Harmonize?*, 22 CARDOZO ARTS & ENT. L.J. 1, 18-19 (2004) (discussing constitutionality of expansion of forms of infringement for existing patents).

187 One exception to Congress's favorable views of the patent system has been recent patent reform efforts to address patent assertion entities ("PAEs"), also known as trolls. *See generally* Colleen V. Chien, *From Arms Race to Marketplace: The Complex Ecosystem and Its Implications for the Patent System*, 62 HASTINGS L.J. 297 (2010) (coining the term "patent assertion entities"). Some commentators have criticized aspects of these reform efforts. *See, e.g.*, Timothy Holbrook, *Not All Patent Trolls Are Demons*, CNN (Feb. 21, 2014, 9:08 AM ET), http://www.cnn.com/2014/02/21/opinion/holbrook-patent-trolls-demons (explaining the benefits that patent assertion entities provide to holders of valid patents).

188 *See* Transocean Offshore Deepwater Drilling, Inc. v. Maersk Contractors USA, Inc., 617 F.3d 1296, 1310 n.4 (Fed. Cir. 2010) ("[The district court] never reached the factual issue of whether the subject of the offer to sell was of a 'patented invention' by analyzing the design of the rig. Of course, in this analysis, the district court must determine what was offered for sale, not what was ultimately delivered.").

189 Timothy R. Holbrook, *Territoriality and Tangibility After* Transocean, 61 EMORY L.J. 1087, 1106 (2012) [hereinafter *After* Transocean].

The Federal Circuit expressly adopted this approach in *Transocean Offshore Deepwater Drilling, Inc. v. Maersk Contractors USA, Inc.*[190] In that case, Maersk had offered to sell an oil rig and that offer had been accepted.[191] The rig ultimately delivered, however, differed from the one contemplated in the offer and sale and, in fact, did not infringe.[192] The Federal Circuit nevertheless concluded that there could be infringement based on the diagrams and descriptions contained in the offer to sell.[193] The court emphasized that the "underlying purpose of holding someone who offers to sell liable for infringement is to prevent 'generating interest in a potential infringing product to the commercial detriment of the rightful patentee.'"[194] Because an offer to sell or sale of an item that has yet to be constructed can harm the patentee, the court allowed a claim for infringement based solely on a paper contract and rejected the defendant's argument that "the entire apparatus must have been constructed and ready for use in order to have been sold."[195]

The *Transocean* decision is the first to find infringement under § 271(a) based on documents alone without a physical embodiment of the invention.[196] We have written in support of the court's focus on the economic interests of the patentee,[197] as have other commentators.[198] By focusing on the harm done to the patentee by the sale or offer to sale, the court opened the door to finding infringement based on the sale or offer to sell of a CAD file. An offer to sell or sale of

190 617 F.3d 1296.

191 *Id.* at 1307.

192 *Id.*

193 *Id.* at 1310 n.4.

194 *Id.* at 1309 (quoting 3D Sys., Inc. v. Aarotech Labs., Inc., 160 F.3d 1373, 1379 (Fed. Cir. 1998)).

195 *Id.* at 1311.

196 *See* Holbrook, *After* Transocean, *supra* note 189, at 1106. Abbreviated New Drug Application ("ANDA") litigation also is based primarily on paper — the ANDA — as opposed to what is actually sold on the market. *See* Holbrook, *Threat of a Sale*, *supra* note 9, at 815-17.

197 *See* Holbrook, *After* Transocean, *supra* note 189, at 1106; *see also* Holbrook, *Threat of a Sale*, *supra* note 9, at 788-98; Osborn, *Offer to Sell*, *supra* note 123, at 172-76, 199-200.

198 *See* Melissa Y. Lerner, *You Can Run, but You Can't Hide: The Expansion of Direct Infringement and the Evisceration of Preventive Contracting in* Maersk, 93 J. PAT. & TRADEMARK OFF. SOC'Y 207, 232 (2011); Scott A. Cromar, Note, *The Location of the Contemplated Sale as the Ultimate Guide in "Offer to Sell" Transnational U.S. Patent Infringement Cases*, 2012 U. ILL. L. REV. 1755, 1783; Rex W. Miller, Note, *Construing "Offers to Sell" Patent Infringement: Why Economic Interests Rather Than Territoriality Should Guide the Construction*, 70 OHIO ST. L.J. 403, 441-50 (2009).

a CAD file of the patented invention would directly impact the patentee's commercial interests. The sale of the CAD file could displace the sale of the actual item. The patent owner may also have to lower its price — price erosion — in order to compete with the CAD files, even if no one ever purchases them.[199]

Such a step is not terribly surprising. The Supreme Court has recognized in the patent validity context that an invention can be commercially appropriated absent a tangible embodiment.[200] Under the 1952 Patent Act's on-sale bar, a patent applicant is barred from obtaining a patent if she offered to sell the invention more than one year prior to filing the application.[201] The Supreme Court in *Pfaff v. Wells Electronics* made it clear that, to be on-sale, the invention need not be physically built: diagrams and other descriptions that would enable a person of ordinary skill in the relevant field to build the device are sufficient.[202] Thus, in the on-sale bar context, the Supreme Court has recognized that "the value of an invention can be appropriated even absent a physical incarnation of the invention."[203] *Transocean* is, in essence, a modest extension of this reality.

One commentator, however, has rejected application of *Transocean* to CAD files.[204] Mr. Brean argues, as a doctrinal matter, that *Transocean* is inconsistent with the Federal Circuit's earlier decision in *Lang v. Pacific Marine & Supply Co.*[205] Mr. Brean highlights the

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199 *See supra* note 125 (discussing price erosion).

200 Pfaff v. Wells Elecs., Inc., 525 U.S. 55, 67-68 (1998).

201 35 U.S.C. § 102(b) (2006). The America Invents Act ("AIA") also precludes a patent if the invention was on sale, but provides a one-year grace period only if the on-sale activity was by the inventor or by someone who took the invention from the inventor. *See* 35 U.S.C. § 102(a)–(b). For a discussion of how the AIA prior art provisions operate, see MOORE, HOLBROOK & MURPHY, *supra* note 71, at 691-98. While it is highly likely that the interpretations of the 1952 on-sale bar will define the AIA provisions, there is some dispute as to whether "secret" sales will trigger the bar under the AIA as they do under the 1952 Patent Act. *See generally* Mark A. Lemley, *Does 'Public Use' Mean the Same Thing It Did Last Year?*, 93 TEX. L. REV. (forthcoming 2015), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2394153 (discussing uncertainty surrounding interpretation of amended statute).

202 *Pfaff*, 525 U.S. at 68. *See generally* Timothy R. Holbrook, *The More Things Change, the More They Stay the Same: Implications of* Pfaff v. Wells Electronics, Inc. *and the Quest for Predictability in the On-Sale Bar*, 15 BERKELEY TECH. L.J. 933 (2000) (suggesting how courts should approach on-sale bar questions after the *Pfaff* decision).

203 *See* Holbrook, *After* Transocean*, supra* note 189, at 1108.

204 Brean, *Asserting Patents*, *supra* note 18, at 792.

205 *Id.* at 791-93. Brean also relies on the district court decision *in Ecodyne Corp. v. Croll-Reynolds Engineering Co.*, 491 F. Supp. 194 (D. Conn. 1979), to support the argument that there must be a physical embodiment in order for there to be a sale of

Transocean court's language that reads: "[A] 'sale' is not limited to the transfer of tangible property; a sale may also be the agreement by which such a transfer takes place. In this case, there was a contract to sell a rig that included schematics."[206] Mr. Brean interprets this language to mean that "*Transocean* still requires an agreement to transfer a tangible object" and thus would not cover the sale of CAD files.[207]

Before addressing Mr. Brean's doctrinal position, we emphasize that ours is not merely a doctrinal inquiry. We are not simply asking whether the law at present *will* allow such liability. We are asking whether the law *should* do so. Our contention is that it should, as a normative matter, regardless of whether current case law permits it. But, even doctrinally, we do not share the view that *Transocean* was wrongly decided and that it should not apply in this context.

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the invention. *Id.* at 790-91. *Ecodyne* does expressly hold as such, but the decision is obviously not binding on the Federal Circuit. Indeed, it pre-dates both the creation of the Federal Circuit and the amendment of § 271(a) to include offering to sell the invention as a form of infringement. *See* Technical Mfg. Corp. v. Integrated Dynamics Eng'g, Inc., 183 F. Supp. 2d 339, 342-43 (D. Mass. 2002) ("Compounding the conceptual difficulty is the fact that both *Joy Technologies* and *Ecodyne* arose during an earlier period when United States patent law did not include liability for *offers* to sell infringing products.").

Moreover, the court's argument in *Ecodyne* would render the "sell" form of infringement superfluous: if the invention must be made in order for there to be a sale, then there would be no need for infringement via a sale. The issue would resolve into the issue of the appropriate damages award. *See* Holbrook, *Threat of a Sale*, *supra* note 9, at 759-60 ("The Court, by phrasing the question of whether the infringer 'did . . . make (and then sell)' suggests that the making of the invention is a necessary prerequisite to selling the invention. This reading of the statute seemingly vitiates the 'sale' form of infringement because, for there to be a sale, the person selling the device would have infringed already under the 'make' provision. This reading violates the canon of statutory construction that 'courts should disfavor interpretations of statutes that render language superfluous.'" (citations omitted)); *see also* Holbrook, *After* Transocean, *supra* note 189, at 1107-08 ("The Court [in *Deepsouth*] thus seems to suggest that infringing sales are tied to the manufacture of the good, not merely to the sale. *Transocean* is arguably inconsistent with this view. In *Deepsouth*, all of the components were manufactured, just not assembled. . . . The stronger argument is that the Supreme Court did not truly confront purely intangible infringement through sales. Instead, it was focused on the actual manufacture of the components that were then sent overseas. The Court did not address what would have happened if the device ultimately assembled had been sold in the United States pursuant to a contract before any of the parts were assembled. The tangibility issue simply was not before the Court.").

[206] Brean, *Asserting Patents*, *supra* note 18, at 792 (quoting Transocean Offshore Deepwater Drilling, Inc. v. Maersk Contractors USA, Inc., 617 F.3d 1296, 1311 (Fed. Cir. 2010)) (internal quotation marks omitted).

[207] *Id.* at 793.

Mr. Brean reads far more into *Lang* that it deserves.[208] In *Lang*, the patent owner filed an infringement suit based on the production of a patented boat hull, but the hull was not yet fully constructed.[209] The accused infringer was not the manufacturer of the hull but instead the intended purchaser.[210] The Federal Circuit affirmed a dismissal of a complaint for lack of subject matter jurisdiction, but the complaint contained two counts that related to patent infringement.[211] The first count was for a declaratory judgment for the threat of future infringement, and the Federal Circuit held there was no actual controversy because "the accused infringers had not distributed sales literature, prepared to solicit orders, or engaged in any activity indicating that the ship would soon be ready for sea."[212] As for the second count, a request for a preliminary injunction, the entirety of the Federal Circuit's reasoning is as follows:

> That statute, by itself, cannot be interpreted to cover acts other than an actual making, using or selling of the patented invention. Because Pacific Marine's allegedly infringing ship's hull was still nine months from completion when the complaint was filed, the district court correctly dismissed Count II for failure to state a claim under section 271.[213]

There is virtually no discussion of whether a sale could constitute infringement absent a tangible item. Given the thin, conclusory reasoning and that the accused infringer was not the seller, Brean reads too much into the opinion by suggesting that *Lang* requires a tangible item for there to be an infringing sale.

Moreover, and most importantly, *Lang* predates the adoption of the Agreement on Trade Related Aspects of Intellectual Property ("TRIPS"), as a result of which Congress amended § 271(a) to add

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208 *See id.* at 791.

209 Lang v. Pac. Marine & Supply Co., 895 F.2d 761, 763 (Fed. Cir. 1990) ("At the time suit was filed, Thompson Metal was in the process of manufacturing a hull structure for Pacific Marine & Supply that Lang contends would, when finished, infringe its patent.").

210 *Id.*; *see also* Lang v. Pac. Marine & Supply Co., 703 F. Supp. 1404, 1406 (D. Haw. 1989) ("Pursuant to a contract with Pacific Marine, Thompson Metal is in the process of manufacturing the hull structure for a swath type vessel which Plaintiffs contend will infringe on one or more of their patents.").

211 The complaint contained five counts total. *Lang*, 895 F.3d at 763. Lang appealed the two counts relating to patent infringement, one alleging false patent marking, and the other alleging false advertising. *Id.*

212 *Id.* at 763-65.

213 *Id.* at 765 (citations omitted).

"offering to sell" and "importing" as forms of direct infringement.[214] As such, the decision has no precedential effect on the interpretation of the "offer to sell" provision, as was performed in *Transocean*.[215] Moreover, the adoption of "offers to sell" as a form of direct infringement may require a reconsideration of the "sale" form if inconsistencies arise between the two.[216]

Transocean of course does not definitively answer the question of CAD files because the court was not considering digital infringement. Yet the thrust of the opinion may be broader than Mr. Brean suggests for at least three reasons. First, although the offer to sell did contemplate the eventual transfer of a tangible device, the defendant would have been liable *even if no transfer ever took place*.[217] Thus tangibility was not a requirement for infringement under the court's analysis.

Second, rather than focusing on the tangibility of the device, the court focused on the economic interests of the patentee.[218] The patentee's interests would often be more directly implicated by the sale of CAD files than a contract for the future sale of a tangible item. CAD files are easily transferable and are one click away from producing a tangible object. A transfer of a CAD file is likely to take place immediately and makes future, tangible infringement all too easy. Contracts for future delivery as in *Transocean* may never lead to tangible infringement because the contracted item may never be built, let alone delivered.

Third, as this Article has discussed, 3D printing and other DMT are bridging the digital and physical worlds, rendering many of the distinctions between "tangible" and "intangible" anachronistic. Whether the device was "tangible" at the time it was transferred is inconsequential from the view of the patentee's interests. Because the

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[214] *See* Uruguay Round Agreements Act, Pub. L. No. 103-465, § 533(a)(3)(B), 108 Stat. 4809, 4988 (1994); *see also* Holbrook, *Territoriality Waning*, *supra* note 186, at 722.

[215] *See* Transocean Offshore Deepwater Drilling, Inc. v. Maersk Contractors USA, Inc., 617 F.3d 1296, 1308-10 (Fed. Cir. 2010).

[216] *See* Technical Mfg. Corp. v. Integrated Dynamics Eng'g, Inc., 183 F. Supp. 2d 339, 342-44 (D. Mass. 2002).

[217] *Transocean*, 617 F.3d at 1310-11. Infringement would hold even if the device was never constructed or was constructed in a modified way to avoid infringement. Indeed, the defendant in *Transocean* attempted to avoid infringement by constructing the device in a way that differed from the specifications contained in the offer to sell. The court refused to allow subsequent design modification to avoid infringement, stating, "[t]he potentially infringing article is the rig sold in the contract, not the altered rig that Maersk USA delivered to the U.S." *Id.* at 1311.

[218] *Id.* at 1309.

CAD file can be printed with ease in the privacy of a home or business, the patentee does not care whether it was printed before the transfer or after. In fact, the transfer of the CAD file is potentially *more* harmful to the patentee, because that CAD file can be copied and further distributed to many more users.

Opponents of our view could argue that CAD files are different from the *Transocean* scenario. In *Transocean*, the offer and completed sale contemplated the delivery of a single item, the oil rig.[219] The lost sale is tied to the singular item contemplated by the commercial activity. In contrast, a sale or offer to sell a CAD file is not limited to one instantiation of the invention. The CAD file can be used to create multiple copies of the patented invention. There is no correlation between the sale and the item. The CAD file, in some sense, just the *potential* for infringement, and there is no infringement until an item has been produced. Thus, infringement should be limited in the context of CAD files solely to the "making" of the invention, once the CAD file is used to direct the printer.

We do not view this as a distinction of importance. Part of that argument begs the question of what the "item" should be — the file or the ultimately produced item. Moreover, it would seem that the sale of the file actually risks far greater harm to the patent owner than the sale of a single embodiment (tangible or intangible) of the patented invention. Ultimately, we view this concern as one more of remedy — injunctions and the appropriate damages award — as opposed to one of liability. In other words, a CAD file versus a contract may impact how we measure the harm to the patentee and, as a result, the appropriate damages. It should not determine the threshold question of whether there is liability.

Hence, the Federal Circuit and even the Supreme Court increasingly recognize that tangibility is not the *sine qua non* of offers to sell and sales of patented inventions.[220] It is possible that the Federal Circuit could already regard the offer to sell and sale of CAD files as an act of patent infringement.[221] Nevertheless, patentees may remain vulnerable

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[219] *Id.* at 1307.

[220] *See* Holbrook, *After* Transocean, *supra* note 189, at 1108 (discussing Pfaff v. Wells Elecs., Inc., 525 U.S. 55 (1998)).

[221] Treating offers and sales of CAD files as acts of infringement would produce many interesting consequences. Although space constraints prevent us from exploring them in this Article, we query for future research whether mere advertisements of CAD files might constitute contract-law "offers" because there is no "multiple acceptance" problem that renders most advertisements mere invitations for offers. *See* E. ALLAN FARNSWORTH, CONTRACTS 134 (4th ed. 2004) ("A customer would not usually have reason to believe that the shopkeeper intended exposure to the risk of a

to harm from CAD files because, as discussed previously, CAD files can be made so cheaply that others might be willing not to sell them, but to offer them to the world for free.[222]

B. Should a CAD File Constitute "Making" the Patented Invention

A large gap in protection to the patentee, however, is that liability for selling or offering to sell the invention requires a *sale*; offers to donate and actual donations are not infringing.[223] If freely transferred CAD files are not sales or offers to sell, a patentee could only capture the creators and purveyors of such files through a change or extension of current law. Some of the CAD webpages that have popped up simply post these files and allow free downloads, and peer-to-peer networks already facilitate free transfers of CAD files.[224] These activities fall outside of the commercial appropriation protection afforded by the "sales" and "offers to sell" forms of infringement.

Patentees may want to rely on the statutory category of infringement by "making" the patented invention.[225] Each act of copying a CAD file would constitute an independent act of "making" the invention. Given the simplicity of translating a file into a physical embodiment, we consider whether the tangible-intangible divide still makes sense. In earlier work, one of us argued that "making" the patented invention required a physical embodiment because the infringement involved

multitude of acceptances resulting in a number of contracts exceeding the shopkeeper's inventory."). Additionally, numerous extraterritoriality issues will arise when offers cross national borders. *See* Lucas S. Osborn, *Ripple Effects in the Law: The Broadening Meaning of an "Offer to Sell" in Patent Law*, 17 STAN. TECH. L. REV. 549, 559-72 (2014) [hereinafter *Ripple Effects*] (describing extraterritorial consequences of inter-country offers).

222 *See supra* notes 126–28 and accompanying text.

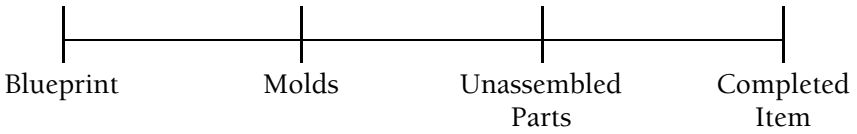
223 *See* HollyAnne Corp. v. TFT, Inc., 199 F.3d 1304, 1309-10 (Fed. Cir. 1999) (holding, in the personal jurisdiction context, that "a mere offer to donate, where a donation is never made, cannot be an offer for sale" under § 271(a)). The court limited its holding to the facts of the case, which were that the offered donation was small and insignificant, the donation was never consummated, and the would-be donor appeared not to be motivated by any current or future commercial gain. *Id.*

224 Ernesto, *supra* note 66. For a webpage facilitating finding free CAD file downloads, see *Where to Find Free 3D CAD Models for 3D Printing*, 3D PRINTING SYS., http://3dprintingsystems.com/where-to-find-free-3d-cad-models-for-3d-printing (last visited Feb. 10, 2015).

225 *See* 35 U.S.C. § 271(a) (2012) (listing the unauthorized "making" of the patented invention as acts of infringement). A patentee could also attempt to sue a CAD file owner for "using" the invention, but current law interprets "using" the invention in such a way as to make this claim unlikely to succeed. *See* Brean, *Asserting Patents*, *supra* note 18, at 800-03.

the physical appropriation of the invention.[226] Commercial appropriations through sales and offers to sell the invention, however, would not require a physical embodiment.[227] CAD files and 3D printing, however, require us to reconsider this bifurcation.

In thinking about the ways that an invention can be "made," one can consider a spectrum of activities that begin to approximate the making of the invention, represented in the below diagram.



At the far right is the classic case of making the invention — a completed tangible item. There is no controversy that completion of the patented invention would qualify as "making" the invention under § 271(a). At the other extreme, there are blueprints, engineering design diagrams, and the like. These items, whether paper or digital, disclose the claimed invention, yet there remains a need for considerable effort and skill to create the physical manifestation of the invention. Historically, such diagrams would not constitute an infringing "making" of the invention,[228] and we agree. The amount of effort, skill, and resources required to translate the blueprint into the actual invention convinces us that mere blueprints should not constitute infringement for making the claimed invention.

Molds are somewhat closer to finished items, at least for inventions amenable to being formed in this fashion. Once the mold is created, an industrial process can create the item; yet this entails expensive and detailed machinery and processes.[229] So, while this moves us down the

[226] Holbrook, *Threat of a Sale*, *supra* note 9, at 805 ("The nature of the appropriation varies according to the infringing act. In the context of offers to sell the invention and actual sales of the invention, the appropriation is commercial. In this context, the infringer has utilized the invention for commercial gain without compensating the patentee. In the context of 'making,' 'using,' or 'importing' the invention, however, the appropriation is physical use of the invention without compensation. To properly analyze infringement as appropriation, the courts should take a bifurcated approach, analyzing offers to sell and sales distinctly from the infringement analysis for making, using, or importing the invention.").

[227] *Id.*

[228] *See supra* note 177.

[229] *See* Alec, *Is 3D Printing a Viable and Affordable Alternative to Injection Molding Production?*, 3DERS (Nov. 6, 2014), http://www.3ders.org/articles/20141106-is-3d-printing-technology-a-viable-and-affordable-alternative-to-injection-molding-

spectrum to some extent, we do not believe that molds cross the line where the mold alone should constitute an act of making the claimed invention. We also expect that this question rarely arises because, unlike CAD files, few, if any, molds can create a complete and operable patented product with no further assembly required.[230]

Another point on the spectrum is the situation where someone has made all of the components of the invention but has not assembled them. These scenarios were present in *Deepsouth*[231] and *Paper Converting Machine Co. v. Magna-Graphics Corp.*[232] In *Deepsouth*, the accused infringer had manufactured the components of the invention and shipped them abroad for assembly.[233] Addressing the territorial limits of U.S. patent law, the Supreme Court, in a 5–4 decision, concluded that the accused infringer had not "made" the invention within the United States under § 271(a) of the Patent Act.[234]

The Federal Circuit did not confront a territoriality issue in *Paper Converting*. Instead the court had to deal with a patent's expiration: the accused infringer never assembled the complete machine during the patent term.[235] The infringer instead tested various parts of the device in isolation, and the customer assembled the machine two days after the patent expired.[236] The Federal Circuit concluded that this activity constituted infringement and distinguished *Deepsouth* as being limited to the extraterritorial issue.[237]

The Federal Circuit's distinction of *Deepsouth* is dubious, and courts have since marginalized *Paper Converting*.[238] Regardless, the Supreme

production.html.

230 *See, e.g.*, *Casting: Metal Casting Process*, THE LIBRARY OF MFG., http://www.thelibraryofmanufacturing.com/metalcasting_basics.html (last visited Dec. 31, 2014) ("A mold is formed into the geometric shape of a desired part.").

231 Deepsouth Packing Co. v. Laitram Corp., 406 U.S. 518 (1972).

232 Paper Converting Mach. Co. v. Magna-Graphics Corp., 745 F.2d 11 (Fed. Cir. 1984).

233 *See* Holbrook, *Extraterritoriality*, *supra* note 158, at 2131-32.

234 *See Deepsouth*, 406 U.S. at 531. Congress legislatively overruled *Deepsouth* when it adopted 35 U.S.C. § 271(f) in 1984. *See* Cardiac Pacemakers, Inc. v. St. Jude Med., Inc., 576 F.3d 1348, 1359-60 (Fed. Cir. 2009); *see also* Holbrook, *Extraterritoriality*, *supra* note 158, at 2132.

235 *Paper Converting*, 745 F.2d at 15-16.

236 *Id.* at 14-15; *see also* J. Dwyer Murphy, Case Note, Paper Converting Machine Company v. Magna-Graphics Corporation*: Increased Protection Against Making and Using Combination Patents*, 34 AM. U. L. REV. 761, 776 (1985).

237 *Paper Converting*, 745 F.2d at 16-20.

238 *See* De Graffenried v. United States, 25 Cl. Ct. 209, 214 (1992); Conner Peripherals, Inc. v. W. Digital Corp., No. C-93-20117-RMW-EAI, 1993 WL 645932, at *12 (N.D. Cal. Aug. 16, 1993) (noting that the narrow purpose of *Paper Converting*

Court's split decision in *Deepsouth* decision and the arguably inconsistent holding of the Federal Circuit in *Paper Converting* confirm that the creation of the components of a device that remain unassembled falls far closer to the line of an infringing "making" of the invention (and, in the minds of some, actually crosses that line).

Where, then, do CAD files fall? They are completely intangible, which makes them considerably different than unassembled components. Yet they are far different than blueprints or molds because the creation of the object from the file is simple and routine. It just takes the push of a button. Potentially, it is even easier than assembling the components of an apparatus, which could take considerable effort and skill, not to mention tools.

Our contention is that the interest in CAD files is not the files themselves, but instead the object ultimately produced. Generally, someone does not download a CAD file simply for the purpose of having the file. Instead, the purpose is to produce the object for which the file codes. As a result, some of these freely disseminated CAD files would likely displace some of the patent holder's sales. The dramatically reduced gap between the physical and intangible suggests that the mere creation of the CAD file could, and perhaps should, constitute an infringing "making" of the patented item. Otherwise, patentees will often be helpless against massive, gratuitous dissemination of CAD files.[239] If the courts or Congress were to take this step, it would provide greater protection for patent holders against infringement in the emerging era of 3D printing and similar technologies.

C. Intangible Infringement via the Doctrine of Equivalents

The above direct infringement analysis highlights that 3D printing and other DMT have matured after the current patent infringement laws were drafted. Luckily, patent law, being concerned with the forefront of technological advancement, has important doctrines to accommodate technological change. One such doctrine, the doctrine

was to preserve the patent term).

[239] Although space constraints prevent us from addressing them here, we note that if the law considered copying a CAD file to be "making" the invention, many legal questions would arise. Just to raise a few: Query whether internet intermediaries should be liable for making copies on their servers? If a CAD file enters the United States electronically, does that constitute an "importation" (and if so, who is liable for the importation)? What of files passing temporarily through the United States on the "wires" of the internet (when 35 U.S.C. § 272 is limited to inventions needed on temporarily present vessels, aircraft, or vehicles)? We leave these questions to future work.

of equivalents, ensures that the "scope of a patent is not limited to its literal terms but instead embraces all equivalents to the claims described."[240]

The doctrine was created to prevent competitors from avoiding infringement by making unimportant and insubstantial differences to their technology.[241] For example, one cannot escape infringement of a patent covering a complex patented machine by simply substituting screws for bolts when attaching the machine pieces together (assuming the claim required bolts). The doctrine is particularly useful to prevent the patent's obsolescence. Patent owners are able to capture technologies that arise after the patent's issuance that nevertheless are deemed close enough to the claimed invention to constitute infringement.[242]

While the application of the doctrine of equivalents is highly fact-intensive and not a "prisoner of a formula,"[243] courts have developed various formulations for analyzing whether a particular accused device is equivalent to the patented device.[244] First, courts can use the "insubstantial differences" test, which simply asks whether there is a substantial difference between an element of the patented product and the accused product.[245] Second, courts can follow the "triple identity" test and ask whether the accused element performs substantially the same function in substantially the same way to achieve substantially the same result.[246] Finally, the known interchangeability of the claimed limitation and the element in the device accused of infringing also informs the analysis.[247] Evaluation of equivalency remains a highly fact-intensive inquiry.[248]

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[240] Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 535 U.S. 722, 732 (2002).

[241] *Id.*

[242] *See* Christopher A. Cotropia, *"After-Arising" Technologies and Tailoring Patent Scope*, 61 N.Y.U. ANN. SURV. AM. L. 151, 174-75 (2005); Timothy R. Holbrook, *Equivalency and Patent Law's Possession Paradox*, 23 HARV. J.L. & TECH. 1, 15-29 (2009) [hereinafter *Patent Law's Possession Paradox*].

[243] Graver Tank & Mfg. Co. v. Linde Air Prods. Co., 339 U.S. 605, 609 (1950).

[244] We are using language loosely here; as explained below, the equivalents analysis looks not at the invention as a whole, but rather at each element or limitation in isolation.

[245] *See* Warner-Jenkinson Co. v. Hilton Davis Chem. Co., 520 U.S. 17, 39-40 (1997); Voda v. Cordis Corp., 536 F.3d 1311, 1326 (Fed. Cir. 2008); Sage Prods., Inc. v. Devon Indus., Inc., 126 F.3d 1420, 1424 (Fed. Cir. 1997).

[246] *Warner-Jenkinson*, 520 U.S. at 39-40.

[247] *Graver Tank*, 339 U.S. at 609 ("An important factor is whether persons reasonably skilled in the art would have known of the interchangeability of an ingredient not contained in the patent with one that was.").

[248] *Id.*

As one of us has noted previously, it may be possible for patentees to use the doctrine of equivalents to capture CAD files, even if the courts do not adopt our above analysis for direct infringement for selling, offering to sell, or making the invention.[249] A court confronting equivalency in the CAD context will have to perform the test on an element-by-element basis.[250] Initially, this might appear conceptually difficult because CAD files do not have elements in the same way that physical devices do. The file itself has no "components" for a basis of comparison; they are merely code for the printer to produce the item. This line of thinking, however, demonstrates a pre-digital era framework. In the digital era, courts could compare the elements *of what the CAD file would print* to the limitations listed in the patent claims.

To a pre-digital mind, CAD files are very different from the physical device, and thus we suspect that there will be strong resistance to applying the doctrine of equivalents in this way. Again, however, in a post-digital manufacturing world, if a patentee cannot protect against the distribution of CAD files, it is largely powerless to stop many forms of infringement. Thus, if literal infringement cannot help the patentee, a fairness rationale could suggest applying the doctrine to CAD files.[251] Applying the doctrine of equivalents in this novel way also finds support in the doctrine's emphasis on technology that becomes significant after a patent was filed.[252] In a world with

[249] Osborn, *Regulating 3D Printing*, *supra* note 5, at 587 ("[A]s 3D printing brings closer together merges the worlds of bits and atoms, the equivalents argument does not seem that far-fetched — the CAD file is practically the same thing as the physical product.").

[250] *Warner-Jenkinson*, 520 U.S. at 29 ("Each element contained in a patent claim is deemed material to defining the scope of the patented invention, and thus the doctrine of equivalents must be applied to individual elements of the claim, not to the invention as a whole."). Patent claims contain "elements" or "limitations," which are simply the sub-parts of the invention. Thus, a patent claim to a chair might contain the elements of four legs, a flat surface for seating support, and a vertical surface for supporting the back of the user. The claim must also describe how the various elements are put together. JANICE M. MUELLER, PATENT LAW 96 (4th ed. 2013).

[251] *See generally* Holbrook, *Patent Law's Possession Paradox*, *supra* note 242, at 36-37 (arguing fairness as most persuasive normative basis for doctrine of equivalents); Michael J. Meurer & Craig Allen Nard, *Invention, Refinement and Patent Claim Scope: A New Perspective on the Doctrine of Equivalents*, 93 GEO. L.J. 1947, 1956-60 (2005) (tracing a fairness rationale for the doctrine of equivalents).

[252] *See* Meurer & Nard, *supra* note 251, at 1970 ("The third source of friction arises from the difficulty foreseeing technical developments relevant to the patented technology."); *see also* Chiuminatta Concrete Concepts, Inc. v. Cardinal Indus., Inc., 145 F.3d 1303, 1310 (Fed. Cir. 1998) ("The doctrine of equivalents is necessary because one cannot predict the future. . . . [A] variant of an invention may be

ubiquitous DMT, CAD files will in many ways be insubstantially different from the physical device, just as a digital copy of a book is insubstantially different from the printed version.

IV. SHOULD COURTS RECOGNIZE CLAIMS FOR DIGITAL PATENT INFRINGEMENT?

Thus far, we have largely described potential applications of patent laws to DMT in light of the harm that patentees might incur from CAD files. We have demonstrated that patent law is already flexible enough to capture some digital patent infringement and that additional extensions of the law would capture much more. But it is important to look holistically at the issue in light of the patent system's various goals and the effects of recognizing a claim for digital patent infringement. This Part explores a number of these countervailing considerations.

A. Impact on the Incentive to Innovate

Because the main purpose of the patent system is to incentivize innovation,[253] we must carefully consider the impact on the costs and risks of innovation if the extensions we propose are adopted. As we have argued, if patentees cannot control the CAD files that are central to DMT, they will lose much of their ability to monetize their patent rights. This loss of enforcement power could dampen innovative incentives, possibly leading to underinvestment in innovation.

But there is a flipside to the incentive story for DMT because DMT has the potential to significantly lower the costs of innovation, thus reducing the need for a strong patent system. One of us has explored

developed after the patent is granted, and that variant may constitute so insubstantial a change from what is claimed in the patent that it should be held to be an infringement."); Cotropia, *supra* note 242, at 161 ("As of late, the emphasis on the doctrine of equivalents has focused on protecting one specific type of equivalent termed an 'after-arising equivalent.'"). Of course, 3D printing has existed since the 1980s, but it has only recently begun to enter the public's general awareness. *See* Osborn, *Regulating 3D Printing*, *supra* note 5, at 560. Hence, neither inventors nor patent attorneys would be likely to have considered CAD files as a meaningful method of protection until recently. It cannot, however, be considered an "after-arising" technology indefinitely. At some point, it becomes the patentee's obligation to affirmatively draft claims to CAD files, if patent law will allow it.

[253] *E.g.*, Diamond v. Chakrabarty, 447 U.S. 303, 307 (1980) ("The patent laws promote [technological] progress by offering inventors exclusive rights for a limited period as an incentive for their inventiveness and research efforts.").

the issue elsewhere[254] and it is worth highlighting some of the impacts of DMT on innovation costs.[255] For example, 3D printing is dramatically lowering the costs of scientific research tools used for basic research.[256] 3D printing also lowers the costs of prototyping an invention and advancing the prototype into a commercial embodiment.[257] Once a commercial embodiment is ready for production, 3D printing lowers the costs and risks of a product launch because the inventor can manufacture on an as-needed basis, rather than paying huge up-front costs for mass-production machines. Of course, because CAD files can be transmitted directly to purchasers for remote printing, the costs of distributing final products can be greatly reduced as well.

These are examples to highlight that, once mature, DMT will demand a thorough reevaluation of the patent system's balance. If DMT dramatically reduces the costs and risks of innovation as a whole, then it might also correspondingly reduce the need for current patent incentives.[258] A crucial premise of the patent system is that inventors need the period of exclusivity to recover sunk research and development costs.[259] If DMT dramatically reduces these costs, then lawmakers may need to recalibrate the system. This is not necessarily to say that we should abolish the patent system, but rather that we might modify it to provide a smaller incentive. For example, we might shorten the patent term from its current term of twenty years from the application date.[260]

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[254] Lucas S. Osborn et al., *The Case for Weaker Patents*, 90 ST. JOHN'S L. REV. (forthcoming 2016), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2585764.

[255] As used here, innovation includes the stages of basic research, invention, prototyping, developing a commercial embodiment, marketing, and distribution. *Id.* at 14-15.

[256] Joshua M. Pearce, *Building Research Equipment with Free, Open-Source Hardware*, 337 SCIENCE 1303, 1303-04 (2012); Osborn et al., *supra* note 254, at 15-22.

[257] *See, e.g.*, CHEE KAI CHUA ET AL., RAPID PROTOTYPING: PRINCIPLES AND APPLICATIONS 13-14 (3d ed. 2010) (describing the benefits of 3D printing); Osborn et al., *supra* note 254, at 22-35.

[258] However, one must also take into account that DMT makes it easier for infringers to copy successful products quickly. Osborn et al., *supra* note 254, at 44-46.

[259] *See* Timothy R. Holbrook, *Possession in Patent Law*, 59 SW. L.J. 123, 134-35 (2006) [hereinafter *Possession*].

[260] Osborn et al., *supra* note 254, at 52-55. Our international obligations under the Agreement on Trade Related Aspects of Intellectual Property ("TRIPS") would limit Congress's ability to alter patent terms because it requires at least a twenty-year term. *See* Uruguay Round Agreements Act, Pub. L. No. 103-465, § 532, 108 Stat. 4809, 4984 (1994) (adopting twenty-year term pursuant to TRIPS); Agreement on Trade-Related

Other scholars have likewise noticed the disruption that DMT will bring to patent law. Mark Lemley has noted that 3D printing and related technologies make it "entirely plausible to envision a not-too-distant world in which most things that people want can be downloaded and created on site for very little money — essentially the cost of raw materials."[261] He explains that in such a world, the need for intellectual property laws will be dramatically reduced such that "justified instances of IP will become islands in a sea of cheap goods, content, and even services delivered to your home in the form of digital information."[262]

But Professor Lemley's world without scarcity does not yet exist (as he readily admits).[263] Adjusting patent law as a whole based on DMT does not yet make sense because DMT does not yet account for a significant amount of manufacturing.[264] And even when it does, it likely will not lower innovation costs equally across all technologies. If this is so, then lawmakers might decide to avoid weakening all patents. Instead, they could weaken only patents covering technologies for which DMT has most dramatically lowered innovation costs. Technologies most affected by DMT will generally be those in which designers can create CAD files that will print finished (or nearly finished) products.[265]

Aspects of Intellectual Property Rights, art. 23, Apr. 15, 1994, 1869 U.N.T.S. 299 ("The term of protection available shall not end before the expiration of a period of twenty years counted from the filing date."). To attempt to avoid problems with TRIPS, the PTO could dramatically increase the last of the patent maintenance fees. Osborn et al., *supra* note 254, at 55-59.

261 Mark A. Lemley, *IP in a World Without Scarcity* 2 (Stanford Law Sch. of Pub. Law, Working Paper No. 2413974, 2014), *available at* http://ssrn.com/abstract=2413974.

262 *Id.* at 6.

263 *Id.* at 5.

264 *See* WOHLERS ASSOCS., WOHLERS REPORT 2013, at 128 (2013) (noting that in 2012 the 3D printing industry's total revenue was about $3.4 billion and that if it captured just 1% of the global manufacturing market it would be worth $105 billion). 3D printing companies use the technology to produce finished parts in about 28% of their work. *Id.* at 20.

265 Finished products that can be 3D printed will tend to have reduced prototyping, development, manufacturing, and distribution costs. Osborn et al., *supra* note 254, at 15-35. Even where a manufacturer cannot 3D print a completely finished product, patent law traditionally protects against the manufacture of non-staple, key components of the product. *See* 35 U.S.C. § 271(c) (2013). If digital patent infringement claims do not protect against CAD files that manufacture key components of products, the incentives to invent those finished products will be reduced.

Even before Congress acts, courts could target these DMT-affected technologies by refusing to recognize a cause of action for digital patent infringement even though selling and transferring CAD files harms patentees. This approach has an appeal in that it is inherently technology-specific: to the extent DMT reduces the need for patents covering specific technologies, only those patents are affected. On the other hand, such a decision might best be left to Congress after a holistic study of the issue.

Needless to say, the effects of DMT on the patent system warrant careful and thorough study. We cannot here provide an in-depth analysis, but we hope that future scholarship will explore this important area.

B. Effects on Laypeople

DMT and digital patent infringement have the unique potential to bring laypeople into intimate contact with patent law, particularly if the making, using, and selling of CAD files constitutes direct infringement. Such persons have little knowledge of patent law.[266] Yet DMT may expose them to potentially massive monetary damages[267] for making, using, selling, and offering to sell CAD files and the corresponding physical objects.[268] Technically, laypeople commit

[266] *See generally* Jeanne C. Fromer & Mark A. Lemley, *The Audience in Intellectual Property Infringement*, 112 MICH. L. REV. 1251, 1263-64 (2014) (noting that patent infringement is determined from an expert, not lay, point of view); Janis & Holbrook, *supra* note 98 (discussing various persons who may encounter patent law).

[267] Unlike copyright law's statutory damages, patent law's monetary remedies are based on actual harm. *Compare* 17 U.S.C. § 504(c) (2012) (providing for statutory damages not tied to actual damages), *with* 35 U.S.C. § 284 (2012) (allowing damages "adequate to compensate for the infringement" and no provision for statutory damages). Thus, a patentee would need to prove damages or a reasonable royalty, which might be difficult, especially where CAD files are distributed without charge. But even uncompleted offers to sell and free transfers of CAD files can harm the patentee through lost sales and price erosion. *See supra* note 125 (discussing price erosion). A patentee can also obtain an injunction to stop future infringement. *See* 35 U.S.C. § 283 (2012).

[268] Whether or not courts recognize a cause of action for digital infringement, individuals who print physical objects will be liable as infringers. *See, e.g.*, Doherty, *supra* note 18, at 358-60 (describing how 3D printing will expose laypeople to claims for patent infringement for printing physical objects). But finding these individuals will be very difficult because they are likely to print the objects in the privacy of their home. Depoorter, *supra* note 14, at 1496 ("[S]ince most infringement occurs inside private homes, there is a greater perception of safety and anonymity with unauthorized 3D printing than when purchasing illegal goods in markets or online using a credit card. Like music and movie downloading on peer-to-peer networks, most infringement will be difficult to detect."). A cause of action for digital

patent infringement often even outside of the DMT context. Any time laypersons use an infringing device — such as a cell phone that might be covered by thousands of patents — they are infringing any relevant patents by using the invention.[269] Thus far, however, patentees have generally not sued individual end users, likely because (1) they can more efficiently sue upstream, centralized, and deep-pocketed companies, and (2) suing one's customers is hardly a good business model for engendering customer goodwill.[270]

The potential for such widespread liability in the general public is comparable to laypeople's exposure to copyright infringement claims in the Napster and Grokster era, when copyright holders demanded huge sums of money from teenagers and other individuals.[271] Just as copyright infringement lawsuits against individuals created a normative backlash against the copyright system and copyright holders,[272] patent infringement lawsuits against unwitting infringers would likely energize the masses against patent law and patent holders. Indeed, we have already seen such a backlash against patent assertion entities, pejoratively referred to as patent trolls, who have sued small actors like coffee shops.[273] The difficulties for patent law are even greater than they were for copyright because patent law does not require copying. Moreover, patents are opaque documents,[274] directed to technologists and lawyers,[275] so even laypersons who may be aware of the patent would likely have no idea whether they infringe.[276] Most people who copied music knew they were doing

infringement would undoubtedly increase legal exposure of individuals.

[269] *See* 35 U.S.C. § 271(a) (defining unauthorized use of patented invention as act of direct infringement). The smart phone users would not be infringing if the manufacturer of the phone had obtained a license, thus exhausting the patent rights as to the consumer. *See* Quanta Computer, Inc. v. LG Elecs., Inc., 553 U.S. 617, 635-38 (2008).

[270] *See* Hughes, *supra* note 14, at 728-29 (summarizing arguments against suing customers, but arguing that sometimes it may be a good idea).

[271] Amy Harmon, *Recording Industry Goes After Students over Music Sharing*, N.Y. TIMES (Apr. 23, 2003), http://www.nytimes.com/2003/04/23/us/recording-industry-goes-after-students-over-music-sharing.html.

[272] *Id.*

[273] *See* Scott Joslove, *Patent Trolls Threaten Small Businesses*, THE HILL CONGRESS BLOG (Dec. 05, 2013, 2:00 PM), http://thehill.com/blogs/congress-blog/economy-budget/192096-patent-trolls-threaten-small-businesses.

[274] Sean B. Seymore, *The Teaching Function of Patents*, 85 NOTRE DAME L. REV. 621, 633-41 (2010) (discussing the complex language of patents).

[275] Timothy R. Holbrook, *Patents, Presumptions, and Public Notice*, 86 IND. L.J. 779, 785-86 (2011) (discussing technical and legal nature of the patent document).

[276] Janis & Holbrook, *supra* note 98, at 88-89 & n.53.

something the law forbade,[277] but individuals are unlikely to have any idea that CAD files and their physical instantiations infringe a patent.[278] Further, even if someone became concerned about patent infringement, determining whether the patent was infringed would likely require an expensive attorney, and even then a large zone of uncertainty may persist.[279]

As DMT matures, lawmakers and patent holders should pay careful attention to societal norms surrounding patent law. If laypeople see patent laws as unfair or unduly burdensome, they may decide to break the law or to advocate for change to it.[280] As Professor Wu described in the copyright context, a legal regime is susceptible to technological avoidance strategies when it lacks normative support.[281] Thus, if societal norms differ extensively from patent law's regime, a wave of internet-based patent "piracy" may emerge.[282] Minimally, such a normative shift could threaten the legitimacy of the patent system.[283]

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[277] *See* David McGuire, *Report: Kids Pirate Music Freely*, WASH. POST (May 18, 2004, 5:39 PM), http://www.washingtonpost.com/wp-dyn/articles/A37231-2004May18.html ("More than half of young Americans with Internet access continue to download free music even though they know that they are breaking the law, according to a poll released today.").

[278] *See supra* notes 97–99 and accompanying text. Many people will be completely unaware that a patent exists. WEINBERG, IT WILL BE AWESOME, *supra* note 18, at 5.

[279] Patent infringement is notoriously difficult to predict accurately because it involves so many indeterminate inquiries, such as validity, claim construction, and the doctrine of equivalents. *See supra* notes 95–96.

[280] *See* Osborn, *Regulating 3D Printing*, *supra* note 5, at 605-07 (discussing change and avoidance responses to laws).

[281] Tim Wu, *When Code Isn't Law*, 89 VA. L. REV. 679, 707-08 (2003) (stating that a regime that relies on gatekeeper enforcement and lacks normative support is susceptible to technological avoidance strategies).

[282] *See* Depoorter, *supra* note 14, at 1493 ("Users of 3D printers will likely form beliefs and attitudes that support liberal uses of 3D printers and will reject legal reform to the contrary. Users of 3D printers might experience loss aversion when what they consider to be legitimate is suddenly found to be illegal. In this process, the perception of having something 'taken away' might add to the resistance we can expect when IP rights will be enforced on products of 3D printing."); Osborn, *Regulating 3D Printing*, *supra* note 5, at 619 ("To the extent [patent law] does not suffer from a normative weakness, 3D printing will pose less of a piracy threat to the patent regime than to the copyright and trademark regimes.").

[283] *See generally* Depoorter, *supra* note 14, at 1498-99 ("If the public perceives enforcement to be excessive, this might reinforce or strengthen a belief that the legal regime is not legitimate or that a legal rule is unjust."); Timothy R. Holbrook & Mark D. Janis, *Expressive Eligibility*, 4 U.C. IRVINE L. REV. (forthcoming 2015) (manuscript at 13) (on file with authors) (discussing the Supreme Court's potential concerns in eligibility doctrine with the legitimacy of the patent system).

Facing the prospect of massive infringement by the general public, courts may decide to avoid this problem by not recognizing claims for digital patent infringement. Another option would be simply to exempt individuals from patent infringement suits involving digital patent infringement, similar to proposals made in the patent assertion entity context.[284] Such a step, however, would need to be legislative because the patent statute does not contain any such carveouts.

Both of these proposed solutions, however, are overbroad: they would protect not only innocent laypersons but also intentional, repeat infringers who appropriate a significant share of a patent's value. To resolve this problem, one could extend liability only to those making commercial use of the patented invention.[285] In addition, the law could extend liability only to individual infringers who bear some culpability, rejecting the current strict liability regime. Culpability could range from an intent to infringe, knowledge of infringement, recklessness, negligence, or simply having actual notice of a patent. The highest standards, intent to infringe and knowledge of infringement, would make it difficult for patentees to enforce their patent for the same reasons as in the indirect infringement context.[286] Intermediate standards like recklessness and negligence would give courts flexibility to work toward a fair result, but would come at the costs of uncertainty and litigation expense. An objective test that asks whether the accused infringer had actual notice of the patent reduces uncertainty and expense, but puts a relatively high burden on laypeople to ascertain the merits of a potential patent dispute.

Alternatively, courts could use remedies to achieve the same objectives. Courts could decline to use injunctive relief against innocent infringers. As to damages, courts could use an infringer's status as an innocent infringer to reduce the damages considerably, with a reasonable royalty rate approaching zero. This flexibility is in sharp contrast to copyright law, which has statutory damages that limit courts' discretion.[287] Whereas judges have no choice to award

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[284] *E.g.*, *Legislative Solutions for Patent Reform*, ELEC. FRONTIER FOUND., https://www.eff.org/issues/legislative-solutions-patent-reform (last visited Aug. 8, 2014) ("End-user immunity — The law should not allow trolls to prey on end users.").

[285] For a proposal along these lines, but for the actual printing of the physical object, see Doherty, *supra* note 18, at 368-69. Another proposal, also offered in the context of printing the physical object, suggests limiting infringement suits to those involving a minimum amount in controversy. *See* Desai & Magliocca, *supra* note 39, at 1717.

[286] *See supra* notes 81–101 and accompanying text.

[287] 17 U.S.C. § 504(c) (2012).

statutory damages if plaintiffs elect that remedy in the copyright context, judges have greater flexibility in the patent context to address concerns of digital infringement against innocent infringers from the general public.

In sum, DMT will expose laypersons to patent infringement liability on an unprecedented scale. As this potential becomes reality, various actors in the patent system must be prepared to address the potential consequences. Our purpose is to highlight some of these issues; it is far beyond the scope of this Article to be able to address all of them. We leave those questions to future study.

C. Effects on Intermediaries[288]

Individuals are not the only group affected by digital patent infringement. With digital infringement, websites and other intermediaries that host CAD files may be exposed to additional liability beyond concerns of indirect infringement.[289] With each assertion of direct infringement, intermediaries would face the same expense and uncertainty as individuals do. While intermediaries might have more resources than individuals, they could face a staggering number of infringement assertions because they host many files. Rather than face the expense and distraction of defending patent suits, the intermediaries may simply shut down even if only a small percentage of their files were infringing. But losing legitimate CAD file intermediaries would harm DMT's progress and leave society without useful tools for sharing legitimate CAD files.

These intermediaries resemble those involved in copyright disputes (such as YouTube and Napster) in that they host files without direct knowledge of each specific file on their site.[290] Realizing this similarity, commentators have proposed to protect innocent intermediaries from indirect infringement claims by enacting a DMCA-like regime[291]for the patent context.[292] Such a regime would

[288] Here, we mean online intermediaries, in contrast to the manufacturing intermediaries that are needed in traditional manufacturing contexts. *See* Depoorter, *supra* note 14, at 1495 (discussing "intermediaries in manufacturing").

[289] *See supra* notes 59–70 and accompanying text.

[290] *See* Metro-Goldwyn-Mayer Studios Inc. v. Grokster, Ltd., 545 U.S. 913, 922-24 (2005).

[291] For a description of the DMCA, see Doherty, *supra* note 18, at 365-66.

[292] A well-written student note represents an early example of this proposal. *See id.* at 365-68. Other commentators have echoed this call. *See, e.g.*, Desai & Magliocca, *supra* note 39, at 1718-19 (arguing for extending the notice-and-takedown rules of the DMCA to patents and trade dress).

allow patent holders to send take-down requests for files they believe infringe, and the intermediary could protect itself from infringement claims if it took the file down.[293] Such a proposal could be extended to direct digital infringement. Under this regime, intermediaries would be immune from liability until they have actual notice of a claim for infringement. We realize that, as in the copyright context,[294] a takedown regime may be abused and lead to non-infringing material being removed. Further, the cost of evaluating a responding to takedown notices may result in a de facto extrajudicial regime where any assertion by a patent holder results in the removal of the file. Recognizing these flaws, we nonetheless believe that if courts choose to recognize claims for digital infringement, a DMCA-like process would be preferable to a regime where intermediaries face liability for direct digital infringement even without actual notice of a patent.

D. Spillover Effects

Recognizing a cause of action for digital patent infringement would yield many follow-on effects, some of which we have identified herein.[295] One secondary effect we wish to highlight is our expectation that patent holders would seek to extend the logic to software patents by analogy.[296] Patent law does not permit claiming software in the abstract, but courts did allow claims directed to software loaded on computer-readable medium.[297] In the aftermath the Supreme Court's

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[293] Doherty, *supra* note 18, at 365-68.

[294] *See, e.g.*, Jennifer M. Urban & Laura Quilter, *Efficient Process or "Chilling Effects"? Takedown Notices Under Section 512 of the Digital Millennium Copyright Act*, 22 SANTA CLARA COMPUTER & HIGH TECH. L.J. 621, 666-79 (2006) (describing various problems with DMCA takedown notices in a data set studied by the authors).

[295] *See supra* note 239.

[296] We recognize that software patents are notoriously difficult to define. *See* Mark A. Lemley, *Software Patents and the Return of Functional Claiming*, 2013 WISC. L. REV. 905, 931 n.102 [hereinafter *Software Patents*] (listing several attempts to define software patents). Although CAD files fall under a broad definition of software, here we define software as "the programs that run on a computer and perform certain functions." *Software*, MERRIAM-WEBSTER, http://www.merriam-webster.com/dictionary/software (last visited July 1, 2014). Thus, as we use the terms, patented "software" relates to application programs that run on a general-purpose computer, whereas "files" connote collections of data used by software programs. *See File*, TECHTERMS.COM, http://www.techterms.com/definition/file (last visited July 2, 2014). In this usage, software programs include AutoCAD or Microsoft Word, which interact with files such as CAD files or Word documents, respectively.

[297] *See* Julie E. Cohen & Mark A. Lemley, *Patent Scope and Innovation in the Software Industry*, 89 CALIF. L. REV. 1, 7-10 (2001) (discussing the history of software patents). Computer-readable media include CDs and diskettes. Courts also allowed

decision in *Alice Corporation v. CLS Bank International*, it remains unclear to what extent, if at all, computer software remains patent eligible.[298]

One popular patent claim format for capturing a software-on-readable-medium invention has been the *Beauregard* claim, based on the eponymous case that allowed such claims.[299] A *Beauregard*-style claim would give a patent holder direct control over infringing files,[300] but the viability of these claims (and other software patent claims) are in doubt in light of recent case law.[301] Because *Beauregard*-style claims are of doubtful validity, patentees might seek to extend digital infringement logic to non-3D printing patent claims that require software loaded on a computer.[302]

Even if courts recognize a cause of action for digital patent infringement for CAD files, we think reasons exist for not extending analogous actions to traditional software patent infringement. As an

software to be claimed through method and system claims. *Id.* at 10-11.

[298] *See* Alice Corp. v. CLS Bank Int'l, 134 S. Ct. 2347, 2358 (2014) (requiring software to improve functioning of computer to be eligible subject matter and stating that mere implementation on generic computers is insufficient); Timothy R. Holbrook & Mark D. Janis, *Patent-Eligible Processes: An Audience Perspective*, 17 VAND. J. OF ENT. & TECH. L. (forthcoming 2015) (manuscript at 110-15) (on file with authors) (criticizing the "eligibility as king" dynamic emerging in patent doctrine).

[299] *In re* Beauregard, 53 F.3d 1583, 1584 (Fed. Cir. 1995) (vacating the Patent Office Board of Appeal's decision because the parties, one of whom was the Commissioner of Patents and Trademarks, had come to share the view "that computer programs embodied in a tangible medium, such as floppy diskettes, are patentable subject matter under 35 U.S.C. § 101").

[300] *See* Osborn, *Regulating 3D Printing*, *supra* note 5, at 587 n.206; Dillon, *supra* note 18, at 452-55.

[301] *See, e.g.*, *Alice Corp.*, 134 S. Ct. at 2356 (finding patent claims invalid as too abstract where the claims were directed to a computer system and method for assisting with closing financial transactions in a way that avoids settlement risk); Bilski v. Kappos, 561 U.S. 593, 612 (2010) (rejecting the "useful, concrete, and tangible result" test used in *State Street Bank & Trust v. Signature Financial Group, Inc.*, 149 F.3d 1368, 1373 (Fed. Cir. 1998)); Planet Bingo LLC v. VKGS LLC, 576 F. App'x 1005, 1009 (Fed. Cir. 2014) (invalidating a computer-aided method and system for managing a game of bingo); Digitech Image Tech., LLC v. Elecs. for Imaging, Inc., 758 F.3d 1344, 1351 (Fed. Cir. 2014) (invalidating a process of combining two datasets into a single data set); CyberSource Corp. v. Retail Decisions, Inc., 654 F.3d 1366, 1374-75 (Fed. Cir. 2011) (invalidating a Beauregard-style claim); *see also* David L. Schwartz, *Retroactivity at the Federal Circuit*, 89 IND. L.J. 1547, 1562-64 (2014); Ashby Jones, *Courts Nix More Software Patents*, WALL ST. J. (Sept. 21, 2014, 7:48 PM), http://online.wsj.com/articles/federal-courts-reject-more-software-patents-after-supreme-court-ruling-1411343300 (detailing patents invalidated after *Alice Corp.*).

[302] For an example of such a claim, see Microsoft Corp. v. AT&T Corp., 550 U.S. 437 (2007). S*ee also supra* notes 133–59 and accompanying text.

initial matter, we observe that in contrast to the many-times intangible outputs of criticized software patents,[303] CAD files produce mechanical objects that lie at core of traditional patentable subject matter.

Furthermore, whatever criticisms exist against digital patent infringement for CAD files, even more criticisms exist against software patents.[304] One criticism is that software patent claims have an uncertain scope and meaning, thus making infringement difficult to determine.[305] With digital patent infringement, however, the patent claims are directed to traditional apparatus claims, which involve much less uncertainty. Second, software patents may be less likely to be valid than other kinds of patents,[306] but no evidence suggests that the mechanical patents that would be involved in digital patent infringement are of suspect validity. Third, observers assert that software patents are overbroad, using functional claims to cover more than what was actually invented.[307] These criticisms would generally not apply to mechanical devices.[308] Finally, software patents tend to be associated with patent thickets, defensive patenting,[309] and patent trolls

[303] *See, e.g.*, Jay Dratler, Jr., *Does Lord Darcy Yet Live? The Case Against Software and Business-Method Patents*, 43 SANTA CLARA L. REV. 823, 833-36 (2003) (criticizing software and business method patents); 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) (discussing business method patents, many of which are software patents).

[304] *See, e.g.*, Lemley, *Software Patents*, *supra* note 296, at 928 ("Software patents are widely acknowledged as creating a large number of problems for the patent system."). *But see* David Kappos, Dir., U.S. Patent & Trademark Office, Keynote Address at the Center for American Progress: An Examination of Software Patents (Nov. 20, 2012), *available at* http://www.uspto.gov/news/speeches/2012/kappos_CAP.jsp (arguing in favor of software patents).

[305] Dan L. Burk & Mark A. Lemley, *Fence Posts or Sign Posts? Rethinking Patent Claim Construction?*, 157 U. PA. L. REV. 1743, 1744-45 (2009).

[306] John R. Allison et al., *Patent Quality and Settlement Among Repeat Patent Litigants*, 99 GEO. L.J. 677, 707-09 (2011); Robert Hunt & James Bessen, *The Software Patent Experiment*, BUS. REV., July–Sept. 2004, at 22, 24-27, *available at* http://www.philadelphiafed.org/research-and-data/publications/business-review/2004/q3/brq304rh.pdf.

[307] *See* Kevin Emerson Collins, *Patent Law's Functionality Malfunction and the Problem of Overbroad, Functional Software Patents*, 90 WASH. U. L. REV. 1399, 1400 (2013) ("Software patents are overbroad. Compared to patents in other fields of endeavor, they routinely grant inventors rights that extend further beyond the technology that an inventor has actually invented and disclosed."); Lemley, *Software Patents*, *supra* note 296, at 907-08.

[308] Lemley, *Software Patents*, *supra* note 296, at 908-09 ("This is a problem primarily in software.").

[309] Defensive patenting refers to "the strategy of obtaining patent protection without necessarily intending to assert or enforce those negative rights associated with a patent."

(non-practicing entities).[310] Although patents directed to mechanical devices are not immune from contributing to these phenomena, no data suggest that they do so disproportionately. Cumulatively, these arguments against software patents suggest courts should hesitate before extending additional patent protection for software.

Moreover, courts need not extend digital patent infringement to traditional software patents because they enjoy additional protection via copyright.[311] Copyright protection is important to software developers precisely because it allows them a measure of control over the unauthorized distribution of software code uncombined with hardware.[312] The drawback of copyright is that it protects against only near-verbatim copying of the software,[313] while patents protect software functionality more broadly.[314] Nevertheless, the ability to stop the pirates who copy software verbatim is a valuable tool for software developers.[315]

Admittedly, CAD files may be eligible for copyright protection,[316] but such protection will likely be more limited than even that for computer programs. CAD files fit within copyright law's definition of a computer program,[317] but are unlikely to contain creativity in the same way as program software. Unlike program software, which developers structure in part based on creative expression, the text or code of CAD files is unlikely to be structured creatively.[318] For this

Dan Pierron, *Defensive Patenting*, WIDERMAN MALEK (May 23, 2013, 8:57 AM), http://www.legalteamusa.net/tacticalip/2013/05/23/defensive-patenting. Companies obtain these defensive patents as a determent against others suing them. *Id.*

310 *See* Lemley, *Software Patents*, *supra* note 296, at 928-29, 932-34.

311 Computer programs enjoy dual protection under both copyright and patent law: the creative, as opposed to utilitarian, aspects of computer software are protected as literary works under copyright law. Apple Computer, Inc. v. Franklin Computer Corp., 714 F.2d 1240, 1247-48 (3d Cir. 1983); *see also* 17 U.S.C. § 117 (2012).

312 *See, e.g.*, Peter S. Menell, *Tailoring Legal Protection for Computer Software*, 39 STAN. L. REV. 1329, 1369 (1987) (noting that copyright "inhibit[s] competing firms from reproducing [software] on a mass scale").

313 *See, e.g.*, Pamela Samuelson, *The Uneasy Case for Software Copyrights Revisited*, 79 GEO. WASH. L. REV., 1746, 1770 (2011) (noting that copyright law as applied to software "generally results in programs having thin copyright protection"); *see also* Osborn, *Art and 3D Printing*, *supra* note 39, at 825.

314 Many say too broadly. *See* Cohen & Lemley, *supra* note 296, at 5.

315 Menell, *supra* note 312, at 1369.

316 Osborn, *Art and 3D Printing*, *supra* note 39, at 825-34 (analyzing the possibility of protecting CAD files through copyright).

317 17 U.S.C. § 101 (2012) (defining a computer program as "a set of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result").

318 Osborn, *Art and 3D Printing*, *supra* note 39, at 825-26. Although the object

reason, CAD files are protectable under copyright, if at all, as pictorial, graphic, or sculptural ("PGS") works.[319] Although the categorization of CAD files under copyright law may be tedious, it is not inconsequential. As PGS works, CAD files must contain originality and are only protectable to the extent that they are not useful articles.[320] These requirements limit protections for files created by scanning and perhaps files drawn manually if they lack originality.[321] It is possible that courts might construe all CAD files for utilitarian objects as useful articles because their primary purpose is utilitarian — to instruct a printer how to make a useful object.[322] While a detailed copyright analysis is beyond the scope of this Article, at least some CAD files will not be protectable by copyright and uncertainty exists as to many others.[323]

Finally, even if a particular CAD file had copyright protection, that would not prevent another person from independently creating his own CAD file. Where copyright law does not protect the underlying physical object (for example, because it is a useful article), anyone is free to make her own CAD file of it; they simply cannot copy the copyrighted CAD file.[324] Because 3D scanners and related technology may allow for virtually costless independent creation of CAD files

embodied in the CAD file may be creative, the actual "code" used to describe it will simply be the exact, uncreative instructions needed to depict the object. Program software, in contrast, can contain creative organization. Computer Assocs. Int'l, Inc. v. Altai, Inc., 982 F.2d 693, 706-12 (2d Cir. 1992).

319 17 U.S.C. § 101 (defining PGS works in part as "two-dimensional and three-dimensional works of fine, graphic, and applied art, photographs, prints and art reproductions, maps, globes, charts, diagrams, models, and technical drawings, including architectural plans").

320 Osborn, *Art and 3D Printing*, *supra* note 39, at 826-33.

321 MICHAEL WEINBERG, PUB. KNOWLEDGE, WHAT'S THE DEAL WITH COPYRIGHT AND 3D PRINTING? 15-20 (Jan. 29, 2013) [hereinafter WHAT'S THE DEAL], *available at* https://www.publicknowledge.org/files/What's%20the%20Deal%20with%20Copyright_%20Final%20version2.pdf; Desai & Magliocca, *supra* note 39, at 1706-08; Osborn, *Art and 3D Printing*, *supra* note 39, at 828-31.

322 Osborn, *Art and 3D Printing*, *supra* note 39, at 832-33.

323 For a fuller exposition of these points, see *id.* at 824-835. *See also* WEINBERG, WHAT'S THE DEAL, *supra* note 321, at 5-22.

324 Bleistein v. Donaldson Lithographing Co., 188 U.S. 239, 249-50 (1903). This is why more than one artist can paint a picture of Mount Everest: Mount Everest is not copyrightable. But one cannot copy another's painting of Mount Everest, because the painting is protected by copyright. *Id.* at 249 ("Others are free to copy the original. They are not free to copy the copy."). To put this in the DMT context, copyright law will not stop someone from independently creating a CAD file of a fuel injector (which is not copyrightable because it is a useful article), either from scratch or by 3D scanning it.

from physical objects, any copyright protection of CAD files for utilitarian objects may be valueless.[325]

In sum, commentators heavily criticize software patents, and copyright law can protect software. Hence, even if courts recognize claims for digital patent infringement for CAD files, we do not think an analogous extension should be made for software-combined-with-hardware patents.

E. Impact on Follow-On Innovation

The patent system is not concerned with creating incentives for merely the first invention.[326] Patents disclose the invention,[327] encouraging other innovators to draw on the teachings of the patent and to improve upon it or design around it.[328] If a follow-on innovator makes the invention, then technically they are infringing, as there are only extremely limited safe harbors for experimenting with patented inventions.[329] One way to avoid this problem is for a follow-on innovator to create computer models or designs of the patented invention, and then to alter them virtually to explore ways to improve or design around the patent.[330]

A robust regime of digital patent infringement could undermine the ability of others to design around the patented invention.[331] If we view creation of the CAD file as a form of "making" the claimed invention, then even these digital efforts to design around would technically be a

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[325] Although software may also be reverse engineered, the underlying object (the software code) is protected by copyright. Computer Assocs. Int'l v. Altai, Inc., 982 F.2d 693, 702 (2d Cir. 1992) ("It is now well settled that the literal elements of computer programs, i.e., their source and object codes, are the subject of copyright protection.").

[326] *See* State Indus., Inc. v. A.O. Smith Corp., 751 F.2d 1226, 1236 (Fed. Cir. 1985) ("One of the benefits of a patent system is its so-called 'negative incentive' to 'design around' a competitor's products, even when they are patented, thus bringing a steady flow of innovations to the marketplace.").

[327] 35 U.S.C. § 112(a) (2012).

[328] Holbrook, *Possession*, *supra* note 259, at 131-32; Osborn, *Ripple Effects*, *supra* note 221, at 583-84.

[329] *See* Katherine J. Strandburg, *What Does the Public Get? Experimental Use and the Patent Bargain*, 2004 WISC. L. REV. 81, 83.

[330] *See* B. Thomas Watson, *Carbons into Bytes: Patented Chemical Compound Protection in the Virtual World*, 12 DUKE L. & TECH. REV. 25, 28-29 (2014) (describing the use of molecular modeling to avoid infringing a patent to a chemical).

[331] *Cf.* Holbrook, *Threat of a Sale*, *supra* note 9, at 779 ("An overly broad definition of offer to sell infringement could have a chilling effect on competitors, particularly attempts to design around the patent.").

form of infringement. These concerns about downstream users counsel against extending the definition of "making" to these activities. In contrast, allowing "sales" of, and "offers to sell," CAD files to constitute infringement may not encounter the same concerns, or at least not to the same degree. Sales activity necessarily means that a party is attempting to commercialize the invention, appropriating its economic value.[332] There is less concern that the infringer is seeking to improve upon the invention in this context. Consideration of these downstream impacts supports a bifurcated approach: maintain a tangibility requirement for "making" the patented invention, but permit intangible infringement by "selling" or "offering to sell" the claimed innovation.

Whether to extend patent law in the ways we have explored is clearly a complex question. Even though digital infringement, particularly direct infringement, is justifiable on technical terms, such an expansion may work considerable costs on other parties.

CONCLUSION

The interaction of the patent system and DMT is a difficult one. The extent to which the patent system should respond to the unique issues that DMT present is a vexing question that could have significant impacts on the incentives that patents are intended to provide. On one hand, the proliferation of such technologies likely will negatively impact patent owners, making it more difficult for inventors to protect their innovations from unauthorized appropriation. This concern suggests that the patent system should accommodate greater patent protection, be it through indirect infringement or, as we posit in this Article, expanded views of direct infringement. On the other hand, an overly broad expansion of patent protection could work considerable costs and negative collateral impacts on third parties and other incentives, such as the incentive to design around patented technologies. Given the potency of patents' exclusive rights, courts or Congress must carefully consider the benefits and disadvantages of expansively applying patent infringement doctrine to emerging DMT.

Nevertheless, we believe that affording protection to patent holders against sales or offers to sell the CAD files strikes the appropriate balance. In this context, the accused infringer is seeking to extract the commercial value of the invention, undermining the value of the patent to the patentee. Liability here is less likely to trigger the collateral consequences that we have addressed because the infringer is directly

[332] *Id.* at 805.

competing with the patent holder in some way, as opposed to merely using CAD files to design around the patent. The economic value of the patented invention is what will drive the commercial demand for the CAD file. As such, we believe that an extension of *Transocean* is an appropriate way to protect patent holders' economic interests.

Whether a CAD file should constitute an infringing "making" of the claimed invention presents far more complex issues. As a technological matter, we believe that the divide between the tangible and intangible has been almost entirely bridged by DMT. Because the physical instantiation of the patented article is a mere touch of the button away, treating the CAD file differently than the product produced by the 3D printer seems arbitrary. From this technological perspective, then, the courts could reasonably conclude that a CAD file alone constitutes an infringing "making" of the claimed invention, even if the invention is never printed. To reject this approach risks creating significant gaps in the protection that a patent affords to its owner.

Yet, this extension gives us pause because of the potential collateral consequences that would arise. Because patent infringement is a strict liability tort, permitting CAD files alone to be infringing, even in the absence of commercial activity, would open up a wide swath of potential liability. Someone who is simply are scanning a patented item into a CAD file could now be viewed as infringing, having reconstructed the device via the CAD file. Persons creating CAD files, either by designing them or by scanning an item, differ significantly from persons seeking to commercialize CAD files through sales or offers to sell. Thus, we are not so sanguine that liability for making a patented invention should extend to CAD files alone. Any such expansion — be it by the courts or Congress — should only take place after a careful consideration of the externalities such liability could generate.