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ABSTRACT

3D printing is a rapidly-growing technology that enables creation of three-dimensional solid objects made from a digital Computer Aided Design ("CAD") file. Patent law issues are particularly relevant and uncertain in the realm of 3D printing. Thus, analysis of the Patent Act is needed to better understand direct infringement (of either the use of a 3D printer, of a CAD file, or under the doctrine of equivalents), indirect infringement, and contributory infringement in the context of 3D printing. A key issue in this analysis is whether a CAD file should be viewed as making the object itself, since 3D printing involves creation of CAD files that can print the physical object at the press of a button. As the rapidly growing field of 3D printing blurs the line between the digital and physical world, it makes sense to develop new regulations and reform existing ones. Moreover, digital regulation must address cross-border digital commerce since separate steps of the 3D printing value chain be easily performed in multiple countries or by multiple actors, and easily transmitted across borders.

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INTRODUCTION

¶1 Guns. Body parts. Implants for medical uses. Apparel and fashion accessories. Jewelry. Artwork. What do these all have in common? Each is a 3D printed object that can quickly and easily be printed by Do It Yourself ("DIY") consumers.[1] 3D printing has gained attention in the press recently, as commercially affordable additive manufacturing technology has become widely available. Hobbyists, enthusiasts, and artists are utilizing 3D printers to print objects for domestic and household uses. Additionally, the medical community has utilized 3D printing.[2] 3D printers can even be used to print other 3D printers.[3]

¶2 The availability of 3D printing technology to consumer masses and the ability to create and almost immediately 3D print objects has created a revolution. The DIY community never had to worry about infringing on patents since their work was unlikely to draw the attention of patent owners; however, the consumer availability of 3D printing has enabled a DIY consumer to create a design in the form of a digital file that can be easily transmitted and made available to others. The digital file is called a Computer Aided Design ("CAD") file, which is a virtual blueprint model that is used to produce 3D printed objects.[4]

¶3 As 3D printers have become increasingly accessible to the public, websites and online platforms that enable sharing of CAD files have grown in popularity. These websites enable an easy means to upload, share, and download CAD files via the Internet, just as was done with digital music files. As a result, online social communities built around 3D printing are arising. 3D printing enables the DIY community and small, innovative companies to rapidly and electronically share their electronic designs with others around the world. Additionally, crowd-funding websites have successfully launched online campaigns aimed at reducing the cost of 3D printing, which allows even more people to access this technology.

¶4 Moreover, physical products are already being designed, sold, and distributed on the computer and over the Internet, with end consumers only printing the physical manifestation of the product.[5] In sum, the 3D printing revolution is enabling the consumer

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[1] Davis Doherty, *Downloading Infringement: Patent Law as a Roadblock to the 3D Printing Revolution*, 26 HARV. J. OF LAW & TECH. 353, 354 (2012) (noting that the DIY community is comprised of a collection of people who are engaged in the creation, modification, and repair of objects without the aid of paid professionals).

[2] ENABLING THE FUTURE, http://enablingthefuture.org/upper-limb-prosthetics/the-limbitless-arm/ (last visited Apr. 3, 2015) [http://perma.cc/KP6L-7LU2]. Enabling the Future is an organization that creates 3D printed hands for children throughout the world who were born with missing hand and fingers, and they have created nearly 1,000 3D printed body parts already. *See id.*

[3] Thierry Rayna & Ludmila Striukova, *The Impact of 3D Printing Technologies on Business Model Innovation*, *in* DIGITAL ENTERPRISE DESIGN & MANAGEMENT 119, 124 (Pierre-Jean Benghozi et al. eds., 2014).

[4] Michael Weinberg, *It Will Be Awesome if They Don't Screw Up: 3D Printing, Intellectual Property, and the Fight Over the Next Great Disruptive Technology*, PUBLIC KNOWLEDGE, Nov. 2010, at 3-4 (explaining that the CAD design process eliminates the need to design physical prototypes out of clay or Styrofoam, and that a designer can use a CAD program to create and manipulate a virtual model that is saved to a file).

[5] Daniel Harris Brean, *Asserting Patent to Combat Infringement via 3D Printing: It's No "Use,"* 23 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 771, 781 (2013) (noting that "factories, warehouses, product transportation infrastructure, and storefronts can potentially be replaced with a directory of CAD files and a website in a number of industries").

masses to easily create, develop, and print 3D objects as well as easily access, share, and modify electronic CAD files that enable printing.

¶5 Given the ease with which physical objects can rapidly be replicated, reproduced and repaired, there are many unanswered questions with respect to intellectual property rights. In particular, the legal regimes that made sense in the traditional manufacturing world are being challenged in their attempted application to the digital manufacturing world. There are newfound challenges to the law that govern utility patents, copyrights, design patents, trademarks, and trade dress as it applies to 3D printing.

¶6 Just like technological disruptions of the past, such as with the advent of the printing press, personal computing, and the Internet, the 3D printing revolution will also confront new issues at the intersection of technology, business, and law. With the rapid promotion of CAD files that enable printing of 3D objects, new issues will arise. There is not much jurisprudence regarding how patent law applies to 3D printing with respect to personal use. The Article analyzes some of the current scholarship on patent law in 3D printing and provides some new perspectives.

¶7 Professors Timothy Holbrook and Lucas Osborn have published one major work in the area of 3D printing and patent infringement.[6] Holbrook and Osborn point out that the line between digital and tangible has eroded in the world of 3D printing and also provide an analysis supporting the idea that digital files can infringe patent claims in 3D printing.[7] However, there are still gaps in their analysis, and there are unanswered questions concerning the best way to regulate digital patent infringement in the realm of 3D printing.

¶8 This Article seeks to fill in where Holbrook and Osborn left off and also challenges some of their assumptions. This Article also expands the regulatory regime for 3D printing developed by Holbrook and Osborn and suggests new proposals for regulation of digital patent infringement specific to 3D printing. It goes beyond Holbrook's and Osborn's evaluation of the flexibility of and countervailing considerations within patent law to capture digital patent infringement.

¶9 This Article proceeds as follows: Part I provides an overview of the intellectual property law regimes of patent law and copyright law and suggests questions that remain unanswered by current law. While this Article focuses on patent law, this initial part provides a brief discussion of other aspects of intellectual property, with an overview on copyright law issues and rights in the context of 3D printing as well as the dichotomy between copyright law and patent law.

¶10 Part II focuses on the current perspectives of patent law on 3D printing, critiques these perspectives, and provides new views to the current thinking. It also provides an overview of CAD technology and its progression in other settings, as well as settings specific to 3D printing. This Part then analyzes the patent statute and its shortcomings when applied to 3D printing, focusing on what constitutes infringement as it relates to 3D printing.

¶11 Part III proposes new reforms that could help to regulate the world of 3D printing. Specifically, this Part proposes congressional changes and analyzes the repair and reconstruction doctrine in patent law as applied to 3D printing. Additionally, it summarizes prior digital trade regulations for copyright law. This Part proposes to take lessons learned

[6] *See generally* Timothy R. Holbrook & Lucas S. Osborn, *Digital Patent Infringement in an Era of 3D Printing*, 48 U.C. DAVIS L. REV. 1319 (2015).

[7] *Id*.

from copyright legislation and provides takeaways that can be applied to patent law legislation for 3D printing. Finally, this Part discusses avenues available to police over blocking digital information before it enters the U.S.

I. INTELLECTUAL PROPERTY PROTECTION FOR 3D PRINTING

A. Background on 3D Printing

¶12 3D printing is a technology that enables creating and replicating of arbitrary three-dimensional solid objects made from a digital file.[8] 3D printing starts with making a virtual design of an object that one wants to create using a CAD file.[9] CAD files are templates that can be utilized by a computer to print 3D-objects. Users can create CAD files from scratch in a computer program or from scanning an existing three-dimensional object.[10]

¶13 Once the CAD file is on the computer, the user can load it into 3D printer software. The user can set specifications of the print such as print speed, size of the print, material type, and color.[11] The CAD file is utilized to print the 3D solid object by slicing the digital object into thousands of electronic 2D layers. The user can then upload this modified electronic file into a 3D printer that reads every decomposed sliced 2D layer and prints each object successively layer by layer.[12] The printer also blends each layer together so there is no remaining sign of each of the 2D layers. 3D printers are similar to consumer inkjet printers, but instead of depositing a single layer of printed ink, 3D printers deposit the user's chosen material to successively add layers to create a physical object. 3D printers can use a wide variety of materials, including polymers, resins, precious metals, bio-absorbable materials, nanomaterials, and even human cells.[13]

¶14 Since 3D printing is driven by digitization in the form of CAD files, the production of objects is easy, fast, and cheap. 3D printing technology enables users to create prototypes quickly in a cost-effective manner. Also, 3D printing allows users to print 3D-objects at their home. 3D printing enables people to create and make for themselves nearly any shape of any physical object. It also enables customization and production of objects based on preferences. A consumer can replicate, self-design, and electronically modify multiple scanned objects prior to printing quickly and in multiple copies if so desired.

¶15 3D printing has become more affordable in recent times and therefore is reaching a widespread distribution among the general public. Moreover, there are now websites that enable uploading, accessing, and downloading 3D-printing digital CAD files. The increasing accessibility of 3D printing has prompted disruption of traditional

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[8] Marc Mimler, *3D Printing, The Internet, and Patent Law: History Worth Repeating*, 62 RIVISTA DI DIRITTO INDUSTRIALE 352, 352-370 (2013).

[9] Sklyer R. Peacock, *Why Manufacturing Matters: 3D Printing, Computer-Aided Designs, and the Rise of End-User Patent Infringement*, 55 WM. & MARY L. REV. 1933, 1937 (2014).

[10] Lucas S. Osborn, *Regulating Three-Dimensional Printing: The Converging Worlds of Bits and Atoms*, 51 SAN DIEGO L. REV. 553, 559 (2014).

[11] Hjalte Worm Frandsen, Personal 3D Printing & Intellectual Property Rights 15 (Mar. 3, 2014) (unpublished M.A. thesis, University of Copenhagen) (on file with author).

[12] *See* Rayna & Striukova, *supra* note 3, at 6.

[13] Brian Vogel, *Casting 3D Printing's Coming IP Litigation: Usual Suspects and Dark Horses*, BNA (Oct. 11, 2014), http://www.bna.com/casting-3d-printings-coming-ip-litigation-usual-suspects-and-dark-horses/ [http://perma.cc/9Q5T-7BKP].

manufacturing processes, mass customization, desktop manufacturing, and new business models based on rapid prototyping of complex shapes and materials.[14]

¶16 While 3D printing has gained popularity with consumers and DIY users, it is also being utilized to create final products for product development. More than 20% of the 3D printed output is now final products, and it is predicted that this number will rise to more than 50% by 2020.[15] Since patent owners might already have rights to certain 3D printed objects, there could be an infringement of an existing patent if a user utilizes a 3D printer to print what may be the same object.

¶17 Besides utilizing 3D printers to print products, 3D printers are also being used to print replacement parts for existing objects. Patent law also regulates such a replacement use function. Thus, in utilizing 3D printing, there are a number of patent law issues that must be addressed as well as issues related to copyright, design, trademark, and/or trade dress rights.

B. Overview on Types of Intellectual Property Protection

¶18 Copyright law, patent law, trademark, and trade dress law are the primary types of intellectual property law protection.[16] 3D printing is an emerging digital technology that will disrupt all areas of intellectual property law.[17] In order to understand the effects of 3D printing on each intellectual property regime, it is first important to understand what is subject to protection and what is not subject to protection under each theory.

¶19 Typically, copyright law protection is sought for original, creative works; patent law protection is sought for useful works; and trademark law protection is sought for identification of goods by consumers in the marketplace.[18] The U.S. Constitution specifically gives Congress the power to grant copyright and patents rights.[19] The Lanham Act defines a trademark as including "any word, name, symbol, or device, or any combination thereof."[20] Trade dress law applies to the form of product packaging or the product's basic shape or design.[21]

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[14] Zack Schildhorn, Lux Capital, Address at Eckert Seamans Presentation: 3D Printing: A New Disruptive Technology?: Legal Challenges and Questions Surrounding 3D Printing (May 12, 2012).

[15] *The Printed World*, THE ECONOMIST (Feb. 10, 2011), http://www.economist.com/node/18114221[http://perma.cc/JV8J-73DM].

[16] Michael Weinberg, *What's the Deal With Copyright and 3D Printing?*, PUB. KNOWLEDGE, Jan. 2013, at 3.

[17] Lucas Osborn, *Intellectual Property Law's Digital Future*, *in* RESEARCH HANDBOOK ON DIGITAL TRANSFORMATIONS (F. Xavier & Majlinda Zhegu eds., forthcoming 2016) (manuscript at 1), http://ssrn.com/abstract=2533673 [http://perma.cc/HW6F-8DB4].

[18] *Id*.

[19] *See* U.S. CONST. art. 1, § 8, cl. 8 (granting Congress the power "[t]o promote the progress of science and the useful arts, by securing for a limited times to authors and inventors the exclusive right to their respective writing and discoveries.")

[20] 15 U.S.C. § 1127 (2012). Trademark law is not designed to encourage creation, but instead is more geared towards regulation of consumer confidence through identification and understanding of the source of goods. 3D printing allows anybody to make one's own product shape that appears to be similar to an established brand. Since any object made by a 3D printer can carry meaning, then trademark law can be of relevance. There can be trademark infringement claims if somebody had specific knowledge that illegal copies of CAD files were being traded or sold and did not take appropriate action.

[21] *See* GLENN MITCHELL ET AL., U.S. TRADE DRESS LAW: A PRIMER FOR THE NEW MILLENNIUM 5-6 (International Trademark Association 2002) (noting that historically, trade dress referred only to the manner in which a product was "dressed up" to go to market, but that over time trade dress has taken on a

¶20 The issues of concern with trademark law—specifically trade dress law—in the 3D printing context are: (1) If somebody has trade dress protection, then 3D printing could lead to more infringement based on unauthorized third-party users of those marks, thereby reducing product configurations, and (2) 3D printing could create homemade trade dress based on trade copying and subsequent modification.[22] A 3D printer could be used to create an object to have a particular logo or design; consumers could be confused when trademarks[23] are mimicked and trade dress spreads[24].

C. Dichotomy of Copyright Law and Patent Law

¶21 The Framers of the Constitution had intended for protection of "writings" and "discoveries" as types of intellectual goods.[25] The corresponding intellectual property regimes are respectively copyright law and patent law. Copyright law protects original expression, whereas patent law protects new, useful, and nonobvious inventions.[26] Although at the time that the Framers wrote the Constitution, it may have seemed the "writings" and "discoveries" would cover and protect intellectual goods, there has been and continues to be new sorts of economically valuable products that pose problems under a strict interpretation of the U.S. Constitution.

¶22 This Article focuses on patent law as it relates to 3D printing and as the primary type of applicable intellectual property law of concern to a patent owner who is concerned about enforcements of rights. While the rights afforded by copyright law and patent law both encourage the creation of knowledge and intellectual creativity, such rights are different and do not overlap.[27] Copyright law does not cover functional, mechanical, or utilitarian aspects of a work.[28] Copyright law covers creative, artistic works.[29] On the other hand, patents cover useful articles, which often require an engineer's or a scientist's abilities to produce something or make a thing perform something. In a sense, copyright protection

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far more expansive meaning, which can encompass a product's overall appearance itself).

[22] Devin R. Desai & Gerard N. Magliocca, *Patents, Meet Napster – 3D Printing and the Digitization of Things*, 102 GEO. L J. 1691, 1710 (2014). *See* Osborn, *supra* note 10, at 584-85.

[23] Consumers are not led to believe that all uses of a mark are licensed, and therefore, producers will put greater emphasis on branding goods to differentiate products as 3D printing expands.

[24] Trade dress is the physical manifestation of a trademark. Trade dress is defined as the design and shape of the materials in which a product is packaged; product configuration (the design and shape of the product itself) may be considered a form of trade dress. Trade dress that is distinctive and is capable of identifying the source could obtain trademark protection; 3D printing can produce certain recognizable configurations in its printed objects and establish distinctive trade dress based those configurations.

[25] *See* Weinberg, *supra* note 16, at 2.

[26] However, neither copyright law nor patent law protects abstract functional principles, facts, or ideas, which are all considered part of the public domain.

[27] There is perceived overlap of copyright law and patent law in the 3D printing context, since each regime deals with digital technologies.

[28] *See* 17 U.S.C. § 101 (2012).

[29] There are three requirements for copyrightable subject matter. Copyright law attaches automatically to an "original work of authorship" that is "fixed in any tangible medium of expression" that is either now known or later developed; a negative requirement is that copyright protection does not extend to work that constitutes ideas, procedures, and the like. *Id*. Technology determines the ease with which a copyright may be enforced or infringed. Developments in digital technology threaten the effectiveness of the exclusive copyrights.

and patent protection are mutually exclusive; a useful article cannot be protected by a copyright, and conversely, an artistic work cannot be protected by a patent.[30]

¶23 However, both copyright law and patent law impact the advent of digital technologies, such as 3D printing, which enables instantaneous and mass distribution of technologies.[31] Both copyright law[32] and patent law are evolving in response to technological change, to emerging information and digital economies, and to globalization and cross-border digital trade. Additionally, both regimes regulate the transmission and transformation of works that have a digital component.

¶24 Digital content is global in nature and spans borders. The complexity regarding applicability of either copyright law or patent law to a particular technology arises either when the technology is difficult to define, when there are multiple subcomponents, or when there are multiple actors. The applicability of either copyright law or patent law influences the patent owner's infringement claim, which would have drastic differences in recovery and in litigation strategy.

¶25 However, given that there are some uncertainties as to whether 3D printing work can attain copyright protection,[33] a DIY user should take caution in pursuing copyright protection. Since there are uncertainties as to whether an object scanned into a CAD file meets originality, such as whether there was independent creation and significant creativity, then copyright protection might not be the best avenue for a DIY user. Moreover, since some courts consider the merger doctrine[34] to be a defense to a claim for copyright

[30] *See* Weinberg, *supra* note 16, at 2-3 (discussing how physical objects serve some utilitarian purpose, which means that they are not eligible for copyright protection, whereas the "types of things that you would look to an artist to produce," such as paintings, movies, novels, and sculptures would not be afforded patent protection).

[31] Copyright issues when applied to 3D printing are similar in many ways to what the music industry has faced. 3D printing will do for physical objects what MP3 files did for music. Similar to the presence of multiple actors in infringing music file sharing and downloading, 3D printing could also contain a multi-party value chain. There could be a party that creates the CAD file; a party that uploads the CAD file; a party that manages the sharing and exchange of files, passive websites, active websites, and printer companies; and entities that perform the step of printing. The copyright system has encountered a similar set of actors in digital music file sharing and downloading. Such peer-to-peer music systems enabled the transfer of copyrighted works. Similarly, websites hosting CAD files that tell 3D printers how to make an item could face contributory infringement claims. Such 3D printing sites effectively serve as digital intermediaries for hosting CAD files and as a conduit for 3D printer software. If these websites have CAD files that cover copyrighted content, then they would face notice and takedown actions, either as a website itself or for the owners of the CAD files themselves.

[32] The digitization of technologies, such as with music files and CAD files, poses new copyright law issues as it becomes a challenge to define a copyright owner's rights and to determine whether the three requirements of copyrightable subject matter are met. For example, an owner of the copyright (that is, the owner entitled to enforce the copyright) may not be the same for the CAD file as for the physical object. Additionally, the doctrine underlying copyrightable subject matter applies to design-oriented aspects of three-dimensional items, which is a core aspect and benefit of 3D printing, but does not apply to functional uses of an object.

[33] *See* Lucas Osborn, *Of PhDs, Pirates, and the Public: Three-Dimensional Printing Technology and the Arts*, 1 TEXAS A&M L. REV. 811, 832-35 (2014).

[34] The merger doctrine refers to prohibiting copyright protection when an idea and its expression are inseparable without conditions and limitation. Merger could be an issue for 3D printing since the software used to create the CAD file could do only one thing–make a representation of the object in the CAD file. The digital scans could themselves be a merger of the idea and expression. However, virtually no court has invalidated a copyright based on the merger doctrine, and courts have been reluctant to find merger in copyright cases.

infringement,[35] and since merger is still an unclear area of copyright law[36] when it comes to 3D printing,[37] then a DIY user might not want to pursue copyright protection of anticipated 3D printed objects.[38] Finally, the difficulties in attaining success with copyright infringement claims make patent protection a better strategic course of action.

¶26 While copyright law and patent law are distinct regimes, patent infringement claims give innovators a better strategic enforcement mechanism. Moreover, since 3D printing is ultimately about printing physical objects, patent law is the most applicable intellectual property regime.[39] Hence, further evaluation of patent infringement in the 3D printing context is needed, especially since the brink of the 3D printing explosion is now occurring.

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[35] In general, it can be a challenge to identify a potential copyright infringer, whereas, patent infringement can be easier to police, since detection and reverse engineering are options to utilize for physical detection of potential infringement. Moreover, in the realm of 3D printing, potential end users would be geographically scattered, and hence, it would be difficult to police and to identify who may be infringing a copyrighted work. Alternatively, pursuing patent infringement claims against deep-pocketed corporations would be a better financial strategy than pursuing copyright infringement claims against several solo users. Moreover, there are challenges in the copyright infringement context, since defendants will want to question whether a work has met the copyright requirements.

[36] There will be an effort to copyright CAD files, and in doing so, raise copyright issues related to originality and to the merger doctrine in particular. The merger doctrine assumes that there are only a certain number of ways to express something, and the doctrine is triggered when all protectable ideas merge or when so few ideas are available that protecting them would prevent others from making similar expressions. Originality refers to the threshold required for obtaining copyright protection, which is generally a very low threshold. Originality will be the most difficult requirement to attain in the 3D printing realm, since a CAD file will likely not meet the "original work of authorship" test. The originality element does not include any sort of novelty or ingenuity, but the task of interpreting originality is left to the courts. The work seeking copyright protection must be the product of independent intellectual effort of the author, and cannot be transcribed from another existing source. The originality element exists in the original work of authorship at the moment that the work is fixed in a tangible medium of expression. Digital scans that are not modified when producing CAD files will not meet the originality requirement.

[37] While some digital scans that are modified prior to the 3D printing step may meet the originality requirement, others might not meet originality if they come about from simple and hardly noticeable changes. Additionally, another copyright law consideration for modification of CAD files is that there could be issues related to derivative works. Thus, those seeking copyright protection of a CAD file must first consider how much independent creation and creativity will be incorporated in the digital file following the scanning step in pursuing copyright protection.

[38] Additionally there could be challenges in meeting the fixation and idea/expression dichotomy when it comes to attaining copyright protection with 3D printing. The fixation element is defined as being "sufficiently permanent or stable to permit it to be perceived, reproduced, or otherwise communicated for a period of more than transitory duration." Fixation refers to the work being able to be written down, taped, filmed, or captured in some sort of physical artifact or an object in order to attain copyright protection. However, digital technologies or technology regimes with digital components operated by continuous, automatic copying of the files are being used, and such new technologies cause interpretation issues with the fixation element. This has been a problem with applications that have a transitory computer or software component, such as game consoles, video games, video recording systems, and operating systems. 3D printing applications will not have a problem with the fixation element, since the CAD files are stable before being printed in 3D form.

Moreover, the exclusion of certain elements from receiving copyright protection refers to the idea/expression dichotomy and has the goal of protecting an expression rather than an idea. Copyright law does not protect the underlying ideas expressed in that work. The Copyright Act states that copyright protection does not extend to "any idea, procedure, process, system, method of operation, concept, principle, or discovery." The idea/expression dichotomy is related to the merger doctrine, which states that the if there is only one or a limited number of ways exist to express an idea, then the idea and expression merge into an uncopyrightable whole. Thus, when the idea and the expression of that idea are inseparable, then copyright protection does not apply, since protecting the expression would give a monopoly.

[39] While it seems unlikely that 3D printing will be excluded specifically from copyright law protection (simply because of the potential end user variations that are possible with 3D printing), patent protection,

II. 3D PRINTING DIGITAL PATENT INFRINGEMENT: PERSPECTIVES AND CRITIQUE

A. Patent Law Issues with 3D Printing

¶27 Patent law issues are particularly relevant but uncertain in the realm of 3D printing. Patent law has built-in presumptions where there is infringement: that a high research and development investment was made in order to mass-produce the infringing goods. However, 3D printing challenges that presumption.[40] 3D printing is a new means for production that will make it easier to make a copy of a patented product—and, therefore, easier to infringe a patent[41]—if the copy is related to the functional aspect of an object. The advent of 3D printing will make the manufacture and sale of 3D objects more difficult to police because one can easily download a design from the Internet and print it at home without paying for it.[42] Somebody printing a patented product with a 3D printer could be liable either for direct patent infringement by "making" a replica or for indirect infringement by actively inducing the infringement of a patent by a direct infringer.

¶28 The most likely patent infringement scenario for 3D printing is that of the everyday consumer independently creating a CAD design for an infringing item and then sharing that design through a CAD file-sharing website with users who either print or purchase copies of that item. This increasingly common scenario presents avenues for indirect patent infringement: (1) liability for making, using, offering to sell, or selling a patented invention, (2) liability for actively inducing infringement of a patent, and (3) contributory infringement for offering to sell or selling a component of a patented machine for use in a patented part of an invention. In addition to the CAD file users, a passive website host of CAD files could also be liable under any of these theories.

¶29 3D printing will be influenced by how patent law considers the digitization of patented objects. A difference between the patent context of 3D printing files and the copyright context in other industries, such as the music industry, is that end users who perform the step of printing may be unaware that the 3D object is patented,[43] whereas the end user of the music file from a peer-to-peer network would know that a song is copyrighted. Since the end user may be unaware of whether the object has any IP protection, there could be a need to police 3D printing; in the music industry, however, the end user knows of the IP protection afforded to the music file. Therefore, while the value chain between 3D printing file sharing and music file sharing is similar, 3D printing could have an additional policing actor that would monitor whether a patented work is eventually printed. The addition of such an actor would add even more complexity to the detection of indirect infringement of a 3D printed file.

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and subsequent infringement of one's patent claims, is a stronger strategic intellectual property consideration. While copyright law could apply to the 3D printing realm, there are inherent challenges with pursuit of copyright infringement, such as individual enforcement, difficulty in finding potential infringers, and expense of enforcing infringement.

[40] *See* Desai and Magliocca, *supra* note 22, at 1693-94 (noting that patent law is going down the same road as copyright law, in the sense that digitization has the economy of physical objects).

[41] Lucas S. Osborn, Joshua Pearce & Amberlee Haselhuh, *The Case for Weaker Patents*, ST. JOHN'S L. REV. (forthcoming 2016) (manuscript at 44-46) (on file with authors).

[42] Mark A. Lemley, *IP in a World Without Scarcity*, 90 N.Y.U. L. REV. 460, 474-75 (2015).

[43] *See* Holbrook & Osborn, *supra* note 6, at 1338-39.

B. Progression of CAD Technology, Leading to 3D Printing

¶30 A CAD file is an electronic blueprint of a physical object.[44] Civil engineers were the first to utilize CAD when it came into existence.[45] Civil engineers made structural designs in CAD and then printed out 2D layouts that served as representations of 3D building structures that were subsequently built by construction engineers.[46] Mechanical engineers then modified CAD programs for mechanical design uses, such that 3D objects with detailed depth, thickness, and volume characterizations could be rendered in CAD files.[47] These CAD files were subsequently sent to manufacturing engineers to produce the 3D version of the mechanical product or device.[48] Manufacturing engineers coupled CAD technology[49] with solid freeform fabrication,[50] selective laser sintering,[51] and rapid prototyping for additive manufacturing,[52] in which objects were built via an additive process rather than traditional subtractive processes.[53]

¶31 While such CAD uses have served engineers well in engineering design and computational engineering as wells as scientists in computational chemistry, the mass consumer market was far removed from the world of CAD before the advent of 3D printing. Additive printing technology started to be used in the consumer market to build objects for consumers in a layer-by-layer fashion. The advancement of MEMS-based printhead

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[44] *See* David Cohn, *Evolution of Computer-Aided Design*, DESKTOP ENGINEERING (Dec. 1, 2010), http://www.deskeng.com/de/evolution-of-computer-aided-design/ [http://perma.cc/59WZ-S8AZ].

[45] *See* David Weisberg, *A Brief Overview of the History of CAD*, *in* THE ENGINEERING DESIGN REVOLUTION 2-1, 2-10 (2008).

[46] *See id.*

[47] *See* MARIO HIRZ, WILHELM DIETRICH, ANTON GFRERRER & JOHANN LANG, INTEGRATED COMPUTER-AIDED DESIGN IN AUTOMOTIVE APPLICATIONS 31 (2013).

[48] *See id.*

[49] Martin LaMonica, *Additive Manufacturing*, MIT TECH. REV. (Apr. 23, 2013), http://www.technologyreview.com/featuredstory/513716/additive-manufacturing/ [http://perma.cc/3XY4-6D2W].

[50] *See* Michael J. Wozny, Systems Issues in Solid Freeform Fabrication (Sept. 1992) (unpublished manuscript) (on file with the University of Texas at Austin), http://sffsymposium.engr.utexas.edu/Manuscripts/1992/1992-01-Wozny.pdf [http://perma.cc/K32H-LY7E] ("Solid Freeform Fabrication deals with the problem of fabricating, under computer control, a CAD description of a desired part by selectively solidifying or bonding one or more raw materials into a thin layer, representing a horizontal slice of the desired part; and then fusing the successive thin layers into a 3D solid object. The material may be a gas, liquid, powder or a thin solid sheet, while the solidification process may be polymerization, sintering, chemical reaction, plasma spraying or gluing. The geometry data may be CAD geometry, CAT or MRI imaging data, or special forms like contour slices.").

[51] *See* Matthew Wellington, *How Does Selective Laser Sintering Work?*, 3D PRINT HEADQUARTERS (Mar. 11, 2014), http://3dprinthq.com/how-does-selective-laser-sintering-work/ [http://perma.cc/Q4TL-43MR] ("Selective Laser Sintering is an additive manufacturing technique which can be used to turn digital CAD designs into 3-Dimensional objects.").

[52] *See* Terry Wohlers, *AutoCAD and Rapid Prototyping*, CADENCE, Nov. 1995, at 1 ("Advances in CAD solid modeling have also contributed to the growth of RP.").

[53] Computational engineers then began to implement complex mathematical modeling techniques, such as the finite element method and finite element analysis, to overlay modeling and simulation capabilities on top of the 3D CAD models so as to enable predictive analysis of electromagnetic, fluidic, structural, and thermal phenomena on such structures. Computational chemists then began to modify CAD software that was previously utilized in engineering to serve as a design tool for making *in silico* models of chemical structures; subsequently, rational design of chemical structures were enabled in such programs to serve as precursors for chemical synthesis and fabrication. These computational uses of CAD required supporting greater processor power and development in visualization capabilities to precisely design and predictively model structures.

technology along with improvements in consumer inkjet and bubblejet technology made printing of 3D objects feasible. Such printers became capable of printing layer upon layer of various materials more easily and quickly,[54] leading to the advent of 3D printing by consumers.

¶32 As consumers found more mainstream and niche uses for their 3D printing needs, 3D printing uses for personal, home, and small business needs rapidly multiplied. In parallel, CAD files served as the blueprints to enable printing 3D objects at home and with the use of a home computer. The combination of advancements in printing technology, the prevalence of more powerful personal computers, the growth in online commerce, and the growing market demand for 3D printed objects has caused a recent explosion of 3D printing technology into the mainstream consumer market.

¶33 With such rapid technology advancements, market interest, and worldwide interest, a number of legal issues have arisen in intellectual property law. The ability to quickly create, reproduce, modify, copy, transfer, share, post, and download CAD files for 3D printing has created complex intellectual property issues. One such issue is the decentralization of creating a patented 3D object. The widespread digitization, diffusiveness, and decentralization of CAD files for 3D printing create challenges for protecting patent owners.

¶34 "Digital patent infringement" has become a term referring to the making, selling, and transferring of CAD files designed to print the patented 3D object.[55] 3D printing applications present a number of complexities related to the applicability and strategic considerations of patent infringement under § 271 of the Patent Act. If a patent owner is concerned when somebody else prints an object that potentially infringes on what may be covered in the patent owner's claims,[56] the patent owner can pursue multiple infringement claims under § 271 against the potential infringer who has used a 3D printer or has aided another in the use of a 3D printer.

C. Direct Infringement in 3D Printing Under 35 U.S.C. § 271(a)

¶35 In this section, the direct infringement of a CAD file is analyzed under the following scenario:

¶36 A patent owner has attained a patent on a physical object, and another individual has 3D printed a seemingly similar object directly from a CAD file. The patent owner is considering whether to pursue direct infringement claims against the individual who 3D prints an equivalent device or against the third party who aids in printing the CAD files itself. If a digital file contains the necessary electronic information to directly print a functioning physical object, the patent owner should consider:

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[54] *See* Osborn, *supra* note 17, at 8 (noting that 3D printers do not print a single layer on a substrate, but instead additively build up multiple layers).

[55] *See* Holbrook & Osborn, *supra* note 6, at 1319 (suggesting that CAD files will stress the patent systems, and that the line between digital and tangible has already eroded to the point that CAD files could be viewed as infringement in and of themselves).

[56] *See* Osborn, *supra* note 17, at 11-14 (discussing that even though the end user who prints the object is clearly the one who is liable, it could be a challenge and costly for the patent owner to find the end user who is infringing).

(1) Can that digital file infringe a patent claim that is directed to that underlying physical object?
(2) What aspects of the Patent Act can protect a patent owner from potential infringers, and who are the potential infringers that the patent owner can pursue a claim against?

¶37 A patent owner can sue an infringer who is directly infringing the patented invention. Direct patent infringement arises when someone without authorization makes, uses, sells, offers to sell, or imports the patented invention into the United States.[57] This has typically been tied to the physical form of a device, apparatus, or system; however, infringement can also arise by selling or offering to sell the patented invention solely based on diagrams and schematics.[58] There are two ways to consider infringement in 3D printing under § 271(a):

(1) Direct infringement by making a device without authorization from the patent owner–for example, when somebody uses a 3D printer to print an object covered by a patent; and
(2) Direct infringement based on the CAD file itself, as infringing patent claims directed to the physical objects.

1. Direct Infringement via Use of 3D Printer

¶38 In digital patent infringement context, anybody who uses a 3D printer to print a patented object directly infringes when the object is made without authorization or without a license from the patent owner.[59] The patent owner, if successful in finding the user of the 3D printer, could sue for infringement for the user printing the patented object.

¶39 However, this approach presents inherent challenges for the patent owner. A challenge with 3D printing is that its widespread consumerization and decentralization makes it difficult to identify the infringer who infringes by using a 3D printer. The patent owner will likely be unable to identify the direct infringer due to the mass adoption and use of 3D printers.[60] It could be nearly impossible to identify who utilized a particular printer to print an object created from a CAD file.

¶40 Holbrook and Osborn point out that even if the patent owner were to identify the infringer who 3D printed the patented object, the patent owner would face civil procedure challenges, such as personal jurisdiction and joinder of parties, forcing the patent owner to sue each infringer separately.[61] Holbrook and Osborn compare 3D printing-related direct infringement challenges to those of the music industry, where MP3 files similarly became widespread due to the digitization of music, the diffusiveness of music file sharing, and the

[57] 35 U.S.C. § 271(a) (2012).
[58] *See generally* Timothy R. Holbrook, *Territoriality and Tangibility after Transocean*, 61 EMORY L.J. 1081 (2012).
[59] *See* Holbrook & Osborn, *supra* note 6, at 1354 (noting that historically, direct patent infringement by making, using, or importing the invention was tied to physical inventions, whereas infringing sales and offers to sell the invention have been based on the economic value of the invention being assumed and not on the physical embodiment of the invention).
[60] *Id*. at 1332-33 (noting that 3D printers will be geographically and diffusively dispersed; and, therefore, it will be difficult to identify their users).
[61] *Id*.

decentralization of peer-to-peer platforms.[62] In the world of digital music downloads, few actions were pursued against the many individual users that had downloaded music files.

¶41 Similarly, it appears at first glance that it would be difficult to identify who may be producing a patented invention using a 3D printer. Another problem could be that a different process might have been utilized to make the patented object, such as a subtractive manufacturing process or injection molding.

¶42 An alternative way to assert direct infringement against the user could be based on use or creation of the digital files themselves. However, there is still the question as to whether a digital CAD file could even infringe under § 271(a).[63] Therefore, it may be relatively simple for the user-defendant to move to dismiss the patent owner's direct patent infringement claim in the context of 3D printing.

¶43 However, the patent owner can make a case against such a quick dismissal in specific scenarios where direct patent infringement in 3D printing can be detected and pursued under § 271(a). Just as CAD files become more easily and more frequently shared online or in an electronic form, there will be a development of security and detection capabilities associated with CAD files.

¶44 With any rapidly adopted electronic product in the past, a need has arisen for security protocols and security tracking. Just as encryption developed for communication systems, cryptography and secure image filtering developed for photography and image processing, and new protocols developed for online music file sharing, similar security measures will arise for CAD files shared via networks, and it will become easier to identify and acquire a particular CAD file for 3D printing. One potential security measure will be to control and restrict the CAD file blueprints and make it more difficult for the 3D printing user to print the object.[64]

¶45 If security measures are developed and implemented in CAD files for 3D printing uses, then the diffusiveness of 3D printers will become less of an infringement concern for the case of CAD files that come from legitimate sources. While many CAD files might come from a scan, patent owners will have at least some relief when CAD files come from legitimate sources, and they would be able to pursue direct infringement claims where security measures can track the infringer by printing. Thus, while Holbrook and Osborn point out that the challenges of pursuing direct patent infringement are legitimate, their perspective ignores potential developments in security technology specific to 3D printing applications (outside of the scanning-side of the business) that will make it easier to identify each infringer separately.

¶46 Nonetheless, even if direct digital patent infringers are identified, patent owners may not have incentive to pursue such actions, since the litigation could damage one's current or expected future customer relationships and public relations.[65] The music industry faced such negative press when organizations such as the Recording Industry Association of America (RIAA) aggressively pursued legal action against individuals who directly

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[62] *Id*.

[63] *Id.* at 1334 (noting that most commentators have dismissed infringement lawsuits based on CAD files by assuming that direct infringement against CAD files is not viable).

[64] Gerald Walther, *Printing Insecurity?: The Security Implications of 3D Printing*, SCI. AND ENGINEERING ETHICS (Dec. 18, 2014) (discussing the need for development of security technology before 3D printing becomes widely available, and proposing self-regulation as another option for the 3D printing industry).

[65] *See* Holbrook & Osborn, *supra* note 6, at 1333.

downloaded copyright-protected music files via peer-to-peer networks. Similarly, patent owners might not want to risk negative press, even when direct patent infringement by printing can be detected. The patent owner should be cautious because prospective customers may be concerned about liability from utilizing 3D printers. Since it might not make good business sense for a patent owner to pursue a direct infringement claim against the end user of a 3D printer, a patent owner might instead consider pursuing a direct patent infringement claim against an intermediary that prints CAD files on behalf of the end user, such that the intermediary operates as a printing business.

¶47 The issue that arises is whether a "3D printing services" business that prints a patented invention commits direct infringement because it has made the patented invention. The patent owner will argue that since the "3D printing services" business makes the device using a 3D printer, then the intermediary would be liable for direct patent infringement, even though it was printing on behalf of another individual for a services fee since it was printing a patented invention.

¶48 The patent owner may consider pursuing direct infringement claims against the intermediaries, which are more easily identifiable than end users. The intermediary "3D printing services" companies will cater to those who do not own a 3D printer or do not want to purchase a 3D printer. As demand for intermediary "3D printing services" businesses grows, it might be easier for the patent owner to identify and pursue direct infringement claims against such businesses.

¶49 The "3D printing services" business faces the challenge of not knowing whether its printed objects infringe the patent. These businesses would be quick stop shops for "3D printing services" akin to a Kinkos for office printing. Because their business model would initially be based on throughput and operational efficiency, such a business would not focus on hiring sophisticated patent counsel and would not have the time to investigate quickly whether a given object is patented; however, as such businesses grow and mature, they would consider liability and contractual indemnification from the customer. Thus, such intermediaries would serve as better targets for patent owners to pursue infringement claims against.[66] Similar to peer-to-peer music sharing platforms in the copyright realm, such "3D printing services" intermediaries would be easier to identify than end-use customers. Further, advertising by such a business of their "3D printing services" would be sufficient evidentiary support to pursue direct infringement claims under § 271(a).

2. Direct Infringement of a CAD File

¶50 A better patent infringement theory for the patent owner would be to pursue a direct infringement claim against the owner of the CAD file under § 271(a).[67] While it could be difficult to identify who prints a patented invention using a 3D printer, identifying the owner of the CAD file itself could be another option for the patent owner. The CAD file

[66] *But see id*. at 1377 (stating that "intermediaries would face the same expense and uncertainty as individuals do [and] could face a staggering number of infringement assertions because they host many files . . . [such that] intermediaries would likely be shut down even if a small percentage of their files were infringing," and, therefore, while patentees would have targets to pursue infringement claims, such assertions on a mass scale could ultimately dampen the growth of 3D printing).

[67] Direct patent infringement arises when someone without authorization makes, uses, sells, offers to sell, or imports the patented invention into the United States. 35 U.S.C. § 271 (2012).

owner could directly infringe under § 271(a) simply by selling or offering to sell the CAD file. But should CAD files be treated identical to the 3D printed object?

¶51 In comparing the differences between an intangible electronic representation and its tangible physical embodiment, the time to transition, the complexity in transitioning, and the degree in transformation from intangible to tangible should be the focus. These comparisons should be the new test for differentiating what is tangible from what is intangible in patent law. An implication of such a new standard is that if the transition time, complexity, and degree of transformation are substantial, then the intangible electronic representation and the tangible electronic representation should not be treated alike. For example, 3D printing of a curved geometrical shape with multiple textured surfaces would be more complex and more time intensive than a blocked shaped, planar, and smooth surface object. Such differences between the electronic representations and physically printed objects could lead to uncertainty as to what is considered tangible or intangible.

¶52 The patent owner could argue that the CAD file is specific to a particular 3D printed item and, therefore, infringes on the patent owner's patented invention.[68] The patent owner could point out that the CAD file is potentially a specific precursor of a 3D printed patented invention. The CAD file could contain the physical exemplification of the device and would simply be one click away from transforming the CAD file into the actual printed object. The patent owner could argue that, in the age of digital manufacturing, when an electronic file is representative of the printed object, the CAD file should be treated as identical to the tangible object.[69] As support, the patent owner could note that there is increasing commonality between electronic media and its equivalent physical embodiment; for example, e-books, thumbnail images, and MP3 files each can be treated identically to books, photographs, and songs respectively.

¶53 The patent owner could have a legitimate justification for the argument that a CAD file should be treated as identical to the tangible object since CAD files that are utilized for 3D printing are typically a simple upload-and-click application. There is not much ingenuity, complexity, nor time required after the click. In fact, all one needs to do is simply wait for the 3D-printing step to transpire. The CAD files are effectively the same as having the physically printed object, since only a click separates the object from the electronic file. Thus, the patent owner's viewpoint of § 271(a) is legitimate, since a CAD file could be considered a tangible object and there would be direct patent infringement if one "offers to sell" or "sells" such a digital file. The patent owner would have a strong argument that a sale is considered an infringement of the 3D object because there is little difference between the digital file and the 3D-printed object, and that the CAD file is the equivalent of making the patented invention under 35 U.S.C. § 271(a).

¶54 The patent owner could support this viewpoint by noting that the purpose of the sale of the digital file would be to extract just the economic worth of the printed object. Thus, such an offer to sell or the sale itself could be considered direct patent infringement.

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[68] *See* Holbrook & Osborn, *supra* note 6, at 1367 (contending that the interest in a CAD file is not the file itself but instead is the object ultimately produced, since an individual who downloads a CAD file is generally doing so to produce the object encoded by the file and not to simply have the file).

[69] *Id.* at 1331-32, 1367 (suggesting that the creation of the CAD file could be considered an infringing making of the patented invention, or else patentees would be helpless against massive dissemination of CAD files).

Additionally, CAD files themselves are the most valuable aspect of 3D printing since they directly and significantly affect the pricing and sales potential of the printed 3D object.

¶55 Holbrook has stated that the infringing sale and offer to sell an invention are "an appropriation of the economic value of the invention, as opposed to its physical incarnation" so that a physical embodiment is not necessarily required.[70] Holbrook and others have written that the economic interest of the patentee should support whether there is infringement based on a document or an electronic file alone.[71] The economic interest argument should not drive a determination of infringement under § 271(a). Such a perspective would differentiate between actors and give preference to larger, more established companies that have a clear economic incentive, over smaller, more entrepreneurially minded companies and individual actors. Instead, removing the economic motivation and focusing on whether there is economic harm to the patentee[72] would be a better criteria of determining whether a CAD file that can directly print an object would be considered to be an offer for sale.

¶56 As a doctrinal matter, a key issue for 3D printing is whether the offer to sell involves a transfer of the tangible object itself. 3D printing is a bridge between the digital and physical worlds and renders the distinction between tangible and intangible essentially meaningless. It could be argued that the CAD file could be considered tangible once it is transferred for eventual printing, since the CAD file is a digital representation of the tangible object. In doing so, the transfer of ownership is not of importance and since the printing step is performed with ease and at convenience to the user. In effect, the sales offer and the printing of the 3D object can be viewed as a single delivery of the digital file.

¶57 Holbrook and Osborn point out that there should be liability for the sale or the offer to sell since there need not be a tangible item; however, the issue of damages will be based on the production or potential production of multiple objects.[73] On the contrary, an argument that one could make is that one CAD file can produce multiple physical copies of objects; thus, there would not be a true offer for sale simply due to the multiplicitous nature of 3D printing. In this perspective, there is not a true transfer and, hence, not a true offer for sale.[74] The fact that a CAD file can be used to create multiple copies of the patented invention weakens the applicability of § 271(a). Thus, the patent owner faces many challenges in pursuing a direct infringement claim under § 271(a). Holbrook and Osborn also contend that the interpretation of whether an offer to sell in the 3D printing

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[70] *See* Holbrook, *supra* note 54, at 1106; 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, 805-13 (2003).

[71] *See* Holbrook & Osborn, *supra* note 6, at 1358 (discussing that by "focusing on the harm done to the patentee by the sale or offer to sale, the court open[s] the door to finding infringement based on the sale or offer to sell a CAD file"). Holbrook has previously discussed that 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." *Id.*

[72] *Id*. at 1358 (noting the economic harm to the patentee test mentioned in Transocean Offshore Deepwater Drilling, Inc. v. Maersk Contrs. USA, Inc., 617 F.3d 1296 (Fed. Cir. 2010)).

[73] *Id.* at 1360 (suggesting that there should be liability for the sale of CAD files).

[74] *Id.* at 1363 (suggesting that the "sale or [the] offer to sell a CAD file is not limited to one instantiation of the invention [but] can be used to create multiple copies of the patented invention"). Hence, Holbrook and Osborn suggest one perspective is that the sale and the item are one and the same.

context is a true transfer has a bearing on the remedy, such as injunctions or appropriate damages.[75]

¶58 While the patent owner could point out that the amount of difference between the digital file and the 3D-printed object is minimal, the differences could vary greatly by application. Moreover, the argument that there is or was an offer to sell could further be weakened since multiple copies are produced and since the transfer is not a true sale. Also, the amount of damages that results from selling or offering to sell the CAD file is subjective and difficult to determine. For all of these reasons, it would not be prudent for a patent owner to pursue a claim for direct patent infringement against an owner of a CAD file for his a sale or an offer to sell the file.

¶59 While the patent owner does not have a strong infringement claim against the owner of the CAD file under § 271(a) for a sale or an offer to sell, the patent owner might make a claim under § 271(a) for "making" the patented invention. Section 271(a) also covers making of the patented invention, and 3D printing is very close to the line of making the patent invention. Holbrook and Osborn reason that CAD files are not blueprints or molds, and that the mere creation of the CAD file could constitute an infringing "making" of the patented item.[76]

¶60 However, embodiments that reflect an engineer's or a scientist's thought process would not be considered "making" the invention. Ordinarily, blueprints, injection moldings, and molds in general are not considered part of the "making" process; similarly, CAD files should not fall under "making" an invention. Even though the CAD file closely represents the finished item, the fact remains that the electronic file is a precursor to the physical object. Thus, the patent owner's claim that the CAD file is the equivalent of making the patented invention will not qualify as infringement under § 271(a).

3. Direct Infringement Under Doctrine of Equivalents

¶61 While there are challenges to finding direct infringement via the use of a 3D printer and of a CAD file itself, the doctrine of equivalents[77] accommodates for technological advances such as 3D printing. The doctrine of equivalents enables scope of a patent beyond the literal terms of the patent claims.[78] It grants patent owners protection for creations that were not in their possession at the time of the patent applications.[79] Additionally, the doctrine of equivalents intends to catch those who attempt to copy the patented technology and make a minor change to avoid infringement.[80] Since 3D printing emerged well after

[75] *Id*.

[76] *Id.* at 1365, 1367 (suggesting that blue prints and molds did not historically constitute the "making" of a claimed invention; however, the creation of an object from a file is simple and routine, with the interest in the CAD files being the object itself and not the files).

[77] *Id.* at 1367-68 (noting that the doctrine of equivalents allows the patent owner to capture after-arising technologies that are deemed to be close enough to the claimed invention in order to constitute patent infringement).

[78] Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 535 U.S. 722, 731-32 (2002) (noting that the doctrine of equivalents was created to prevent competitors from avoiding infringement by making unimportant and insubstantial differences to their technology).

[79] Timothy R. Holbrook, *Equivalency and Patent Law's Possession Paradox*, 23 HARVARD J.L. AND TECH. 1, 2 (2009).

[80] Christopher Cotropia & Mark Lemley, *Copying in Patent Law*, 87 N.C. L. REV. 1421, 1431 (2009).

current patent infringement law came into effect, the doctrine of equivalents can be utilized to enable claims to go beyond the literal terms and instead extend to the equivalent.

¶62 The doctrine of equivalents is entirely judge-made law that recognizes the possibility of "nonliteral infringement" or "nontextual infringement." The doctrine of equivalents essentially conveys to the patent owner the full benefit of the invention. Thus, the patent owner could utilize the doctrine of equivalents, when applied to each individual element of a claim, to capture CAD files.[81] The doctrine of equivalents analysis is based on whether the accused element in the accused product would be nearly equivalent to the patented product.[82] In following the doctrine of equivalents, courts typically follow the "triple identity" test to ask whether the accused element in the accused product performs substantially the same function in substantially the same way to achieve substantially the same result.[83]

¶63 The patent owner could utilize the doctrine of equivalents to capture CAD files by noting that the CAD files similarly perform substantially the same function in substantially the same way to achieve substantially the same result of the invention. However, there is a natural tension from courts finding liability of 3D printing related inventions under the doctrine of equivalents because the courts would be effectively extending the right to exclude beyond the literal boundaries of the patent claims.

¶64 The proper analysis would be to determine whether the accused product or process contains elements identical or equivalent to each claimed element of the patented invention.[84] This is a fact-intensive analysis, and the patent owner could make an argument that the printed physical devices are identical to what is described in the patent for the CAD file. This analysis considers the doctrine of inherent anticipation, which does not require that the inherent feature be appreciated at the time of the earlier patent, as long as the disclosure makes the feature necessary and inevitable.[85]

¶65 The patent owner would need to overcome the presumption that CAD files are not physical devices, and would need to consider CAD as files being capable of printing physical devices that are substantially the same as the patented invention.[86] The patent owner would need to argue that the patentee cannot anticipate every change or permutation, should not be expected to foresee everything, and should be allowed to capture something additional after patenting.

¶66 The patent owner could argue that, under the reasoning of *Warner-Jenkinson*, a CAD file is a type of change or permutation of a patented device, and, therefore, the patent owner would be able to capture the output from a CAD file as being substantially the same. While the patent owner may face resistance that a CAD file cannot qualify as being a change or permutation of the patented device since it is not of the same physical form, the patent

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[81] *See* Holbrook & Osborn, *supra* note 6, at 1368-69.

[82] *See* Sue Ann Mota, *The Doctrine of Equivalents and Prosecution History Estoppel: The Supreme Court Supports Flexibility Over Certainty in Patent Cases in* Festo v. SMC, 9 RICH. J.L. & TECH. 2, 16 (Fall 2002) ("Under the doctrine of equivalents, a patent holder should be able to protect against not only a literal infringer, but also those who design around the patent application, and create nearly equivalent, although not identical, versions.").

[83] Warner-Jenkinson Co. v. Hilton Davis Chem. Co., 520 U.S. 17, 39-40 (1997).

[84] *Id*.

[85] Cynthia Chen, Schering Corp. v. Geneva Pharmaceuticals, Inc.*: Clarification of the Inherent Anticipation Doctrine and Its Implications*, 20 BERKELEY TECH. L.J. 95, 109 (2009).

[86] *See* Holbrook & Osborn, *supra* note 6, at 1369 (further defining the doctrine of equivalents in the digital era to be what the CAD file would print to the limitations listed in the patent claims).

owner has a legitimate argument that a CAD file prints a device with the same limitations as the patent claims of the patented invention.

¶67 Additionally, since a patent owner cannot prevent the mass distribution of CAD files and cannot pursue infringement action against an end user infringer who may be difficult to identify, the patent owner's only other recourse is against the CAD file creator. The patent owner has legitimate infringement claims against a CAD file creator who has created a substantially similar device in an electronic form that is simply a button press away from being printed into an actual physical form that would literally infringe on the patent owner's claims.

¶68 A 3D printing patent owner should be able to capture after-arising technologies in the form of a CAD file that is close to the claimed invention that is being infringed.[87] Since 3D printing digital files effectively have the same elements but in digital form, the CAD file is not substantially different as the eventually printed 3D objects. Therefore, there should be support for the patent holder's case. Additionally, there is further policy support for protection of such after-arising technologies since the very concept for 3D printing is to enable quickly designing, developing, and printing objects.

¶69 Slight changes and advancements are inevitable and any policies that restrict what can be captured by the creativity in 3D printing will inevitably hinder the progress of 3D printing. Fairness suggests applying the doctrine of equivalents to CAD files.[88] Holbrook and Osborn are correct that CAD files are insubstantially different from the physical device, and therefore, the doctrine of equivalents should apply to CAD files.[89] The judicially created doctrine of equivalents was created to prevent competitors from avoiding infringement by making insubstantial changes to their technology. The slight deviations in the CAD files are inevitable and at the very heart of the type of changes that the doctrine of equivalents was created to capture.

D. Indirect Infringement of a CAD File Under 35 U.S.C. § 271(b)

¶70 Pursuing direct infringement of CAD files appears impractical and faces civil procedure and joinder difficulties. Beyond claims against those intermediaries who are developing "3D printing services" businesses or claims against the CAD file creator, direct patent infringement is otherwise difficult to assert in the 3D printing context. The underlying support for a direct infringement claim against either "3D printing services" businesses or the CAD file creator is grounded on the premise that a CAD file is a near representation of the 3D printed object; a premise that has limitations and can be attacked by a potential infringer. In these contexts, better claim for the patent owner would be indirect infringement of a CAD file.

¶71 Indirect digital patent infringement may be a more viable infringement theory for the patent owner of a 3D printed object or device. Under § 271(b)[90] one is liable as an indirect infringer if one actively induces the infringement of a patent by a direct infringer. There must be specific intent and active influence or persuasion that induces another party to directly infringe the patent for indirect infringement liability. Circumstantial evidence can

[87] *Id*.
[88] *Id*.
[89] *Id*. at 1370.
[90] 35 U.S.C. § 271(b) (2012).

suffice in proving a claim, but the inducer must have actual or constructive knowledge of the patent, and must actively induce infringement. The three requirements that a patent owner must prove to have an active inducement claim are:

1) direct infringement,
2) specific intent to induce a third party to infringe, and
3) an affirmative act by the inducer.[91]

¶72 The indirect infringer induces a direct infringer by providing him with instructions or information about how to make or use the patented device. In the 3D printing context, an example of indirect infringement would consist of one party facilitating the printing of an infringing object from a CAD file by someone else. The Internet would be utilized to share or to transfer the 3D printing files for those who would potentially print from those files. The patent holder would need to show, either directly or by circumstantial evidence, that the accused inducer provided the direct infringer with access to a 3D printing file and that the direct infringer utilized the file to print the patented object.[92] While it would be difficult to identify the direct infringer who downloaded the file and printed the object, it could be possible to identify who conducted the step of inducing the infringement–the indirect infringer.[93] However, a challenge with indirect infringement is that the Internet is a near impossible network to police, and significant, time-consuming, and costly discovery would be required to uncover which entity provided access.

¶73 There are two contexts where indirect digital patent infringement could arise: active inducement of infringement or contributory infringement.

¶74 With active inducement, there are two separate scenarios. First, individuals could create or obtain a CAD file and transfer the file either directly or indirectly to another individual who does the step of 3D-printing the physical object.[94] Second, a CAD file-sharing network could post and enable sharing of a CAD file, where others could download the CAD file and print the infringed object or device.[95] The second scenario is akin to electronic file sharing via peer-to-peer music sharing networks.[96] In the second scenario, the CAD file is either created using a CAD-creation program or purchased from a seller of CAD files, or an object is scanned into CAD file. Whatever the avenue of receipt or creation of the CAD file, the CAD file is subsequently shared via a network.

¶75 In order for there to be inducement in the 3D printing context, an inducer would need to provide access to the 3D printing file with specific intent that it be printed.[97] One way that this requirement is satisfied is when the inducer uploads or transfers the 3D printing file to be printed, such as via a file-sharing server that enables sharing of 3D printing files similar to music sharing servers. Not only must the inducer intend for the object to be

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

[92] *See* Holbrook & Osborn, *supra* note 6, at 1335-36.

[93] *Id.* at 1336 (discussing that it could be difficult to identify the direct infringer who downloaded the CAD file because of the relative anonymity of the Internet).

[94] *Id.* at 1335.

[95] *Id*.

[96] *Id.* at 1338 (discussing that "accused inducers will include passive websites hosting CAD files and numerous individuals who transfer [CAD] files to others" but that the situation in the 3D printing patent context is different from hosting and sharing of copyrighted files, since 3D printing consumers will have little appreciation that objects are patented).

[97] *Id.* at 1343-44.

printed, but the object must actually be printed. Thus, the question becomes: will the CAD file eventually be printed? Furthermore, how can one determine when such printing actually happened?

¶76 Even though circumstantial evidence could suffice to prove indirect infringement, it would be challenging to prove that a 3D object was printed from such a file-sharing service.[98] Moreover, some CAD files may never result in the printing of the object, but rather, only viewed.

¶77 Additionally, even where there is resulting printing from the use of the 3D printing file, the step of printing could be performed in another country where there is no patent protection for the particular 3D printed object. Mass consumption and globalization of 3D printing could further exacerbate the problem, since it would be difficult to detect printing, and proving infringement could span multiple geographies and be conducted by multiple parties. For any of these reasons, there could be difficulties in detection and enforcement of 3D printing-related indirect patent infringement.

1. Challenges With Active Inducement And Specific Intent in CAD File Sharing

¶78 One challenge with proving active inducement and specific intent is that it can be difficult to identify who is providing access to a CAD file via an online sharing network.[99] Furthermore, to even establish a claim, a patent owner must also demonstrate that direct infringement occurred through the actual printing of the object or deice found in the CAD file.[100] This is similar to music file sharing networks, in which it was similarly difficult for the copyrighted music owner to identify who was providing access to the online-shared music files.

¶79 While security tracking measures and encryption technology can detect when an electronic file is downloaded and also identify the computer on which the action was taken, the legal standard to satisfy this identification element of infringement is still difficult. Furthermore, access to such security information would be difficult for the patent owner to obtain. Even though circumstantial evidence can be utilized to prove the direct infringement part of the claim, this method would be particularly difficult to do in light of what is rapidly becoming an electronically widespread and geographically diffused use of 3D printing. Additionally, there can be multiple downloads of the same CAD file, and it would be a policing challenge to identify and pursue action against multiple infringers.

¶80 The accused infringer who would be providing access to the CAD file must possess a specific intent mens rea, demonstrating an intent to induce acts of infringement.[101] To establish this, the accused infringer would need to have either actual knowledge of the patented invention or be willfully blind of the patent's existence.[102] Willful blindness is a

[98] *Id.* at 1338.

[99] *Id.* at 1336 (noting that proving this kind of direct infringement is difficult because of a lengthy discovery process).

[100] *Id.* (noting that somebody who downloaded the file actually printed the object because direct infringement requires somebody to "make" the patented invention).

[101] *Id.* at 1337-38.

[102] Global-Tech Appliances, Inc. v. SEB S.A., 131 S. Ct. 2060, 2070 (2011) (discussing that willful blindness requires that a patentee demonstrate a "(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 the fact").

particular knowledge that is more specific and more deliberate than generalized knowledge, which only requires knowledge of any patent anywhere that could possibly cover the 3D printed object. Willful blindness requires that that the accused infringer subjectively believed that there was a high probability of infringement, and proving this mindset is difficult.[103]

¶81 Given that willful blindness is difficult to prove in the 3D printing context, the patent owner must prove that the accused indirect infringer actively induced[104] the direct infringer with specific knowledge that the induced act would be patent infringement. This means that the patent owner would need to demonstrate that the accused indirect infringer both knew of the patent holder's patent and that the sharing of the CAD file would constitute patent infringement.

¶82 The specific intent requirement adds a significant limitation to the active inducement part of indirect infringement in the digital patent infringement context. This is essentially a strict knowledge requirement, and can be avoided if the indirect accused infringer independently created the CAD file without knowledge of the patent. The patent owner must show that the indirect accused infringer had the subjective belief that there was a high probability of infringement.[105] Therefore the indirect accused infringer would have had to act with an objectively high likelihood of infringement for the patent holder to establish knowledge circumstantially. This is a high bar to meet. An accused indirect infringer's good faith belief that the patent is not infringed can serve to overcome this subjective belief requirement.[106]

¶83 Holbrook and Osborn argue that it will be especially challenging for patent owners to sue actors through active inducement because creators of CAD files would be unsophisticated actors that are unfamiliar with patent laws.[107] Thus, Holbrook and Osborn's argument with respect to CAD file creators is that even if they did transfer the CAD file, directly or indirectly, to an individual who subsequently printed the 3D object or device, the CAD file creator would not have the specific intent required to actively induce a third party to infringe. The inducer would need to have transferred or hosted the CAD file with a specific intent that the CAD file be utilized and printed into a specific 3D printed object that infringed the patent owner's patent.

¶84 Holbrook and Osborn also suggest that accused infringers would include passive websites that would host CAD files, but would lack sophistication and understanding of the patent laws.[108] Thus, to Holbrook and Osborn, it seems that due to the rising mass consumer appeal and ubiquity of 3D printing among consumers, one who hosts CAD files would also be a layperson lacking specialized knowledge of patent law.

¶85 It is not true that all or even the majority of actors that enable sharing of CAD files would not have knowledge of the patent that covers the eventually printed object. As CAD files for 3D printing become more accessible via online sharing networks, actors that create CAD files and promote CAD file creation will likely become more sophisticated. There

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[103] *See* Holbrook & Osborn, *supra* note 6, at 1341.

[104] *See Global-Tech*, 131 S. Ct. at 2065 (discussing that the term "induce" means to lead on, to influence; to prevail on; or to move by persuasion or influence).

[105] *See* Holbrook & Osborn, *supra* note 6, at 1341.

[106] *Id*. at 1342.

[107] *Id*. at 1338.

[108] *Id*.

could be corporate entities that specialize in this kind of CAD file creating and sharing. Entities that provide guidance on the creation of CAD files and help refine amateur CAD file creation may also be established as the CAD file creation phenomenon takes hold. Such companies would employ in-house patent counsel or hire sophisticated patent law firms as a risk mitigation strategy. Their legal counsels' responsibilities would include monitoring patent related activities and sending notice letters. Such counsel would be tasked with forming opinions of the patent landscape and conducting freedom-to-operate clearances.

¶86 Thus, it would be too quick to dismiss active inducement as an indirect infringement claim, simply by assuming that all CAD file creators who transfer CAD files on sharing networks are ignorant of existing patents and of patent laws. It is too short sighted of a view to not take into consideration active inducement in the 3D printing context.

2. Applicability of Active Inducement in Distribution of CAD Files

¶87 Holbrook and Osborn's perspective, while true of early development in the online CAD file sharing industry for 3D printing, does not delve deeply into organizations that are specifically created to enable CAD file sharing and would have knowledge of the 3D printing patent landscape. Such organizations' entire business justification would be tied to actual printing of 3D objects. Additionally, such organizations would employ patent counsel for patent risk mitigation endeavors. Holbrook and Osborn's reasoning seems to be that the large number of patents to be reviewed by such organizations would be daunting.[109]

¶88 Holbrook and Osborn miss the perspective that further development in the 3D printing industry would yield sophisticated actors that would be cognizant of the patent landscape and would facilitate CAD file sharing. More specifically, companies that are similar to now-defunct online music file sharing services such as Napster and Kazaa will be created specifically for CAD file sharing to be used for 3D printing. These entities could employ counsel for risk mitigation of patent suits and would have a good faith actual notice and understanding of patent landscape.[110] Such a defensive patent litigation risk management strategy would not only avoid the issue of willful blindness in determining patent damages but would also enable a quicker and more adept strategic response to an unexpected patent litigation suit. Additionally, these companies would be "active" in the sense that they would promote active downloading of CAD files. Such actors would not be passive[111] but would actively promote downloading as their business justification in promoting the access to and the sharing of files.

¶89 The 3D printing industry faces the threat of copyright infringement, as well as patent infringement. A similar industry where such active inducement in indirect patent infringement based on electronic files to print 3D objects has been shown is the t-shirt screen-printing industry. As the individualized t-shirt printing industry has grown, so have online platforms that enable creators and artists to develop customized clothing.

[109] *See* Holbrook & Osborn, *supra* note 6.

[110] While some patent search, analysis, and freedom-to-operate studies could be costly, there are market intelligence and patent analytics software tools, such as that provided by Innography (https://www.innography.com/), which can automate searching.

[111] *See* Holbrook & Osborn, *supra* note 6, at 1338, 1343-44 (suggesting that accused infringers would be passive websites that host CAD files but do not consider that such websites could be active as well or predominantly active).

Companies such as Zazzle have faced copyright infringement and the threat of patent infringement related to the screen printing of specialized textured shirts and textured clothing accessories.[112] Zazzle and other online companies that induce sales of "print on demand" items or products incorporating images routinely face active inducement issues; such companies are cognizant of the use of the electronic design files on their online interface to eventually print 3D structures onto customized clothing.[113]

¶90 The 3D printing actors face some of same issues as the t-shirt screen-printing industry. Since Zazzle and similar companies' sole business existence is for creating printed structures based on electronic design files, it is presumable that Zazzle would be aware of the copyright and patent landscape for those who utilize its online custom design services to create for printing customized clothing. While the design-to-print customized clothing industry might be a niche market, the indirect copyright infringement and indirect patent infringement issues that it faces are not dissimilar to what a 3D printing actor would face when enabling CAD file sharing for subsequent 3D printing uses. Thus, a patent owner could have a legitimate claim of active inducement against sophisticated actors aware of patent infringement ramifications for the distribution of CAD files.

¶91 Moreover, the specific intent requirement needed for active inducement claims might not be as strong of a concern to patent owners as Holbrook and Osborn suggest.[114] A patent owner may be able to pursue an active inducement claim against CAD file distributors without the specific intent requirement being a barrier. While specific intent is a requirement for proving active inducement under § 271(b), the exact meaning of specific intent is not clear in the 3D printing CAD file sharing context.

¶92 It may well be that the accused distributor needs to do more steps than simply upload and transfer the CAD file to be considered to have provided the specific intent needed to establish active inducement; there may be additional requirements such as documented actual awareness of specific infringement. It is too soon to dismiss that active inducement with the necessary specific intent does exist in the 3D printing context when it applies to CAD file sharing.

E. Contributory Infringement of a CAD File Under 35 U.S.C. § 271(c)

¶93 Contributory infringement may be easier to establish than direct or indirect infringement. In a claim against a contributory infringer, the patent owner does not need to satisfy the difficult evidentiary requirement of showing intent; the accused contributory infringer only needs to be aware (1) of the patent and (2) that the component does not have a substantial non-infringing use.[115] Hence, a contributory infringement claim is much easier to pursue.

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[112] ZAZZLE, http://www.zazzle.com(last visited March 12, 2015); Steve Shlackman, *Copyright Infringement Is a High-Benefit, Low-Risk Business Model,* ART L.J., (Mar. 23, 2014), http://artlawjournal.com/copyright-infringement-high-benefit-low-risk-business-model/ [http://perma.cc/597H-KXTC].

[113] *Cf.* Bill Rosenblatt, *Copyright and Technology: Flickr's Wall Art Program Exposes Weaknesses in Licensing Automation*, COPYRIGHT AND TECH. (Dec. 7, 2014), http://copyrightandtechnology.com/category/images/ (last visited March 16, 2015) [http://perma.cc/GC2B-C7RP].

[114] *See* Holbrook & Osborn, *supra* note 6.

[115] 35 U.S.C. § 271(c) (2012).

¶94 Liability for contributory infringement is triggered when somebody offers to sell, sells, or imports into the U.S. a component of a patented machine, manufacture, combination or composition, or a material or apparatus for use in the infringement of a patent without any substantial non-infringing uses.[116] Establishing a claim of indirect infringement under the theory of contributory infringement requires:

1) somebody offering to sell, selling, or importing into the U.S.
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) which results in an act of direct infringement.[117]

¶95 Under § 271(c), there is no requirement for the infringer to have an intent to cause infringement like there is under § 271(b), but the infringer must at least have knowledge of the patent and knowledge that that the relevant component is especially adapted for the infringement of that patent.[118] A contributory infringer is aware of the patent, has a presumed intent to infringe with implementing the component into a system, and is aware that the component has no other substantial non-infringing use. Each word of § 271(c) can be analyzed in greater detail in context of 3D printing.

1. Offering to Sell, Selling, or Importing of CAD File Alone

¶96 A patent owner could consider pursuing a contributory infringement claim against a CAD file creator, a CAD file owner, or a CAD file distributor under the theory that the CAD file is being offered for sale, is being sold, or is being imported. The words in § 271(c) are broadly interpreted and can make it relatively easy to pursue a contributory infringement claim. Accordingly, a contributory infringement claim is a much easier course of action for the patent owner.

¶97 The Federal Circuit has interpreted the term "offer" to mean that one must be willing to enter into a bargain and that another person understands that his/her agreement to that bargain is given and will conclude the bargain.[119] However, it is unclear as to scope of the meaning of an offer in patent cases, and Professor Osborn has argued that courts should consider the policy role of the offer concept in cases where courts are interpreting an application of its meaning outside of contract law.[120] The Federal Circuit has interpreted the term "sale" to refer to a transaction, but not when a gift or a donation is made or the transaction is a free transfer.[121] Thus, the patent owner could make a claim that the CAD file is being offered for sale or that there is an actual sale, as long as the CAD file is associated with a commercial transaction either from an owner to a creator or from a creator to a distributor.

¶98 There are, however, unique challenges that a patent owner faces if pursuing a contributory infringement claim under § 271(c). A challenge for the patent owner arising

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[116] *Id*.

[117] *Id*. Furthermore, the component must be a material part of the invention, but cannot be a staple article or commodity of commerce.

[118] *Id*.

[119] *See* Holbrook & Osborn, *supra* note 6, at 1346.

[120] Lucas Osborn, *The Leaky Common Law: An "Offer to Sell" as a Policy Tool in Patent Law and Beyond*, 53 SANTA CLARA L. REV., 143 (2013).

[121] *Id*. at 195 n.252 (citing HollyAnne Corp. v. TFT, Inc., 199 F.3d 1304 (Fed. Cir. 1999)).

in the 3D printing context is the potentially low cost of CAD files when there is a mass consumer use of and ease of access to hosted files on an electronic exchange. For example, if the CAD creator ends up transferring or hosting CAD files at a low or nearly free cost, then the interpretation of "sale" under § 271(c) is muddled. Therefore, it would be difficult for the patent owner to pursue a contributory infringement claim under § 271(c), if there is widespread adoption of 3D printing.

2. Considerations of CAD File as a Component Under 35 U.S.C. § 271(c)

¶99 The second requirement of a contributory infringement claim under § 271(c) is the need for the component to be tendered in an offer or offer of sale. In order for the patent owner to pursue a contributory infringement claim in the 3D printing context, the CAD file must be considered to be a "component" under § 271(c). Typically, an alleged "component" is a physical piece of a larger system, but in the 3D-printing realm, the CAD file itself is sufficiently representative of the final printed component.[122]

¶100 A challenge with CAD files is that they are digital representations of entire devices– electronic embodiments of the 3D-printed objects themselves. The central legal issue is whether the representation of the entire device, which will eventually be printed using a 3D printer, is considered to be a component itself.[123] Put another way, does the fact that the CAD file is a precursor to the physical object itself make the CAD file a component, or would a CAD file be more akin to catalyst in a chemical reaction as an initiator, rather than a part of a whole?

¶101 Holbrook and Osborn make an analogy to traditional manufacturing techniques to dispel the of notion that a CAD file is a component.[124] A component is usually a piece of a larger whole composed of multiple pieces organized to function as a system. The reasoning behind this analogy is that one would not consider an assembly line, traditionally used to make manufacturing devices, as a "component" of the manufactured device.[125] Similarly, a mold that is used in the manufacturing of products would not be considered a component of the final component that is made from the mold. The reasoning is that such assembly lines and such molds were historically not central to protecting the patent owner's interest and were not relevant towards the commercialized value of the technology. Holbrook and Osborn contend that a CAD file that merely results in the printing of a component of a patented invention is not a component of the final combination, thus, the CAD file cannot be considered a component.[126]

¶102 Nonetheless, components can be digital in nature. In the software context, functional components can be digital in nature and part of a larger software architecture or method. These digital elements can be considered "components" when claimed as a functioning portion of the software-computer combination, and *Microsoft Corp. v. AT&T Corp.*[127]

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[122] *See* Holbrook & Osborn, *supra* note 6, at 1347-48 (concluding that a CAD file that will print the finished product is not a component of the finished product).

[123] *Id.* (differentiating a CAD file from prior cases, such as a container that is a physical part of a blender, but still being a digital representation of an entire printed device and not merely a part).

[124] *Id.*

[125] *Id.*

[126] *Id.* at 1347-48. Holbrook and Osborn contend that a CAD file is not a component of a finished product, but they also explore the counterargument that a CAD file is a component.

[127] Microsoft Corp. v. AT&T Corp., 550 U.S. 437, 449-52 (2007).

supports this assertion. The court in *Microsoft*[128] held that software in the abstract was not a component itself but that software encoded on a medium[129] could be considered a component. Thus, based on the court's reasoning in *Microsoft*, software that only provides instructions is not considered a component. However, a CAD file, which is a type of software and is created on a memory medium, could be considered a component when it is claimed to a physical device.[130]

¶103 What is distinctive about 3D printing is that its CAD files could be, in a way, the entire product itself. The CAD file itself includes a memory medium and needs memory to function. Thus, a CAD file is not memory in the abstract but is tied to the very memory that it is comprised of. Moreover, CAD files could be a digital depiction of the eventually printed product, and this depiction could be considered a component. In this way, a patent owner would have a case for contributory infringement under § 271(c) since a CAD file could be considered a component.

¶104 Further support that digital files can be components of a broader product is found in other industries and other applications where digital depictions of objects can be patented components and considered the entire end product. Icons on computer screens that run upon a click of a button have been patented as components of a computer application system.[131] Hypothetical chemical structures that are computationally designed using rational chemistry design and modeling have been patented as part of computational chemical design software package.[132] Very-large scale integration (VLSI) design that is utilized to create integrated circuits has been patented at the structured design step.[133]

¶105 While Holbrook's and Osborn's argument against CAD files as components[134] raises legitimate concerns, there is a strong case to be made for CAD files as components considering the support provided in other industries. Since digital depiction of objects can be considered components in other industries, there is support for treating CAD files as components in the 3D printing industry.[135]

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[128] *Id*. at 450-52 (finding no infringement present since the components were not combined to form the patented invention as is required under § 271(f).

[129] *See* Holbrook & Osborn, *supra* note 6, at 1350 (suggesting that memory is a medium that is key to making software a component).

[130] *Id*.

[131] MPEP § 1504.01(a)(I)(A) (8th ed. Rev. 7, Sept. 2008) ("The USPTO considers designs for computer-generated icons embodied in articles of manufacture to be statutory subject matter eligible for design patent protection under 35 U.S.C. 171.").

[132] *See High Throughput Workflow*, WILDCAT DISCOVERY TECH., http://www.wildcatdiscovery.com/technology/high-throughput-workflow/#hs1 (Aug. 1, 2015) (showing the use of computational, rational chemical structure design for synthesizing and patenting of novel chemical structures) [http://perma.cc/KX95-NN9K].

[133] *See, e.g.*, Controller-Based Power Management for Low-Power Sequential Circuits, U.S. Patent No. 6,105,139 (filed June 3, 1998); Constrained Register Sharing Technique for Low Power VLSI Design, U.S. Patent No. 6,195,786 (filed June 3, 1998); Adaptive Threshold Control Circuit and Method Within High Speed Receivers, U.S. Patent No. 6,275,959 (filed June 20, 1998).

[134] *See* Holbrook & Osborn, *supra* note 6, at 28 (discussing that it is not an intuitive reading of § 271(c) to hold that a CAD file is a "component of the patented machine" and not a component that can be combined outside of the U.S. in a way that infringes a patent).

[135] Nonetheless, the price erosion of CAD files with massive consumer adoption makes it unlikely that transactions with CAD files could fall under offer to sell or be considered as sales; hence, the patent owner's pursuit of an infringement action under § 271(c) is somewhat weakened despite the fact that a CAD file could be considered a component under § 271(c).

F. 102(a)(1) Anticipation Blocking Action as a Patent Infringement Alternative

¶106 There are numerous challenges for a patent owner pursuing an infringement claim under direct infringement via § 271(a), an indirect infringement claim under 35 U.S.C. § 271(b), or a contributory infringement claim under § 271(c). Given that these infringement theories may not ultimately help the patent owner, another alternative for the original CAD file creator would be to demonstrate that the patented invention anticipates other objects. While this is not a patent infringement claim, such a theory would block anybody else from getting a patent through a § 102(a)(1) anticipation bar.[136] Thus, the original CAD file creator could employ anticipation as an alternate patent strategy to block others. This scenario is particularly relevant since patent owners might need to be careful with their CAD files if such CAD files constitute "ready for patenting."

¶107 In the context of anticipation of a similar patented invention, a question would arise whether the CAD file would be considered "ready for patenting" in order for the 102(a)(1) bar to have effect.[137] When there is an offer for sale, the 102(a)(1) anticipation bar requires that the invention be "ready for patenting," and not just be at the stage where it is unclear whether the invention will work.[138] Thus, the offer for sale alone does not trigger the sale bar. In other digital contexts outside of 3D printing, a similar issue has arisen when there is a fuzzy line as to whether the conception of the invention is sufficient.[139] A key question is whether the digital file is representative of being ready for patenting.

¶108 In 3D-printing applications, CAD files are where most of the thought, analysis, and engineering or scientific utility reside. Thus, as blueprint files, CAD files constitute "making" under § 271(a).[140] Holbrook and Osborn argue that CAD files are considerably different from unassembled components and are far different than blueprints and molds, since 3D printing is simple, and the assembly of components is not complex.[141] Since 3D-

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[136] 35 U.S.C. § 102(a)(1) (2013).

[137] In order for the patent owner to have such a claim, the CAD file itself would have to be considered as falling within the 35 U.S.C. § 102(a)(1) "on sale" bar. Assuming that the CAD file does qualify as being offered for sale, some might consider that CAD files for 3D printing are not ready for patenting, since there could still be experimentation on the shape or features of the eventual 3D printed object. But that notion is fundamentally weak, since the consumer performs much of the experimentation in the digital realm while editing the CAD file on the computer, and the file is "ready for patenting" prior to the printing step. Thus, in the 3D printing context, there should be little concern about issues related to "ready for patenting."

[138] Pfaff v. Wells Elecs., Inc., 525 U.S. 55, 67 (1998).

[139] In many other industries, digital files are "ready for patenting" and are being utilized to produce physical objects: (1) CAD files in the construction industry are useful as blueprints to convey how to construct buildings; (2) 3D scanners are used to electronically scan and produce 3D computational representations of 2D objects; (3) Finite Element Models (FEM) are created to perform Finite Element Analysis (FEA) to analyze structural, chemical, fluid, and thermal conditions in predictive engineering studies; (4) Solid Freeform Manufacturing is utilized to additively create 3D objects on a larger scale based on digital files; (5) VLSI design is utilized to design circuits before fabrication; (6) MEMS, such as miniature sensors and actuators, are designed in specialized CAD programs to create masks before release to fabrication; and (7) novel chemicals are designed *in silico*, utilizing combinations of statistical thermodynamics and Monte Carlo methods prior to creating a fabrication recipe for a chemist to perform the subsequent chemical synthesis steps. In each of the aforementioned cases, there is blurry line on whether the invention is a near representation, since such files effectively contain the blueprints of the printed object but are not emblematic of the production step.

[140] Thus, CAD files are equivalent to the tangible object, and the printing step is perfunctory and routine in nature. All of the labor and thought is applied in the creation of the CAD file, while the actual step of printing is simple, pervasive, and cheap.

[141] *See* Holbrook & Osborn, *supra* note 6, at 1367.

printed objects require less assembly than objects produced from injection molding, or use of molds in general, and since 3D-printed objects can be printed at the push of a button, Holbrook and Osborn argue that the CAD file is the object ultimately produced and can be considered part of "making" under § 271(a).[142] Holbrook's and Osborn's perspective is accurate since a CAD file itself is nearly resulting in the made object, and the main value of a CAD file is in production of the object.[143]

¶109 Therefore, CAD files are a near equivalent representation of the printed 3D-object, and there are no gaps in the "ready for patenting" analysis with respect to 3D printing. Thus, a patent owner could consider blocking somebody else from getting a patent through a § 102(a)(1) anticipation bar, as an alternative to an adversarial patent infringement action. This scenario is applicable for the case of patent owners being careful with their CAD files when CAD files constitute "ready for patenting."

III. 3D PRINTING DIGITAL REGULATION

¶110 Patent law in its current form is geared towards physical objects and is not prepared for the shift being created by 3D printing. Since 3D printing involves creation of CAD files that can print the physical object in an instant press of a button, there are blurry lines as to whether the creation of a CAD file should be viewed as making the object itself. Since the line between the digital and physical world is being blurred by 3D printing on a mass scale, it makes sense to develop new regulations and reform existing ones. Holbrook and Osborn have provided a first analysis of the current Patent Act on 3D printing.[144] However, Holbrook and Osborn acknowledge that there is a lack of a holistic study on adjusting patent law based on 3D printing, and that they have not provided a proposed regulatory analysis in their seminal research.[145]

A. U.S.-Based Proposed Congressional Regulations

¶111 The potential application of the Patent Act to 3D printing is unclear. However, given the proliferation of 3D printing patent filings and the potential litigation between patent owners and potential infringers, Congress should take action. Since a CAD file is digital and a form of software, it is unclear whether claims can be drafted to protect CAD files. The Supreme Court has side stepped the question of the patentability of software patents and provided little clarity on the scope of software patent claims.[146] While many cases following *Alice Corp. v. CLS Bank International* explained why particular software claims did not meet patentability requirements, the patentability of CAD files as a form of software is unclear.[147]

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[142] *Id*.

[143] This fitting and assembly of pieces of multiple 3D printed objects is relatively simple since the entire purpose of 3D printing is to reduce complexity and enable everyday consumers to create objects.

[144] *See* Holbrook & Osborn, *supra* note 6.

[145] *Id.* at 1370 (noting that there are countervailing considerations and that any expansion by Congress and courts should only take place after careful considerations).

[146] Alice Corp. Pty. Ltd. v. CLS Bank Int'l, 134 S. Ct. 2347 (2014) (finding invalid claims that are abstract and directed to a computer system and method for assisting with financial transactions in a way that avoids settlement risk).

[147] Jim Singer, *Patent-Eligibility After Alice: A Summary of Decisions that Found Software Inventions Eligible for Patenting*, IP SPOTLIGHT (Nov. 25, 2014), http://ipspotlight.com/2014/11/25/patent-eligibility-

¶112 Additionally, there is a need for regulation in a 3D printing industry that is comprised of many actors in its value chain. A patent owner can sue multiple entities that may be infringing its patents by using a 3D printer. Uncertainties and questions arise as to whom a patent owner should sue.

¶113 If patent owners were concerned about patent infringement by 3D printing, the patent owner would likely not sue end users of 3D-printed objects; instead, the patent owner would sue upstream entities, either intermediaries or the CAD-file owners or the CAD-file creators, which are easier to track and likely have deeper pockets. However, such infringement claims would be of limited utility under the existing patent law.

¶114 It is not clear what the patent owner should pursue for the purposes of a patent infringement claim. Additionally, the only claims that would be effective would be more likely to be effective against either the intermediaries, such as "3D printing services" businesses, or against CAD distributors. Given the challenges of suing upstream, many patent owners might end up suing end users, even as a means to take some kind of action. This could result in a significant increase in litigation against 3D printing intermediaries. Therefore, there is a need for reforming the Patent Act to serve the needs of 3D printing while protecting patent owners.

1. Proposed Digital Millennium Copyright & Patent Act (DMCPA)

¶115 One suggested amendment to the Patent Statute has been to include an exemption to infringement for personal 3D printing.[148] This reform would create immunity for DIY-ers who are consumers and not large-scale manufacturing commercial companies. Such an exemption would promote creativity among DIYs in using 3D printing without being concerned about the threat of patent litigation. However, the problem with an exemption for a specific user of an area of technology area is that there would be further uncertainty as to who exactly is covered by the exemption.

¶116 Additionally, such an exclusive 3D printing exemption would differentiate technology areas, creating further uncertainty as to what technology areas are covered by the Patent Statute and which technology areas are exempt. Further challenges would arise on whether to include or exclude other technologies that are very similar to 3D printing, and inherently possessing both digital and physical aspects. Such an exemption by technology classification would create an administrative nightmare in the USPTO on whether to deny or accept an exemption in technology applications, especially systems and devices that bridge multiple technology domains.

¶117 Instead, Congress should focus on other ways that limit digital patent infringement liability to prevent the pending litigation between patent owners and 3D-printing users and CAD-file sharing websites and "3D-printing services" businesses. Professors Deven Desai and Gerard Magliocca have argued against others' proposals to create 3D printing hardware restriction and digital rights management and have proposed a notice-and-takedown rule akin to the DMCA.[149] One way for Congress to take action is to extend the

after-alice-a-summary-of-decisions-that-found-software-inventions-eligible-for-patenting/ [http://perma.cc/YGB4-CG2R].

[148] *See* Desai & Magliocca, *supra* note 22, at 1713 (suggesting that some exemption should be created for 3D personal printing that is not aimed at large-scale commercial manufacturing).

[149] *See id.* at 1715, 1718 (suggesting that constricting hardware capabilities such that certain items cannot be printed and digital rights management controls are not the solution, but instead that websites that

Digital Millennium Copyright Act (DMCA) to become the Digital Millennium Copyright and Patent Act (DMCPA), which would be a new name and would also serve as a new, modified notice-and-takedown regulation.[150] The supporting reasons for a new DMCPA is that it would avoid having two different notice-and-takedown frameworks (one for copyright law and another for patent law) and also recognizes that websites involved with 3D printing are already implementing the notice-and-takedown rules for copyrights.[151]

¶118 The new DMCPA would target CAD sharing websites that host and share CAD files that are utilized to print infringing 3D-objects; such websites would be liable for contributory infringement. Such a patent notice-and-takedown rule for 3D printing will protect patent owners from websites that host, upload, share, and promote transmission of infringing CAD files. With the growth of such CAD sharing websites, there could be a rise in litigation against many such websites, which may not know or understand that CAD files could be infringing on a patent owner's rights. The creation of a notice-and takedown rule would prompt CAD file sharing websites to take measures that would ultimately reduce litigation against them. There is already much overlap with copyright law, for which the DMCA was enacted to protect copyright owners in the film and music industries. By extending the DMCA to become the DMCPA, there would be protection for patent rights of the patent owner that the CAD file may infringe.

¶119 The burden of identifying infringing material would rest with the patent owner, just as it does with the copyright owner in the DMCA. Some may argue that a DMCPA would not solve the problem of identifying direct infringers who end up printing the 3D object using the CAD file. While this has some merit, it can be resolved. The notice that was sent to the CAD file sharing website could include an explanation of the patent claims that are allegedly being infringed and also a summary that the CAD file sharing website should send to the end use printer. Such a notice-and-takedown effort would reduce the number of direct infringers that print the 3D-object from the CAD file.

2. Additional Reform in Patent Law

¶120 Additionally, Congress should pass a statute that is aimed at clearer standards related to 3D printing and that prevents arbitrary litigation. Another concern for patent owners is that end use consumers will use 3D printing to easily fabricate replacement parts of an object easily through 3D printing rather than to purchase a new part. 3D printing makes it cheaper not only to create entire objects, but also portions of objects or replacements for worn out objects. A patent owner should be concerned that 3D printing can be utilized to avoid patent infringement under the repair-and-reconstruction doctrine.[152] Consumers will be able to preserve worn out objects more easily by cheaply 3D printing replacement parts or by cheaply repairing 3D-objects.

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serve as a conduit for 3D printing software copying should be held accountable for contributory infringement if the site refuses to take down a file after receiving a plausible complaint from a patent owner).

[150] A new notice-and-takedown effort could also implement trademark rights.

[151] *See* Doherty, *supra* note 1.

[152] The doctrine of repair and reconstruction in U.S. patent law enables an individual who is authorized to produce, use, or distribute a patented item to repair and replace unpatented components. In other words, an owner of a patented property has the lawful right to repair the patented property and replace parts. While the owner of the property can preserve the utility and the operability, the owner cannot impermissibly reconstruct the patented article, which would constitute patent infringement.

¶121 Thus, patent owners might argue for reforming the repair-and-reconstruction doctrine to enable patent owners to not lose the full value of the patent rights on their patented invention. While this might raise concerns related to patent exhaustion, the patent owner might argue for reforms since it would be difficult to price goods knowing it would be difficult to capture the repair market; the pricing challenges come from uncertainty on the usage and adoption of 3D printing. Additionally, such a reform would protect consumers who would be accused of patent infringement by repairing or replacing parts using 3D printers.

¶122 The patent exhaustion doctrine allows the purchaser of a patented object the right to use and to repair an object without any restrictions.[153] Additionally, the consumer can repair a patented item by using unapproved parts to repair the item.[154] However, once the patented object is no longer useable, the consumer must buy a new product in order to continue the use, and cannot reconstruct the patented object after it is no longer useable, without committing patent infringement. Moreover, the end user might also end up printing low cost replacement parts for others to use or to buy. The patent owner's revenue streams could be affected if fewer replacement products are sold and potential repair services revenues could be diminished if existing products' replacement parts could be easily replaced by 3D printing.

¶123 The challenging legal issue is whether the consumer has repaired the object innocently or has committed an infringement by reconstruction of a non-useable object. This would be an especially perplexing determination in the 3D printing arena since the actions of end users would be on a mass scale, away from commercial uses, and difficult to police. It would be very unpredictable, difficult, and inconsistent to police repair-and-reconstruction by use of a 3D printer. Thus, the patent owner needs to know with better accuracy when and how a 3D printing end user would be violating the repair-and-reconstruction doctrine. A better demarcation is needed if the repair-and-reconstruction doctrine is to give the patent owner a better understanding of patent rights and prohibit unnecessary litigation.

¶124 One proposal has been to apply an all or nothing standard, such that if the entire device is not copied, then it would not fall under reconstruction.[155] Under such as a standard, unless a patent holder can prove that a consumer replicated all aspects of the device, then the patent holder would get nothing.[156] Thus, an alteration created by a 3D-printer to one particular aspect of the object, whether it be shape or size or texture, would fall under permissible repair. As long as some aspect of the object would be different than before, then replacement of the unpatented part by the end user would still be permissible. The end user would need to apply some labor and skill for modifying the object or some part of the whole object.

¶125 Such a proposal would enable an end user to be free from unnecessary reconstruction liability by simply modifying some aspect of a patented invention. This would be a viable solution since it does not penalize the end user for a limited modification, and only penalizes the end user for a full reconstruction that effectively creates a new replacement

[153] Aro Mfg. Co. v. Convertible Top Replacement Co., 365 U.S. 336, 342-43 (1961).

[154] *Id*.

[155] Kelsey Wilbanks, *The Challenges of 3D Printing to the Repair-Reconstruction Doctrine in Patent Law*, GEO. MASON L. REV., 1147, 1174 (2013).

[156] *Id.* at 1175.

part to take the place of something non-useable. While there could be some criticism for unjustly enriching the end user who may avoid what may be perceived as liability, the end user is not aiming to circumvent the repair-and-reconstruction doctrine and infringe on the patent owner's rights. An end user can modify some aspects of a non-useable device using other technologies; 3D printing should not be limited in use simply because technology for modification is a quicker and easier.

¶126 Instead, the all or nothing approach provides a clear divide in what is applicable and what is not for 3D printing. The patent owner still would have complete ownership of the patented invention. Such a reform of the repair-and-reconstruction doctrine in the form of an all or nothing standard would also force patent owners to more strongly define patent rights. Thus, more clear standards would not only protect the end user from litigation, but would also better define the rights of patent owners in a world of prevalent 3D printing.

B. 3D Printing Regulation in Digital Trade

¶127 While Congress' response to the 3D printing revolution will help to clarify patent infringement, such reform proposals would only be aimed at affecting commerce inside of U.S. borders. The implementations of a refined notice-and-takedown rule and of a modified repair-and-reconstruction doctrine are measures that Congress can implement. Such measures will have limited effect since they will be confined to the U.S. and will not address the global and cross-border flow of digital information in the world of 3D printing. Additionally, a digital trade challenge results when some steps, such as CAD file creation, are done in the U.S. but the final assembly or the printing is done wholly in another country.

¶128 Digital regulation must address cross-border digital commerce. The promise of 3D printing is that actors can be located anywhere in the world. Additionally, 3D printing's separate steps for digital creation or digital modification and physical printing raise further regulatory complexity. A 3D printing user can participate in digital creation, digital modification, and/or physical printing. Moreover, a 3D printing user can be located anywhere in the world. The cross-border dispersion of 3D printing creates further complexity with respect to intellectual property rights because separate steps of the 3D printing value chain can be easily performed in multiple countries or by multiple actors, and easily transmitted across borders.

¶129 Copyright law faced and responded to well-known challenges with the advent of digital music files. Also, open source software development and creative commons licenses have been another means to protect the creativity of authors. Some have suggested that personalized 3D printing technology, which initially started as an open source development project,[157] would better enable free creativity through open source licensing. While open source is well established in the software world, it is a relatively new phenomenon in the 3D printing word. The common open source license terms, such as to "copy and distribute the product, use the product for any purpose, and modify, repurpose, and create derivative works of the product,"[158] are aimed at software and digital uses, and do not contain provisions related to patentable subject matter. Despite the fact that open source licenses

[157] Hjalte Worm Frandsen, A Commercial Perspective on Open Source Hardware: An Interdisciplinary Law and Management Investigation of the Personal 3D Printing Industry (Nov. 2012) (unpublished M.S. thesis, University of Copenhagen and Copenhagen Business School) (on file with author).

[158] *Id.* at 36.

are applicable across jurisdictions with differing laws and promote close collaboration among users of the creation, they do not address physically printed objects and tangible goods. Instead, legislation is needed to protect patent owners who have rights to physical goods.

¶130 Some legislative proposals have been geared towards digital technology; however, these proposals have aimed to regulate the entrance of digital copyrighted works via electronic transmission from anywhere in the world, and have not touched on patentable subject matter. The Stop Online Piracy Act (SOPA) was a bill directed toward expanding the ability of U.S. enforcement officials to combat Internet sites dedicated to the theft of U.S. property marketed as offering counterfeit goods in a way that enabled or facilitated copyright infringement.[159] The Preventing Real Online Threats to Economic Creativity and Theft of Intellectual Property Act of 2011 (PROTECT IP Act or PIPA) enabled the Attorney General to sue an owner or operator of an Internet website dedicated to infringing activities that had a legitimate purpose other than to facilitate copyright infringement.[160] The result of those proposed acts was a massive Internet outcry against them and against their broad and vague language; therefore SOPA and PIPA were not passed.

¶131 Nonetheless, lessons can be learned from attempts made under copyright law to implement legislation aimed at regulating digital content. Copyright law has aimed to evolve to consider potentially infringing electronic information crossing borders, initially in the form of electronic music files and subsequently in electronic transmission of any copyrighted works. Similarly, patent law will need to evolve to consider potentially infringing electronic CAD files that cross borders. A key challenge with patent law as it applies to cross-border development is whether digital files are considered akin to physical goods that face importation and digital trade issues. The act of infringement of a digital patent is even more profound with 3D printing because it is opens up some patents to infringement by the consumer masses and not just for companies. A recent case, *In re Certain Digital Models*, touches on issues related to patent law and digital infringement.

1. Background on "Digital Articles" from In re Certain Digital Models

¶132 A recent dispute based on 3D printing technology has involved infringement of digital files. While the technology involved was plastic dental appliances in the form of invisible braces, the asserted claims were not aimed at physical products.[161] This case involved patents that covered methods of making Align Technology, Inc.'s Invisalign® products.[162]

¶133 Align had invented a patented process for creating plastic teeth aligners in the form of molds involving scanning of a person's teeth and then converting the scans into digital files. The patent claims covered the methods for making aligners through the use of digital

[159] Michael A. Carrier, *SOPA, PIPA, ACTA, TPP: An Alphabet Soup of Innovation-Stifling Copyright Legislation and Agreements*, 11 NW. J. TECH. INTELL. PROP. 21, 21-22 (2013) (noting that the "enable of facilitate" language is broad and would not only punish websites that themselves directly infringed the copyright laws but also those that help others to infringe, and in doing so, the entire Internet itself would satisfy its infringement standard).

[160] *Id*.

[161] Sapna Kumar, *Regulating Digital Trade*, FLA. L. REV. (forthcoming 2015) (manuscript at 11), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2586740 [http://perma.cc/C6RC-S8GC].

[162] Lucas Osborn, *Digital Patent Infringement and the ITC*, PATENTLY-O (Apr. 30, 2014), http://patentlyo.com/patent/2014/04/digital-patent-infringement.html [http://perma.cc/F8TT-F9UE].

data sets and then making the aligners by 3D printing.[163] Align's patent claims were aimed at the methods for producing the aligners, rather than the physical objects, and the claimed methods were for creating the aligners, the digital data sets, and the digital treatment plans.[164] Thus, anybody who used the process or created such digital data sets were infringing Align's patents even before the aligner molds were created.

¶134 In 2006, a complaint was filed by Align against the OrthoClear companies stating that the apparatus imported by OrthoClear from Pakistan violated Align's patents.[165] Align's complaint alleged that ClearCorrect violated Section 337 of the Tariff Act, which allows the U.S. government to protect patent holders from importation of patented articles.[166] In 2012, Align claimed that the violation was of importation of digital goods when OrthoClear downloaded digital files, which were modified in Pakistan by ClearConnect, to a Houston server in order to 3D print models for aligners.[167] ClearConnect had produced the original teeth scans in the U.S. but then had sent the digital files to Pakistan, where the digital files were converted to 3D models in CAD files.[168] The CAD files then were sent back to the U.S. to ClearConnect, which printed the teeth molds.

¶135 A concern was whether the importing digital data sets constituted patent infringement, and whether there could be patent protection of digital representations of physical products.[169] The dispute between Align and OrthoClear centered on whether electronic transmission of digital data sets constituted importation of articles within the meaning of the Section 337 of the Tariff Act.[170] ClearConnect argued that the digital data were not articles, under Section 337 of the Tariff Act. Thus, the heart of the 2014 ITC decision involved issues related to whether "articles" included the electronic data sets and issues related to the policing of digital trade between Align and ClearCorrect.[171]

¶136 Ultimately, the ITC found that the digital data sets that were produced using Align's patented method were considered articles.[172] The ITC held that the statutory phrase

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[163] *Id*. (noting that "[s]cans of the user's teeth [were] converted into digital files, which [were] used to design a series of digital models of the teeth aligners, each one successively moving the teeth closer to the proper alignment" in a process that involved converting digital files into 3D models customized to fit a person's teeth).

[164] *See* Kumar, *supra* note 151.

[165] *See id.* (nothing that the name "OrthoClear" refers to three companies: OrthoClear, Inc. of San Francisco, OrthoClear Holdings, Inc. of Tortola (British Virgin Islands); and OrthoClear Pakistan Pvt, Ltd. of Lahore (Pakistan) and that ClearConnect is an agent of OrthoClear).

[166] *Id*.

[167] *Id*.

[168] Debra Thimmesch, *3D Printing at the Center of Controversial Intellectual Property Debate*, 3DPRINT.COM (Jan. 6, 2015), http://3dprint.com/34255/itc-intellectual-property/ [http://perma.cc/US2X-W932].

[169] *Id*.

[170] *See* Osborn, *supra* note 152.

[171] *See* Thimmesch, *supra* note 158.

[172] Eric Schweibenz, *ITC Issues Public Version of Opinion In Certain Digital Models, Digital Data, and Treatments Plans For use, In Making Incremental Dental Positioning Adjustment Appliances Made Therefrom (337-TA-833)*, ITC 337 L. Blog (Apr. 24, 2014), http://www.itcblog.com/itc-issues-public-version-of-opinion-in-certain-digital-models-digital-data-and-treatments-plans-for-use-in-making-incremental-dental-positioning-adjustment-appliances-made-therefrom-337-ta-833 [http://perma.cc/M8JP-WTJT] (holding that accused products are "articles" within the meaning of Section 337(a)(1)(B) and the mode of bringing the accused products into the U.S. constitutes importation of the accused products into the U.S., and further discussing that while the term "articles" is not expressly discussed in the statute, that the statutory construction of "articles" is most consistent with the overall language of the statute that implements Congress' avowed purposes).

"importation of articles" should be construed to include electronic transmission of digital data and determined that digital importation constituted importation under Section 337 of the Tariff Act.[173] Specifically, the ITC determined that digital data, even if not in a tangible form such as a diskette, flash drive, or tape, is an electronic transmission that constitutes articles under the Tariff Act.[174]

¶137 The case is currently up on appeal to the Federal Circuit, which has not previously considered whether digital information can be considered an article.[175] The ruling from the Federal Circuit on the issue of whether digital information constitutes an article will have tremendous impact, since increasingly physical objects, such as books, or precursors to 3D printed objects are transmitted in an electronic form. The uncertain legal question for Federal Circuit is whether a court should find that a digital file infringes a patent claim of a physical product, either under direct infringement or under the doctrine of equivalents.

¶138 The rapid distribution of digital importation in the 3D printing ecosystem and the ubiquity of digitally transmitting blueprints for subsequent 3D printing makes it easier for parties to infringe on claims directed towards digital representation and digital date sets of 3D printed objects. Additionally, while the Align and Clear Connect dispute was between companies, it demonstrates the rapid progress of 3D printers and serves as a preview of potential patent infringement by individuals who will generate CAD files for use in printing physical products on their 3D printers.

2. Stopping Digital CAD Files as Patented Articles at the U.S. Border through ITC Enforcement

¶139 SOPA and PIPA did not pass, but another legislative attempt was made to regulate digital commerce through the Online Protection and Enforcement of Digital Trade Act (OPEN), which would have amended the Tariff Act to enable the ITC to have jurisdiction over digital importation into the U.S.[176] OPEN would give enforcement rights against entities that willfully promoted copyright infringement, and innovators and creators would have stronger intellectual property rights.[177] OPEN would amend Section 337 of the Tariff Act by adding Section 337A to empower the ITC to investigate unfair digital imports and to issue cease and desist orders against infringers.[178] OPEN was aimed at a much more

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[173] *See* Aarti Shah, *ITC on Digital Imports: Takeaways for Software, Media Cos.*, LAW360 (Apr. 23, 2014), http://www.law360.com/articles/529861/itc-on-digital-imports-takeaways-for-software-media-cos [http://perma.cc/L4Y6-XDGM].

[174] Carl P. Bretscher & Lora A. Brzezynski, *ITC Jurisdiction Covers Transmission of Digital Data*, INTELL. PROP. ADVISORY (McKenna Long & Aldridge LLP) (Apr. 28, 2014) (discussing that the Commission's broad reading of "article" and "importation" also covers movies, photos, media, and other electronic materials, which can be affected by infringing electronic imports and affects industries that use digital data for 3D printing or other manufacturing technologies).

[175] *See* Kumar, *supra* note 151 (manuscript at 12).

[176] *See id.* at 37-38 (noting that OPEN would have allowed the ITC to issue "cease-and-desist orders against entities that assisted in digital infringement including orders to shut down websites that facilitate infringement").

[177] Christina DesMarais, *SOPA, PIPA Stalled: Meet the OPEN Act*, PCWORLD (Jan. 21, 2012), http://www.pcworld.com/article/248525/sopa_pipa_stalled_meet_the_open_act.htmlh [http://perma.cc/M3M5-ERWY] (noting that OPEN would give oversight to the ITC on foreign-based websites and an appeals process for only websites with willful copyright infringement; SOPA and PIPA, in contrast, would have enabled take down of an entire website and sanctions even if just one page on it carried infringing copyright content).

[178] Michael J. Allan & Charles F. Schill, *Rogue Websites and the ITC: New Proposed Piracy*

targeted response and addressed only infringing websites outside of the U.S. that are conducting business in the U.S.[179] The incentive for OPEN was to deter unfair imports from reaching the U.S. market and enable creators to maintain their rights to benefit from what they have created while maintaining an OPEN Internet.

¶140 OPEN was aimed at copyright law and ultimately failed, but the underlying premise of OPEN can be applied to regulating digital patent infringement in 3D printing. The ITC's exclusion orders can protect the rights of patent owners against potential patent infringers and against scenarios such as *In re Certain Digital Models*. While there are inherent challenges to the ITC's enforcement of 3D printing patent infringement, such as abuse from government, censorship concerns, and institutional design concerns,[180] the public interest of protecting patent owners' rights can be adequately addressed by the ITC.

¶141 While some may argue against the creation of a digital border around the U.S. and against a means to police information, patent owners have an equally important concern about protecting their innovation. Additionally, since the 3D printing world is essentially about physical goods simply a click away from being printed via CAD files, then the ITC's mandate would cover digital regulation of CAD files. In sum, the blur in digital and physical in 3D printing patent infringement should be policed by the ITC.

CONCLUSION

¶142 3D printing is a new means for production that will make it easier to make a copy of a patented product, and therefore easier to infringe a patent. Given that the potential application of the Patent Act to 3D printing is unclear, new regulatory frameworks are needed. The implementations of a refined notice-and-takedown rule and of a modified repair-and-reconstruction doctrine are measures that Congress can implement to regulate 3D printing within the U.S. Another possibility to protect the rights of inventors is to amend the Tariff Act to enable the International Trade Commission to have jurisdiction over digital importation into the U.S. and cover digital regulation of CAD files. While OPEN was aimed at copyright law and ultimately failed, the underlying premise of OPEN can be applied to regulating digital patent infringement in 3D printing. The International Trade Commission's exclusion orders can protect the rights of patent owners against potential patent infringers.

Legislation, STEPTOE AND JOHNSON NEWSL., Dec. 16, 2011, http://www.steptoe.com/publications-newsletter-370.html [http://perma.cc/8LZ9-4CD8].

[179] Ryan Lau et al., *Enforcement of Intellectual Property Rights Abroad in a Post SOPA World: OPEN and Its Alternatives*, (Dec. 2012) (unpublished report to Sen. Maria Cantwell and Sen. Mark Winter, on file with the MIT Computer Science and Artificial Intelligence Laboratory).

[180] Kumar, *supra* note 151 (manuscript at 40-42, 44).