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From IP Goals to 3D Holes: Does Intellectual Property Law Provide a Map or Gap in the Era of 3D Printing?

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TABLE OF CONTENTS

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I. INTRODUCTION

Occasionally throughout history the world is introduced to a new technology that completely changes human life, such as the printing press, the Henry Ford assembly line, and the Internet. The next wave in life-changing technology will be the three-dimensional (3D) printer, which will allow the consumer to print any item at home. Not only will people be able to print any item they need via a digital download, but they will also have the power to design it themselves. Since the more basic patents on the invention have expired, these printers will soon become a staple in the common household. 3D printers will soon be readily available, affordable and accessible, and everyday people will be printing whatever objects they desire.

However, like all revolutions that affect major consumer industries, a revolution in the law must also follow, which traditionally tends to lag significantly behind technological advances.[1] The next question inevitably will be how this technology fits into the current intellectual property framework, if at all. The entire act of 3D printing stretches across many facets of the law, as it involves a machine, a product, an underlying digital process, and often the translation of that process. This Article will discuss which of these aspects of 3D printing fit under current patent and copyright laws and which aspects fall into gaps in the existing law. The Article will further discuss viable solutions offered by scholars in the IP community and the policy implications of gaps in the law.

A. BASICS OF 3D PRINTING

A 3D printer uses instructions, a blueprint or design software from a computer to create three-dimensional objects out of hardened powder, molten or liquid substances. The materials are spread into a single-layered pattern via the 3D "print head." Once this first layer hardens, the print head produces another layer on top of the hardened layer. The print head continues this exercise until the three-dimensional object is completed, which sometimes consists of hundreds of thin, individually-stacked layers.[2] This process is referred to as "additive manufacturing."[3] Because the 3D printer uses a layering system to build the object, an object that has interlocking, separate parts can be printed already assembled, rather than having to manually compile all of the individual parts

[1] *See* Vivek Wadhwa, *Laws and Ethics Can't Keep Pace with Technology*, MIT TECH. REV. (Apr. 15, 2014), https://www.technologyreview.com/s/526401/laws-and-ethics-cant-keep-pace-with-technology/.

[2] HOD LIPSON & MELBA KURMAN, FABRICATED: THE NEW WORLD OF 3D PRINTING 12 (2010).

[3] *Id.*

separately.[4] This would cut down on labor costs and time, as well as add to the convenience of utilizing these printers in multiple industries and fabrications. The blueprint sent to the computer to print the object is created using a computer-aided design (CAD) program. Alternatively, a CAD may be created with a 3D scanner, which can scan any object and create a three-dimensional blueprint.[5] This process results in easy replication of virtually any object.

While initial 3D printer systems used a process of layering plastic materials, newer systems of printing may involve a variety of stronger materials.[6] Selective laser sintering (SLS) involves releasing an initial aerosol cloud of building material, usually metals, which a laser then precisely fuses together in the shape of the object.[7] Another process called selective laser melting (SLM) takes the process one step further by melting all the metal material before the building begins. The printer then fuses together the tiny molten metal materials. The SLS and SLM processes have both been used by NASA in rocket and launch design.[8] As has become increasingly apparent in recent decades, many common everyday objects were first utilized and further developed by NASA. The 3D printer will not be an exception to this trend.

The 3D scanners mentioned above are also becoming more widely available. This scanning technology, also known as photogrammetry, is developing rapidly.[9] These scanners collect data from an actual three-dimensional object to create a digital model to the exact specifications of the object. Once the digital model is created, it can then be printed using a 3D printer, making the possibilities for 3D printed objects virtually limitless.[10] Photogrammerty scanners, handheld 3D scanners, and attachable 3D scanners for the iPhone and iPad are either already available for purchase or in the works.[11] This scanning technology has even been recognized as a highly valuable educational tool. In fact, the Smithsonian is in the process of scanning artifacts, artworks, and specimens in its museums to make available to other museums and educators. The program is called "Smithsonian X 3D," and the institution has prioritized 10% of their 137-million-piece collection for the creation of 3D digital models.[12] As this example shows,

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[4] Michael Weinberg, *It Will Be Awesome If They Don't Screw It Up: 3D Printing, Intellectual Property, and the Fight Over the Next Great Disruptive Technology*, PUBLIC KNOWLEDGE 2 (Nov. 2010), https://www.publicknowledge.org/files/docs/3DPrintingPaperPublicKnowledge.pdf.

[5] *Id.* at 3.

[6] Graham Templeton, *How does 3D printing work?*, EXTREME TECH (Oct. 26, 2015), http://www.extremetech.com/extreme/216652-how-does-3d-printing-work.

[7] *Id.*

[8] *Id.*

[9] John Hornick & Carlos Rosario, *3D Scanning: The Achilles Heel of IP Protection for 3D Printing*, 3D PRINTING PROGRESS (Oct. 26, 2015), http://www.3dprintingprogress.com/articles/8580/3d-scanning-the-achilles-heel-of-ip-protection-for-3d-printing.

[10] *Id.*

[11] *Id.*

[12] *About Smithsonian X 3D*, SMITHSONIAN X 3D, http://3d.si.edu/about (last visited Oct. 1, 2017).

there are likely few industries or markets where 3D printing would not provide some substantial service, even in education. Further, the Smithsonian's confidence in 3D printing to provide near exact replicas of their priceless originals shows speaks volumes on the technology's capabilities.

B. INDUSTRIAL AND ECONOMIC IMPACT

The goals and incentives of intellectual property are inextricably intertwined with the economic impact of technology. Therefore, understanding 3D printing's affects is important to adequately view it through an intellectual property perspective. Though 3D printing is still in its early stages, the potential for the technology is astounding. These printers can produce anything from household items and spare parts to even prosthetic limbs, plastic guns, and even small houses. Websites such as Shapeways[13] and Thingiverse[14] provide a community for people to upload and download designs to print on personal 3D printers using a variety of materials such as metal, plastic, porcelain, and wax. These websites offer downloads for items such as jewelry and home appliance parts.[15] Shapeways even features the ability to scan oneself at select locations in the Netherlands to create a personal miniature figurine, or "3D Selfie."[16] Most notably, these printers can produce numerous human body tissues[17] and even food.[18] 3D printers can even print 3D printers.[19]

The eventual low cost of 3D printing combined with their ability to produce most physical things will fundamentally change the economics of industrial manufacturing.[20] Much like the Internet, 3D printers separate the content of the product from the information used to create it, which, in turn, will substantially reduce the manufacturing costs.[21] This feature will inevitably mean that the production of items can come from virtually anywhere which will certainly

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13 SHAPEWAYS, http://www.shapeways.com/ (last visited Oct. 1,2017).

14 THINGIVERSE, https://www.thingiverse.com/about/ (last visited Oct. 1, 2017).

15 SHAPEWAYS, *3D Printing Materials: Plastics, Metal, Ceramics and More*, http://shapeways.com/materials (last visited Oct. 1, 2017).

16 *Shapeways Now Offering 3D Selfies in the Netherlands*, SHAPEWAYS (Sept. 28, 2015), http://www.shapeways.com/presscorner/press-release/2015-09-28-shapeways-now-offering-3d-selfies-in-the-netherlands.

17 Robert J. Szczerba, *No Donor Required: 5 Body Parts You Can Make With 3-D Printers*, FORBES (June 17, 2015, 7:57 AM), http://www.forbes.com/sites/robertszczerba/2015/06/17/no-donor-required-5-body-parts-you-can-make-with-3-d-printers-2/#5391aefc7d55.

18 Jacopo Prisco, *'Foodini' Machine Lets You Print Edible Burgers, Pizza, Chocolate*, CNN (Dec. 31, 2014, 1:06 AM), http://www.cnn.com/2014/11/06/tech/innovation/foodini-machine-print-food/.

19 Ben Rooney, *The 3D Printer That Prints Itself*, WALL ST. J. (June 10, 2011, 1:20 PM), http://blogs.wsj.com/tech-europe/2011/06/10/the-3d-printer-that-prints-itself/.

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

21 *Id.* at 474.

present problems for governments and markets.[22] The emergence of the "home-based factory"[23] may even change the enforcement and regulation of traditional employment laws governing earnings, hours, child-labor, workplace safety, and even unionization as the lines between work and home begin to blur. In fact, 3D printing will touch almost every area of law in existence, including gun laws, products liability, importation, contracts, environmental law, and regulatory competition law, to name only a few.[24] Obviously, intellectual property law is no exception and the approach to 3D printing in this area will be an important guidepost for judiciaries and practitioners when they analyze other areas at law. It is yet to be determined if this is for better or worse, as IP is often one of the most turbulent and evolving areas of the law.

Digitization of a product has already once shaken the parameters of intellectual property, particularly for that of copyright law in the area of music. Music became a nonrivalrous good in the wake of music-sharing sites, such as the infamous Napster. A nonrivalrous good is "like an idea: it need only be created once and has an infinite capacity in that once it is created there is no additional marginal cost in allowing others to use it."[25] It is widely accepted in our economy that a rivalrous good should be allocated to the person who values it most, which allows for freedom in production and earning potential.[26] Thus, under this principle, the producer of a good is given exclusive control and property rights in the good, which they can transfer to a person who is willing to pay for it.[27] This basic principle was undermined in the emergence of streaming and downloading technology and illustrates the same economic issues that will again arise in the growth of 3D printing. Much like with Napster, the original producer of the good can be easily undercut by a million 3D printed versions and recreations of the original. However, unlike with Napster, a potential benefit could be that these newer printed versions might actually be better than the originals.

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[22] *Id.* at 475 (noting lack of control over production).

[23] Elizabeth J. Kennedy & Andrea Giampetro-Meyer, *Gearing Up for the Next Industrial Revolution: 3D Printing, Home-Based Factories, and Modes of Social Control*, 46 LOY. U. CHI. L.J. 955, 984 (2015).

[24] Lucas S. Osborn, *Regulating Three-Dimensional Printing: The Converging Worlds of Bits and Atoms*, 51 SAN DIEGO L. REV. 553, 558 (2014).

[25] Deven R. Desai, *The Life and Death of Copyright*, 2011 WIS. L. REV. 219, 255.

[26] Brett M. Frischmann, *An Economic Theory of Infrastructure and Commons Management*, 89 MINN. L. REV. 917, 945 (2005).

[27] *Id.* at 946.

II. MIND THE GAP: WHERE DOES IP LAW START AND STOP WITH 3D PRINTING?

A. PRODUCT

The product printed by a 3D printer is governed by patent law. Patent law, which is a creature exclusive to federal law, governs inventions.[28] Accordingly, to properly define patents, a fair amount of legalese and statutory language is required as well as the respective keywords and phrases found in the leading case law. The patent system was created by Congress to protect inventions "in a manner to promote free competition and enterprise without unduly encumbering future research and discovery," while also ensuring the eventual public availability of inventions.[29] Under the current intellectual property framework, two kinds of patents are available for an invention that may be 3D printed: design and utility.

To obtain a utility patent, an invention must be a process, machine, manufacture, or composition of matter, which is novel, useful, and non-obvious.[30] Patent protection for a utility patent is for twenty years from the date the patent is issued.[31] "[W]hoever without authority makes, uses, offers to sell, or sells any patented invention . . . infringes the patent" and is subject to liability.[32] Infringement of a utility patent focuses on the invention itself, particularly the function and specification of the product outlined in the patent application, as well as the specific claims to the invention awarded by the United States Patent and Trademark Office.

A design patent protects "original and ornamental design for an article of manufacture."[33] "A design is ornamental if it presents a pleasing, aesthetic appearance," not determined by any functional characteristics.[34] "Additionally, a design patent must fulfill the statutory requirements of novelty, and non-obviousness."[35] The patent grants a monopoly as to the claim of the patent for a term of fifteen years from the date the patent is granted.[36] "[T]he test for design patent infringement is not identity, but rather sufficient similarity—whether 'the accused design could not reasonably be viewed as so similar to the claimed design that a purchaser familiar with the prior art would' "suppose it to be the other.[37]

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[28] Thomas B. Lindgren, *The Sanctity of the Design Patent: Illusion or Reality? Twenty Years of Design Patent Litigation Since* Compco v. Day-Brite Lighting, Inc., *and* Sears, Roebuck & Co. v. Stiffel Co., 10 OKLA. CITY U.L. REV. 195, 197 (1985).

[29] 35 U.S.C. § 200 (2012).

[30] *See* 35 U.S.C. § 101-103 (2012) (noting the requirements for obtaining a utility patent).

[31] 35 U.S.C. § 154(a)(2) (2012).

[32] 35 U.S.C. § 271(a) (2012).

[33] *See* 35 U.S.C. § 171 (2012).

[34] Lindgren, *supra* note 28, at 197–98.

[35] *Id.* at 198.

[36] *See* 35 U.S.C.A. § 173 (West 2017).

[37] *See* Pac. Coast Marine Windshields Ltd. v. Malibu Boats, LLC, 739 F.3d 694, 701 (Fed. Cir. 2014) (citing Egyptian Goddess, Inc. v. Swisa, Inc., 543 F.3d 665, 683 (Fed. Cir. 2008)).

B. PROCESS

1. Patent Law. There is, however, a gap in protection in the blueprint of the 3D-printed product. While protection is available for the product itself under a utility patent, and for the look and feel of the design under a design patent, there is no protection for the underlying function of a digital model of a 3D blueprint in patent law. Any potential protection for this underlying digital file was thwarted under the Supreme Court's recent decision in *Alice Corp. Pty. Ltd. v. CLS Bank International,* in which the court virtually made software patents ineligible as to the statute's patentable subject matter requirement.[38] Under *Alice*, a software patent is deemed an abstract idea, and therefore not patentable, unless it includes an "inventive concept," which requires more than mere implementation on a computer (a non-novel technology).[39] With software being the digital DNA of 3D printed objects, this holding will significantly affect patent-holders' rights moving forward.

2. Patent Infringement. Typically, because patent infringement suits can be relatively complex and costly, patent holders will pursue an action against the manufacturer or distributor of the patent being infringed upon, rather than the purchasers of the product themselves.[40] These entities make far better fiscal targets than the resulting end-users of infringing patents.[41] The bank accounts of the manufacturers and distributors are typically more substantial and reliable than those of individual purchasers, as these manufacturers and distributors are often repeat-offenders of patent rights.[42] Further, a patent-holder need only procure an injunction against these select few defendants to cease the extensive patent abuse. However, in the context of 3D printing, an end-user may download a CAD file and never use it, thereby not infringing on the patent. Patent infringement requires the actual use of the article itself, rather than the simple downloading of the 3D blueprint. As such, proving patent infringement would require an implausible amount of expensive discovery to be performed on every individual end-user. Ultimately, this would simply prove to be economically impracticable and even wasteful as these vast discovery costs would dwarf any damages potentially recovered.[43]

Further, a company could not be a direct infringer for the sale of a CAD file to an end-user wishing to print the object at home. While an offer for the sale presents a distinct basis for finding direct infringement, an offer to sell CAD files for a patented product would not be an infringement for the same reasons that a

38 134 S. Ct. 2347, 2350 (2014).

39 *Id.* at 2357.

40 Robert Maier, *Patents In A 3D World: The Challenge of the Second File-Sharing Revolution*, INTELL. PROP. TODAY (Jan. 6, 2014), https://www.lexology.com/library/document.ashx?g=a058d949-392c-4290-a9a9-34e7e4d6188b.

41 *Id.*

42 *Id.*

43 *Id.*

sale of a CAD file is not an infringement. As explained in *Transocean Offshore Deepwater Drilling, Inc. v. Maersk Contractors USA, Inc.*, "[t]he offer must be for a potentially infringing article," i.e., a tangible object.[44] Under these principles, selling or offering to sell a CAD file of an object cannot be deemed a sale of the patented object itself giving rise to direct infringement liability.[45]

Likewise, secondary theories of patent infringement, such as active inducement and contributory infringement are unlikely to be successful in a 3D printing context. Active inducement, like contributory infringement, requires knowledge that one is infringing or willful blindness to the prospect of infringement occurring.[46] While this form of infringement does not have the strict liability component of direct infringement, it may expand to the more egregious distributors of CAD files in disseminating patent infringing products. However, it will likely be more difficult to encompass end-users who purchase or download the CAD file for infringing products, as consumers are typically less knowledgeable about the law. Further, to prove contributory negligence, assuming that the knowledge requirement has been met, this type of infringement also requires the making, using, or selling of a component of the infringing product, which the Supreme Court does not extend to the software used to enable it.[47]

3. Evolution of Software Patent Law. The answer to this quandary may lie in existing case law and the evolution of the Court's stance on the patentable subject matter as we know it today. In the 1970s, the Supreme Court twice addressed whether inventions containing computer software were patentable, both times ruling in the negative. In *Gottschalk v. Benson*, the Court held that a method for converting binary-coded-decimal numerals into pure binary numerals for use with general purpose digital computer of any type could not be a patentable process as the underlying mathematical formulas were "abstract intellectual concepts" and constituted "the basic tools of scientific and technological work."[48] The Supreme Court reiterated this holding in *Parker v. Flook*, on the question of whether a claimed method for updating alarm limits in the catalytic converter process constituted patentable subject matter.[49] The Court held that because a mathematical formula was inherent in the patent's method, it was no less barred as unpatentable subject matter merely because it contained post-solution activity.[50] Specifically, the Court stated that "[w]hile a scientific truth, or the

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44 617 F.3d 1296, 1300, 1309 (Fed. Cir. 2010)

45 Daniel Harris Brean, *Asserting Patents to Combat Infringement Via 3d Printing: It's No "Use,"* 23 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 771, 793 (2013).

46 *See* Glob.-Tech Appliances, Inc. v. SEB S.A., 563 U.S. 754, 759 (2011).

47 *See* Microsoft Corp. v. AT&T Corp., 550 U.S. 437, 449 (2007) ("Abstract software code is an idea without physical embodiment, and as such, it does not match § 271(f)'s categorization: 'components' amenable to 'combination.' " (citing 35 U.S.C.A. § 271)).

48 409 U.S. 63, 67 (1972).

49 437 U.S. 584 (1978).

50 *Id.* at 590.

mathematical expression of it, is not patentable invention, a novel and useful structure created with the aid of knowledge of scientific truth may be."[51]

The Supreme Court once again addressed software patents in 1981 in *Diamond v. Diehr*.[52] However, interestingly enough, the Court ruled that a process for curing synthetic rubber was patentable even though it contained an underlying mathematical formula.[53] The process in question consisted of constantly measuring the temperature inside a rubber mold and feeding the temperature measurements into a computer, which repeatedly recalculated the cure time by use of the mathematical equation.[54] The computer then signaled a device to open the press at the proper time.[55] The Court reasoned that this case was distinguishable from *Benson* and *Flook* because it was not the mathematical formula being patented, but rather the formula "in conjunction with all of the other steps" of the process.[56] The Court emphasized that an "*application*" of a mathematical formula to an already known process may very well be patentable and deserving of the accompanying protections.[57] However, citing *Benson* and *Flook*, the Court pointed out that an inquiry must always be made as to whether a claim seeks to patent a mathematical formula in the abstract, a principle which should not be "circumvented by attempting to limit the use of the formula to a particular technological environment."[58] Though a core principle of patent law, this statement made in conjunction with the rest of the *Diehr* opinion seemed to confound more than clarify.

Perhaps unsurprisingly, the holding in *Diehr* generated much confusion for the United States Patent and Trademark Office, as well as for lower courts on how to interpret the holding as to future software patent applications and claims, as the majority holding essentially seemed to contradict the core holdings of *Benson* and *Flook*.[59] The lack of clarity as to the future of software patents following the majority's opinion was in fact predicted in Justice Steven's dissent in which he warned that the preceding line of cases did not establish rules enabling a "conscientious" patent attorney to determine which program-related inventions would be patentable.[60] He further expressed concern that the majority's ambiguous focus on the term "algorithm" within the "law of nature"

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51 *Id.* at 591 (quoting Mackay Radio & Tel. Co. v. Radio Corp. of America, 306 U.S. 86, 94 (1939)).

52 450 U.S. 175 (1981).

53 *Id.* at 192-93.

54 *Id.* at 178.

55 *Id.* at 179.

56 *Id.* at 187.

57 *Id.*

58 *Id.* at 191.

59 Daniel A. Tysver, *The History of Software Patents: From* Benson*,* Flook*, and* Diehr*, to* Bilski *and* Mayo v. Prometheus, BITLAW, http://www.bitlaw.com/software-patent/history.html (last visited Feb. 2, 2016).

60 *Diamond*, 450 U.S. at 219 (Stevens, J., dissenting).

as a category of unpatentable subject matter, rather than the terms "mathematical formula" and "computer program" as used in preceding cases, could give rise to "almost any process [being] so described and therefore held unpatentable."[61] As such, it appeared that the only clarity offered by the Court in *Diehr* was that software-related inventions would thereafter be very claim-specific when scrutinized as patentable subject matter.

The Federal Circuit (the highest court for patent matters other than the Supreme Court)[62] sought to clarify the issue of software patentability in 1994 with *In re Lowry*,[63] concerning a patent for a method of organizing stored data in a computer memory.[64] The patent involved creating data models from "attribute data objects" stored in the computer's memory.[65] The claim was originally rejected by the United States Patent and Trademark Office as non-statutory subject matter.[66] The Board of Patent Appeals rejected the examiner's finding,[67] citing *In re Gulack*,[68] in which the Federal Circuit had previously held that "the critical question is whether there exists any new and unobvious functional relationship between the printed matter and the substrate."[69] The Federal Circuit surmised that the issue essentially came down to a matter of "fram[ing]," and determined that the Board incorrectly chose to view the issue as "whether a new, nonobvious functional relationship exist[ed] between the printed matter (data structure . . .) and the substrate (memory)."[70] In reversing the Board's holding[71] distinguishing Lowry's patents from the "printed matter" exception,[72] the Court held that, unlike the current patent claim, printed matter cases "dealt with claims defining as the invention certain novel arrangements of printed lines or characters, useful and intelligible only to the human mind."[73] The Court further stated that printed matter cases have no relevance where "the invention as defined by the claims *requires* that the information be processed not by the mind but by a machine, the computer."[74] Therefore, when the patent concerns data structures within a memory that requires processing by a machine, rather than the human mind, the claim might be considered patentable subject matter.[75]

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61 *Id.*
62 *See* 28 U.S.C. § 1295 (2012).
63 32 F.3d 1579 (Fed. Cir. 1994).
64 *Id.* at 1580.
65 *Id.*
66 *Id.* at 1580, 1582.
67 *Id.*
68 703 F.2d 1381 (Fed. Cir. 1983).
69 *Lowry*, 32 F.3d at 1582 (citing *Gulack*, 703 F.2d at 1386).
70 *Id.*
71 *Id.* at 1585.
72 *Id.* at 1583.
73 *Id.* (quoting *In re* Bernhart, 417 F.2d 1395, 1399 (CCPA 1969)).
74 *Id.*
75 *See id.*

The Federal Circuit further clarified the patentability of computer software in its decision in *State Street Bank & Trust Co. v. Signature Financial Group Inc.*.[76] The patent at issue involved a processing system, identified by the trademarked name "Hub and Spoke," which supported a structure "whereby mutual funds (Spokes) pool their assets in an investment portfolio (Hub) organized as a partnership."[77] Essentially, the structure allowed for partnership tax advantages to mutual fund administrators while likewise providing them with comparable economies of scale.[78] Importantly for IP purposes, however, through Hub and Spoke's functionality, dollar amounts were filtered through a series of calculations and a final share price resulted. The Court found this to be "a practical application of a mathematical algorithm, formula, or calculation, because it produces a useful, concrete and tangible result."[79] In recognition of *Diehr*, the Court noted that an invention capable of manipulating numbers would not necessarily be nonstatutory subject matter unless "useful, concrete and tangible result[s]" were simply not achieved.[80] This particular invention did achieve a result of the sort and therefore was patentable.

In the case of *In re Comiskey*,[81] the Federal Circuit reviewed a patent claiming a "method and system for mandatory arbitration involving legal documents."[82] Due to lack of judicial clarity and direction from previous opinions from both the Federal Circuit and the Supreme Court, the PTO pressed the Federal Circuit to consider and determine *Comiskey* on the Section 101 issue because "the Office needed guidance in this area."[83] As to the actual invention itself, the USPTO further argued that the subject matter at issue, a rather basic six-step method for determining when and how arbitrations should be held, was merely an abstract idea wholly disconnected from a machine and unable to transform "materials to a different state or thing."[84] The Court was forced to reiterate one of the most traditional yet elementary patent law concepts that "the application of human intelligence to the solution of practical problems is not in and of itself patentable."[85] Perhaps due to the previous lack of judicial guidance, the Court even reminded that the original standard of the Patent Act of 1793 was still "essentially" in effect: "[A]ny new and useful art, machine, manufacture, or composition of matter, or any new or useful improvement [thereof] . . . ."[86] The

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[76] *See* 149 F.3d 1368, 1370 (Fed. Cir. 1998), abrogated by *In re* Bilski, 545 F.3d 943 (Fed. Cir. 2008).

[77] *Id.* at 1370.

[78] *Id.*

[79] *Id.* at 1373 (quoting *In re Alappat*, 33 F.3d 1526, 1544 (Fed. Cir. 1994)).

[80] *Id.* at 1374.

[81] 554 F.3d 967 (Fed. Cir. 2009).

[82] *Id.* at 970.

[83] *Id.* at 973 (citing Appellate Brief at 15).

[84] *Id.* (citing Appellate Brief at 12).

[85] *Id.* at 980.

[86] *Id.* at 977.

Court concluded that some of the claims failed to meet this standard.[87] Accordingly, the court remanded to the Patent and Trademark Office to review the remaining claims that described the same process but further included some type of physical device.[88]

A year later, the Supreme Court affirmed the Federal Circuit's ruling in *Bilski v. Kappos*,[89] where the Court had held unpatentable an invention that assisted in hedging risk against market fluctuation.[90] In the prior case of *In re Bilski*,[91] the Federal Circuit reasoned that the patent did not meet the standards set forth in the machine-or-transformation test, which requires that a process is patent eligible if: "(1) it is tied to a particular machine or apparatus, or (2) it transforms a particular article into a different state or thing."[92] However, though the Supreme Court concurred with the Federal Circuit's ultimate holding as to patentability, the Court rejected the Federal Circuit's conclusion that the machine-or-transformation test was the sole test for determining patentable subject matter eligibility.[93] The Court ultimately rejected the patent in *Bilski* on the grounds that, like *Benson* and *Flook*, it similarly attempted to receive a patent for an abstract idea.[94] Nonetheless, as predominantly adjudged in the patent law community, *Bilski* was considered unhelpful as to determining the boundaries of method claims.[95]

In 2011, the Federal Circuit held in *CyberSource Corp. v. Retail Decisions, Inc.*[96] that a credit card internet fraud detection system was unpatentable subject matter.[97] Specifically, the patent recognized the prior art of traditional credit card fraud detection systems, but said that this new system went a step further by detecting IP addresses in internet transactions.[98] Unconvinced, the Court pointed out the logical inference that when the Supreme Court ruled that the machine-or-transformation test was not the sole test for determining whether a process was patent-eligible, the Federal Circuit was then given the opportunity to incorporate other potential tests and criteria it found appropriate.[99] The Federal Circuit first determined that the patent did not meet the machine-or-transformation test anyway. However, in perhaps a small effort to test out the

87 *Id.* at 981.
88 *Id.*
89 561 U.S. 593 (2010).
90 *Id.*
91 545 F.3d 943 (Fed. Cir. 2008), *aff'd but criticized sub nom.* Bilski v. Kappos, 561 U.S. 593 (2010).
92 *Bilski*, 545 F.3d at 954.
93 561 U.S. at 594.
94 561 U.S. at 595.
95 Ryan Steidl, Comment, *Application of Functional Claiming Limitations: The Practical Effects on Software-Related Patents*, 10 J. BUS. & TECH. L. 157, 165 (2015).
96 654 F.3d 1366 (Fed. Cir. 2011).
97 *Id.* at 1367.
98 *Id.* at 1370 (citing 561 U.S. at 613).
99 *Id.*

new freedom gifted it by the Supreme Court, the Federal Circuit further determined that the patent was "drawn to an unpatentable mental process"; something the Federal Circuit deemed to be a "subcategory [sic] of unpatentable abstract ideas."[100] As to the remaining claims involving a computer-readable medium, the Court deemed them failed as well, noting that "the machine 'must play a significant part in permitting the claimed method to be performed,' " which means more than just the incidental use of a computer by a process that may purely be performed through mental steps.[101]

The next significant step in the Supreme Court's attempt to clarify a determination of patent-eligible subject matter came the next year in *Mayo Collaborative Services v. Prometheus Laboratories, Inc.*.[102] The patent at issue concerned a process created to determine the rate at which different patients metabolized thiopurine drugs to better treat autoimmune diseases.[103] Each claim recited (1) an administering step (which instructed the doctor to administer the drug), (2) a determining step (which instructed the doctor to measure the metabolite levels in the patient's blood), and (3) a wherein step (which would describe the concentrations of metabolite levels in the patient's blood and inform the doctor of the dosage most effective for the patient, based on the data).[104] In a unanimous decision, the Court held that methods for making such determinations were already known and well-practiced in the field of medicine, and the activity involved in the process did not transform the laws of nature involved into a patent-eligible application.[105]

The Court relied on its holding in *Flook*, emphasizing the importance of analyzing which steps of a claim are obvious and known in the art, as well as determining if the steps combined to transform the process into an inventive application.[106] The Court ultimately held that similar to the patent in *Flook*, the process's additional steps in no way limited the claim to a singular application. Since the chemical processes were already well-known and used in the medical field, the Court reasoned that, if the formula were removed, no "inventive concept" would remain.[107] The Court appeared to create a two-part test, emphasizing that one must first look to whether the patent claims involved speak to a patentable-eligible concept, followed by an analysis of whether the claims involved add an 'inventive concept':

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100 *Id.* at 1371.

101 *Id.* at 1375 (quoting SiRF Tech., Inc. Int'l Trade Comm'n, 601 F.3d 1319, 1333 (Fed. Cir. 2010)).

102 566 U.S. 66 (2012).

103 *Id.*

104 *Id.* at 1290-91.

105 *Id.* at 1291.

106 *Id.*

107 *Id.* at 1292.

> These statements reflect the fact that, even though rewarding with patents those who discover new laws of nature and the like might well encourage their discovery, those laws and principles, considered generally, are "the basic tools of scientific and technological work." (citation omitted) And so there is a danger that the grant of patents that tie up their use will inhibit future innovation premised upon them, a danger that becomes acute when a patented process amounts to no more than an instruction to apply the natural law, or otherwise forecloses more future invention than the underlying discovery could reasonably justify.[108]

Following this ruling, though the Court relied heavily on *Flook*, it was unclear if the two-part test created in *Mayo* applied to more than just processes involving laws of nature. After this holding, the Patent and Trademark Office subsequently developed its own test for determining subject eligibility for methods that applied natural laws, yet computer programs were excluded from the analysis.[109]

The Court most recently attempted to clarify this issue in *Alice Corp. Proprietary Ltd. v. CLS Bank International*.[110] The *Alice* patents involved a method for mitigating "settlement risk," in financial exchanges via software.[111] Specifically, the patents claimed: "(1) a method for exchanging financial obligations, (2) a computer system configured to carry out the method for exchanging obligations, and (3) a computer-readable medium containing program code for performing the method of exchanging obligations."[112] Explicitly adopting *Mayo*'s two-part test, the Court first rejected the claims as abstract, patent-ineligible concepts.[113] Comparing the patent to the risk-hedging claims at issue in *Bilski*, the Court held that "intermediated settlement is [also] 'a fundamental economic practice long

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[108] *Id.* at 1301–02 (quoting *Benson*, 409 U.S. at 67; Mark A. Lemley, Michael Risch, Ted Sichelman & R. Polk Wagner, *Life After* Bilski, 63 STAN. L. REV. 1315 (2011) ("[A]rguing that § 101 reflects this kind of concern."); CHRISTINA BOHANNAN & HERBERT HOVENKAMP, CREATION WITHOUT RESTRAINT: PROMOTING LIBERTY AND RIVALRY IN INNOVATION 112 (2012) (" 'One problem with [process] patents is that the more abstractly their claims are stated, the more difficult it is to determine precisely what they cover. They risk being applied to a wide range of situations that were not anticipated by the patentee.' "); WILLIAM LANDES & RICHARD A. POSNER, THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW 305–06 (2003) ("The exclusion from patent law of basic truths reflects 'both . . . the enormous potential for rent seeking that would be created if property rights could be obtained in them and . . . the enormous transaction costs that would be imposed on would-be users [of those truths].' ")).

[109] Kelly Fermoyle, *Adapting Alice: How to Formulate A Repeatable Test Based on* Alice v. CLS Bank, 6 CYBARIS®, AN INTELL. PROP. L. REV. 201, 215–16 (2015) (citing MPEP § 2106.01 (8th ed. Rev. 9 Aug. 2012)).

[110] 134 S. Ct. 2347 (2014).

[111] *Id.* at 2349.

[112] *Id.*

[113] *Id.* at 2350.

prevalent in our system of commerce' . . . ."[114] Further, the Court held that the third-party intermediary had long been accepted as a "building block of the modern economy."[115]

The Court declined to go further in clearly defining what qualifies as an "abstract idea," merely stating that risk hedging is one.[116] After including the issue of abstractness as part of the two-part test established in *Mayo*, many hoped the Court would clarify the point in *Alice*. Rather, the Court simply reverted to its habit of judging patents on a case-by-case basis rather than providing a broad guidepost for future patent-seekers.[117] Nonetheless, in this unanimous opinion, the Court strongly reiterated their concern for patents "tying up" underlying abstract ideas,[118] while also acknowledging that, on some level, " 'all inventions . . . embody, use, reflect, rest upon, or apply laws of nature, natural phenomena, [and] abstract ideas.' "[119] Therefore, the Court concluded that it must "tread carefully in construing this exclusionary principle lest it swallow all of patent law,"[120] and consider "application[s] of such [abstract] concepts to a new and useful end" patent eligible.[121]

The Court then approached the second step of the test outlined in *Mayo*: a consideration of the "elements of each claim both individually and as 'an ordered combination' to determine whether the additional elements 'transform the nature of the claim' into a patent-eligible application."[122] This is commonly known as the "inventive concept," and the Court's explanation thereof is helpful: "an element or combination of elements that is 'sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the [ineligible concept] itself.' "[123] In other words, do the elements of the claims combined create something patentable? In analyzing the steps as a whole, the Court rather decisively concluded that the computer components, " 'ad[d] nothing . . . that is not already present when the steps are considered separately' "[124] and "simply recite the concept of intermediated settlement as performed by a generic computer."[125] The Court emphasized that the steps did nothing to add to the function of the computer itself or improve any field of technology.[126] Rather, the

114 *Id.* at 2356 (quoting *Bilski*, 130 S. Ct. at 3231).
115 *Id.* at 2356.
116 *Id.* at 2357.
117 David J. Ball & Douglas F. Stewart, *Software Patents Survive Supreme Court's Alice Decision, but Questions Linger*, 21 WESTLAW J. INTELL. PROP. 2, 3 (2014).
118 *Alice*, 134 S. Ct. at 2354.
119 *Id.* (quoting *Mayo*, 132 S. Ct. at 1293).
120 *Id.*
121 *Id.* (quoting *Benson*, 409 U.S. at 67).
122 *Id.* at 2355 (quoting *Mayo* 132 S. Ct. at 1298).
123 *Id.* (quoting *Mayo* 132 S. Ct. at 1294).
124 *Id.* at 2351 (quoting *Mayo* 132 S. Ct. at 1298).
125 *Id.*
126 *Id.*

Court determined that the "instruction to apply the abstract idea of intermediated settlement using some unspecified, generic computer is not '*enough*' to transform the abstract idea into a patent-eligible invention."[127] This is a remarkable stance taken by the Court, if only for the fact that *Alice*, decided in 2014, is now the leading case in the area of software and patents and is poised on the periphery of the all but certain 3D printing revolution.

After the decision of the Court in *Mayo* and *Alice*, it appears evident there can be no patent protection for the underlying CAD file for a 3D printer. However, one exception discussed above was where a patent claim is drafted to the underlying computer readable medium as in *In re Beauregard*.[128] Though, as previously discussed, *Cybersource* added significant limitations to the Beauregard claim, which could limit the patent of any CAD file given that it is merely a vehicle for the underlying invention.[129] Therefore, unless the Supreme Court somehow dovetails from this line of decisions culminating in *Alice*, there appears no way for the underlying CAD file to receive patent protection. "Absent a newly invented CAD file format or printing method to accompany a newly created digital product, there can be no meaningful patent protection secured for a CAD file to help combat 3D printing infringement."[130] Though there may be protections for the CAD file under copyright law, it too presents its own limitations.

4. Copyright Law. Copyright protection is available under the broad category of "pictorial, graphic, and sculptural works."[131] The reach of copyright protection is quite broad, and many of the copyright statute's definitional terms are remarkably close to what a 3D printer does, uses and produces. As the statute explains, PGS works include "two-dimensional and *three-dimensional* works of . . . art . . . and art reproductions . . . diagrams, models, and technical drawings."[132] A 3D printer is capable of producing or taking its instructions from each of these items ("technical drawings").

Such works shall include works of artistic craftsmanship insofar as their *form* but not their mechanical or utilitarian aspects are concerned; the design of a useful article, as defined in this section, shall be considered a pictorial, graphic, or sculptural work only if, and only to the extent that, such design incorporates pictorial, graphic, or sculptural features that can be identified separately from, and are capable of existing independently of, the utilitarian aspects of the article.[133]

The CAD file or blueprint of the 3D printed product would fall under this category. Further, the 3D-printed product may have copyright protection as a

127 *Id.*
128 53 F.3d 1583 (Fed. Cir. 1995)
129 Brean, *supra* note 45, at 806.
130 *Id.* at 807.
131 17 U.S.C. § 102 (2012).
132 17 U.S.C. § 101 (2012) (emphasis added).
133 *Id.* (emphasis added).

sculptural work or as a "useful article," meaning "an article having an intrinsic utilitarian function that is not merely to portray the appearance of the article or to convey information."[134]

Nonetheless, copyright law is not without its limitations and is in some ways less powerful than patent law.[135] For example, while patent law protects against independent creation and reverse engineering, copyright law does not.[136] If one were to independently generate a blueprint for an item, there could be no copyright liability for creating that blueprint, even if it can effectively be used to print the same object. Additionally, there could be a fair-use argument in using the blueprint to make a product, which is not available under patent law.[137] Further still, if an end user performs a 3D scan of a patented article and creates a new digital blueprint file through that scanning process, the end user would be the creator of that file. Therefore, that person could presumably disseminate it without concern for any copyrights held by the original designer and manufacturer of the scanned article. Lastly, although copyright might protect the transferring and copying of the blueprint files, it is not sufficient to restrict the ultimate printing of the articles themselves. And, of course, copyright holders have faced difficult challenges in enforcing copyrights in the music and media context, and these same challenges would apply in this context.

Copyright is further limited due to matters of originality.[138] A basic principle of copyright law is that for a work to be copyrightable, it must be original. As the Supreme Court stated in *Feist Publications, Inc. v. Rural Telephone Service Co., Inc.*, "the requisite level of creativity is extremely low; even a slight amount will suffice . . . no matter how crude, humble or obvious."[139] As mentioned earlier, devices with which one can scan a 3D-printed item to replicate objects currently exist and will soon be mass-marketed. However, under current law, this digital scan may not be copyrightable due to lack of originality. No originality is involved in the scan, and the person scanning the 3D object contributes nothing to the original digital model, unlike a photograph that incorporates the perspective of the photographer.

For example, in *Meshwerks, Inc. v. Toyota Motor Sales U.S.A., Inc.,* Toyota hired Meshwerks to create digital models of its vehicles so that Toyota could essentially alter the images of its vehicles digitally rather than conduct a new photoshoot every time the company made a slight change to one of the vehicle models. [140] Meshwerks's modeling software produced digital imaging of the vehicles,

134 17 U.S.C. § 101 (2012).

135 Brean, *supra note* 45 at 808.

136 *Id.*

137 *Id.*

138 Deven R. Desai & Gerard N. Magliocca, *Patents, Meet Napster: 3D Printing and the Digitization of Things*, 102 GEO. L.J. 1691, 1706 (2014).

139 499 U.S. 340 (1991).

140 528 F.3d 1258, 1260 (10th Cir. 2008).

resembling a "wire-frame model"[141] based on the vehicles' data points (measurements). The details could then be digitally altered later. The dispute arose when Toyota used the digital images to create multiple advertisements, which Meshwerks argued were intended for one-time use only, thereby violating Meshwerks's copyright images of the digital models.[142] The Tenth Circuit Court of Appeals concluded that the Meshwerks models depicted the Toyota car exactly as the car is, without adding any personal expression to the model that a photographer might add, such as lighting, shading, and angle.[143] The court further stated that, though the copy Meshwerks created was unusual, "[t]he fact that a work in one medium has been copied from a work in another medium does not render it any the less a 'copy.' "[144] However, the court also emphasized that digital modeling can be used to create "copyrightable expressions," under the same principles that photographs may be.[145] While CAD files are similar to more architectural works, they could be construed as factual depictions of the actual 3D-printed product, without an express statement from the legislature on the issue.[146]

Another issue surrounding the copyrightable claim to a CAD file lies in the merger doctrine. As the United States Court of Appeals for the Ninth Circuit explained in *Herbert Rosenthal Jewelry Corp. v. Kalpakian*, the merger doctrine occurs "when the 'idea' and 'expression' of a copyright are thus inseparable."[147] When this occurs, "copying the 'expression' will not be barred since protecting the 'expression' in such circumstances would confer a monopoly of the 'idea' upon the copyright owner free of the conditions and limitations imposed by the patent law."[148] The issue in *Herbert* was whether the defendants were infringing on the plaintiff's "jeweled bee pins" copyright by also making "jeweled bee pins."[149] The court ultimately concluded that a bee pin is an "idea" that the defendants were free to copy, as it constituted an area of production that they did not believe Congress intended for copyright to monopolize.[150] The critical distinction between "idea" and "expression" is difficult to draw. As Judge Hand candidly wrote, "Obviously, no principle can be stated as to when an imitator has gone beyond copying the 'idea,' and has borrowed its 'expression.'" . . . At least in close cases, one may suspect, the classification the court selects may simply state the result reached rather than the reason for it. In our view, the difference is really

141 *Id.*
142 *Id.* at 1261.
143 *Id.* at 1267.
144 *Id.*
145 *Id.* at 1269.
146 Nathan Reitinger, *CAD's Parallel to Technical Drawings: Copyright in the Fabricated World*, 97 J. PAT. & TRADEMARK OFF. SOC'Y 111, 137 (2015).
147 446 F.2d 738, 742 (9th Cir. 1971).
148 *Id.*
149 *Id.* at 739.
150 *Id.* at 742.

one of degree as Judge Hand suggested in his striking "abstraction" formulation in *Nichols v. Universal Pictures* . . . . The guiding consideration in drawing the line is the preservation of the balance between competition and protection reflected in the patent and copyright laws.[151] As more people use scanning technology to create their own 3D printable items, this doctrine will undoubtedly need to be reanalyzed.[152]

C. IMPORTATION ISSUES: LOST IN TRANSLATION

Another critical question revolving around the control of 3D printing is regulation of the underlying CAD file from importation outside of the United States. This may occur when a competing company attempts to avoid patent law infringement by sending a patented invention's CAD file outside the country in order to print the article based on the digital model. The Federal Circuit recently addressed this issue in *ClearCorrect Operating, LLC v. International Trade Commission*.[153] The central issue of this case arose out of a complaint from an orthodontic company, Align, which holds patents for orthodontic teeth aligners.[154] The company uses a digital scan of a patient's teeth to create a series of teeth aligners, which slowly move the teeth to a straight position over a period of time, much like braces do.[155] ClearCorrect also produces teeth aligners, but in an attempt to skirt Align's patents, the company scans the teeth in the U.S. and sends them to Pakistan.[156] A company in Pakistan then creates the digital models for the aligners and sends them back to the United States to be 3D printed.[157]

Align filed a complaint with the United States International Trade Commission (ITC), arguing that these digital models constitute an importation of "articles," thereby violating unfair trade practice and antitrust law, and the ITC agreed.[158] As discussed earlier, digital models themselves do not have patent protection as "software" without an "inventive step." Therefore, protection under the ITC regulation would appear to extend protection to the underlying CAD file of a patent. The U.S. Federal Court of Appeals held that the ITC improperly categorized the digital models as "articles" because the agency gave "article" a broader meaning than the definitions it actually cited.[159]

151 *Id.* (quoting Peter Pan Fabrics, Inc. v. Martin Weiner Corp., 274 F.2d 487, 489 (2d Cir. 1960); Nichols v. Universal Pictures Corp., 45 F.2d 119, 121 (2d Cir. 1930)).

152 Desai & Magliocca, *supra* note 138, at 1709.

153 810 F.3d 1283 (Fed. Cir. 2015).

154 *Id.* at 1287.

155 *Id.*

156 *Id.*

157 *Id.*

158 *Id.* at 1289.

159 *Id.* at 1295.

The court also found that the ITC failed to properly analyze the legislative history of the term "article" regarding the Tariff Act.[160] The Court found that the decision should have been based on the full quote located in a Senate Report, which states, "The provision relating to unfair methods of competition *in the importation of goods* is broad enough to prevent every type and form of unfair practice and is, therefore, a more adequate protection to American industry than any antidumping statute the country ever had."[161] Ultimately, the court found that this quote supported that unfair trade and competition law covered the importation of goods only, rather than "non-material things," such as digital models.[162] It further emphasized that if Congress's intent differed, it must be expressly stated.[163] Specifically, the court appeared to not want to expand its ruling to affect intellectual property law, stating, "Congress is in a far better position to draw the lines that must be drawn if the product of intellectual processes rather than manufacturing processes are to be included within the statute."[164] While the Court declined to analyze the fate of these CAD files under the purview of fair trade law, this case further illuminates the issues that may arise about the ownership of 3D printer models, and how they may affect business operations in the future.

III. SOLUTIONS PROPOSED IN THE WORLD OF IP

A. ROLE OF CONGRESS

There have been numerous articles theorizing how 3D technology might affect the current legal framework as the law will play an important role in the technology's success. Many of these scholars suggest an expansion on the current laws surrounding inventions, or at the very least, a clarification on how the existing legal framework will affect the new technology. Professors Deven Desai and Gerard Magliocca, for example, urge Congress to establish a regulatory scheme that "(1) removes the shadow of infringement liability from some people who use 3D printers for personal purposes; and (2) provides clear rules for websites that host the programs that let these devices function."[165] Given that attempts to establish direct patent infringement for 3D printed products would be futile, the authors argue that Congress should remove all doubt of illegality associated with 3D printing, as at least a handful of people will likely be targeted and forced to pay damages for infringement.[166] On the other side of the

160 *Id.* at 1297.
161 *Id.* at 1301 (quoting S. Rep. No. 67-595, at 3 (1922) (emphasis in original)).
162 *Id.* at 1301.
163 *Id.*
164 *Id.* at 1302 (quoting *Bayer*, 340 F.3d at 1376–77).
165 Desai & Magliocca, *supra* note 138, at 1694–95.
166 *Id.* at 1716.

spectrum, they see creating a fair use exception or making patent infringement an intentional tort as unnecessarily broad.[167] One very interesting remedy they suggest is raising the amount in controversy for federal jurisdiction over infringement claims so as to weed out the commercial infringers from those infringing patents for personal use.[168]

B. NAPSTER REBORN?

Many scholars also propose an extension of the existing Digital Millennium Copyright Act (DMCA) to the protection of CAD files, given the ease with which websites may merely expand their compliance with current law.[169] The DMCA's notice and takedown provisions basically allow copyright holders to stop others from distributing their works on the Internet for online service providers (OSPs), which may not be aware of infringing distribution on their site.[170] This law allows OSPs to escape liability for the dissemination of the copyrighted work so long as they stop allowing the infringement to take place once notified.[171]

Harvard Law school alumnus, Davis Doherty, suggests that an extension of this act should be a two-fold process, the goal being to "(1) implement a standardized notice-and-takedown procedure for websites such as Thingiverse and Shapeways, that grants a safe harbor from liability, so long as the sites did not have actual knowledge of infringement; and (2) establish a limited 'innocent independent inventor' defense that protects DIYers and hosting websites."[172] Doherty also fully supports an "Inventive Commons," a non-profit organization, which would operate under the United States Patent and Trademark Office.[173] The goal of the organization would be to make sure that all unpatented innovations are swiftly recognized and become a part of a patent public domain.[174]

IV. POLICY CONCERNS

This Article has addressed how aspects of 3D printing tend to fall through the cracks as well as solutions proposed by others to address these gaps in the law. However, it is important to note that the right answer to the apparent lack of law applying to 3D printing may be to do nothing. It may be that the existing regulatory system works well for many aspects of this new technology. "The

167 *Id.* at 1716–17.
168 *Id.* at 1717.
169 Davis Doherty, *Downloading Infringement: Patent Law As A Roadblock to the 3D Printing Revolution*, 26 HARV. J.L. & TECH. 353, 359 (2012).
170 *See* 17 U.S.C. § 512 (2012).
171 *Id.*
172 Doherty, *supra* note 169, at 365.
173 *Id.* at 372.
174 *Id.*

existing set of default laws and mandatory laws permits a large amount of private legal ordering. The paradigmatic private legal ordering mechanism is contract, but other mechanisms exist, including simply having no rules or informally adopting self-governing rules and norms."[175]

It is evident that the rise of 3D printing has done nothing to stifle inventiveness. In fact, websites such as Thingiverse show that people are willing to share their inventive ideas with others for no compensation. This distinction between "inventiveness" and "innovation" may be relevant to Congress when deciding whether to expand intellectual property protection in the era of 3D printing.[176] What about innovation? The patent system historically enabled innovators to succeed through their abilities as entrepreneurs, by allowing them to control the licensing and manufacturing of their products. With 3D printing drastically slashing the costs of manufacturing, this trade-off no longer exists. As one Stanford law school professor, Mark Lemley, puts it, "intellectual property law is justified only in ensuring that creators are able to charge a sufficiently high price to ensure a profit sufficient to recoup their fixed and marginal expense" or "only to the extent that that excludability [of the property right] does in fact create value."[177] Therefore, it would appear that from an economic standpoint, when high manufacturing costs no longer exist, there no longer exists an economic justification for patent monopoly.

In fact, as Lemly outlines, more than there being merely no economic justification for broad intellectual property rights, there are actually many costs in overcompensating creators. These costs fall into five categories: intellectual property rights distort competitive norms, create static inefficiencies, interfere with the ability of others to create work, increase rent-seeking behavior, impose great administrative costs, and distorts the general economic equilibrium through the overinvestment in research and development.[178] However, this is not an argument against overhauling intellectual property rights altogether. Rather, Lemly emphasizes that "[g]ranting intellectual property rights imposes a complex set of economic costs, and it can be justified only to the extent those rights are necessary to provide incentives to create."[179]

Further, property rights that have previously been private access only often go through reversals to a more community-based approach depending on the costs and benefits.[180] Technology has much to do with the threat to privatization as is evident with the intellectual commons following Napster peer-sharing.

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175 Osborn, *supra* note 24, at 593 (footnote omitted).

176 Skyler R. Peacock, *Why Manufacturing Matters: 3D Printing, Computer-Aided Designs, and the Rise of End-User Patent Infringement*, 55 WM. & MARY L. REV. 1933, 1956 (2014).

177 Mark A. Lemley, *Property, Intellectual Property, and Free Riding*, 83 TEX. L. REV. 1031, 1057 (2005).

178 *Id.* at 1058-1059.

179 *Id.* at 1065.

180 Saul Levmore, *Two Stories About the Evolution of Property Rights*, 31 J. LEGAL STUD. 421, 424 (2002).

Following Napster, it is clear that "the case for closing access is much stronger the more we think it is necessary to encourage innovation and investment."[181] Following this commons, the extension of copyright extended through the DMCA. Such an extension through patent law would have a much greater effect, as patent law already offers stricter protection. Such an extension of intellectual property protection may undermine the primary goals of patent law by stifling innovation at too high a cost. In other words, "[i]f property rights are costly to enforce (litigation expenses, social friction) and enforcement is not very effective, the legitimacy of the legal rights are undermined."[182]

V. CONCLUSION

The revolution of 3D printing is sure to change manufacturing and many aspects of current laws. Like with all technology, the reactions of lawmakers, judges, and practitioners will affect whether the technology and its use are successful. Ultimately, 3D printing should be gently regulated as it promotes exactly the type of innovation of the arts and sciences that the law aims to bolster. The technology allows for creativity at a cheaper cost than has ever before been possible. However, the largest threat to this development is the current ambiguity of the law. Credence must be given to both the costs and benefits of strengthening the current intellectual property framework and a balance must be reached between rights-holders and other creators. Yet, one thing is clear. A lesson should be learned from the legal chaos that ensued after the widespread infringement that followed from Napster peer-sharing: the law surrounding 3D printing should be clarified now.

[181] *Id.* at 445.

[182] Ben Depoorter, *Intellectual Property Infringements & 3D Printing: Decentralized Piracy*, 65 HASTINGS L.J. 1483, 1502 (2014).