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Patents & 3D Printing: Protecting the Democratization of Manufacturing by Combining Existing Intellectual Property Protections

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PATENTS & 3D PRINTING:

PROTECTING THE DEMOCRATIZATION OF MANUFACTURING BY COMBINING EXISTING INTELLECTUAL PROPERTY PROTECTIONS

I. INTRODUCTION

As technology advances, the law often struggles to keep pace, which can leave companies unexpectedly exposed to new forms of intellectual property infringement. Such is the case with 3D printing, a technology that allows anyone with access to a 3D printer and a computer to become a manufacturer. As remarkable as this technology is, it leaves the possibility of widespread infringement by individuals who are difficult to locate, unlikely to be infringing on a large scale, and unlikely to have deep pockets. Infringement of this sort makes these individuals unattractive targets for lawsuits, because litigation is not cost effective and has limited value as a deterrent.

3D printing stands to disrupt traditional manufacturing by allowing anyone with a computer to create parts.[1] It achieves this by creating, layer by layer, a physical object represented by a 3D Computer Aided Design (CAD) file.[2] Impressive as this is, the technology raises serious concerns about the potential for infringement of copyrights and patents.[3]

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1. *The Free Beginners Guide to 3D Printing*, 3D Printing Industry, 54, 71 (2013), available at, http://3dprintingindustry.com/3d-printing-basics-free-beginners-guide/.

2. *Id.* at 19-23.

3. *See* Daniel Harris Brean, *Asserting Patents to Combat Infringement Via 3d Printing: It's No "Use"*, 23 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 771, 790 (2013); Kyle Dolinsky, *CAD's Cradle: Untangling Copyrightability, Derivative Works, and Fair Use in 3D Printing*, 71 Wash. & Lee L. Rev. 591, 639

By allowing anyone access to manufacturing capabilities, 3D printing also allows that person to recreate protected works on a large scale in the aggregate. This type of infringement is similar to that witnessed by the recording industry, where a large number of people—by only sharing a few songs each—adversely affected the entire industry.[4] As was the case for the recording industry, the potential infringers are unattractive litigants, and worse, a finding of patent infringement, unlike copyright infringement, has an additional hurdle.[5] Patent infringement also requires a showing that the infringer made, used, or sold the patented product in the United States.[6] Fortunately, as the recording industry learned after great cost, infringement can be curtailed by offering the genuine product at a reasonable price, in a convenient way.[7] In the case of 3D printing, manufacturers could be encouraged to sell CAD files in addition to their other products. Thus, the potential infringer has the incentive to purchase the genuine product, in effect creating a carrot. However, carrot and stick deterrents require both a carrot (incentive) and a stick (deterrent). If easy, affordable access is the carrot, then intellectual property protection must be the stick.

Under the current intellectual property regime, 3D CAD files are likely to be treated as copyrightable works, either as software, or as pictorial or sculptural works.[8] This treatment allows a patent holder ("patentee") to augment existing patent protection by leveraging available copyright protections to control the CAD files from which the patented parts can be created. This protection should help to deter infringement in several ways, while still allowing use of the technology. First, it would allow for statutory

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(2014), available at, http://scholarlycommons.law.wlu.edu/wlulr/vol71/iss1/14. (Describing the process of CAD file creation)

4. Robert G. Hammond, *Profit Leak? Pre-Release File Sharing and the Music Industry*, 2 (2013), *available at* http://www4.ncsu.edu/~rghammon/Hammond_File_Sharing_Leak.pdf.

5. 35 U.S.C. §271 (2010).

6. *Id.*; Medtronic, Inc. v. Mirowski Family Ventures, LLC, 134 S. Ct. 843, 849, (2014).

7. Victor Luckerson, *Revenue Up, Piracy Down: Has the Music Industry Finally Turned a Corner?*, TIME (Feb. 28, 2013), http://business.time.com/2013/02/28/revenue-up-piracy-down-has-the-music-industry-finally-turned-a-corner/.

8. Dolinsky, *supra* note 3.

remedies against infringers, under both patent and copyright law.[9] Second, it would encourage patentees to make their CAD files available for sale or download, most likely through a market like Amazon or an iTunes equivalent. Finally, it could be implemented without extensive changes to existing company practices or existing law. By using the law in this way, patentees can gain the benefits of their intellectual property, while still allowing a valuable new technology to flourish.

Drawing from existing intellectual property law and current technology, this article first briefly outlines the 3D printing process and technology in Section II. Next, the article explores the possible types of infringement in Section III, before arguing that patentees should use the existing protections afforded to 3D CAD files under copyright law to augment their existing patent protection in Section IV.

II. BACKGROUND OF 3D PRINTING TECHNOLOGY

A. What is 3D Printing?

3D printing is an exciting new technology that allows anyone with a computer to create his or her own parts and bypass traditional manufacturing.[10] 3D printing allows for the rapid manufacture of physical parts by using a 3D Computer Aided Design (CAD) file, to create the represented part layer by layer.[11]

3D printing refers to several types of additive manufacturing that produce a three-dimensional part from a digital model.[12] The printing is achieved by using an additive process, where successive

9. 17 U.S.C. §§ 501-13 (2008); 35 U.S.C. §§ 281-99 (2011).

10. *See* Stephen Graves, *3D printing will do to the manufacturing industry what Napster did to the music industry*, PC & TECH AUTHORITY (September 18, 2014), http://www.pcauthority.com.au/Feature/392228,3d-printing-will-do-to-the-manufacturing-industry-what-napster-did-to-the-music-industry.aspx?utm_source=feed&utm_medium=rss&utm_campaign=PC+%26+Tech+Authority+Gadgets+feed.

11. *Free 3D Printing Guide*, *supra* note 1, at 20.

12. *What is 3D Printing?*, 3DPrinting.com (Aug. 11, 2014), http://3dprinting.com/what-is-3d-printing/.

layers of material are laid down until a final three-dimensional (3D) object is created.[13] A general analogy to 3D printing is the process for making a Lego structure. First, the builder (with Lego, a child, or with 3D printing, the printer) is given a schematic (with Lego, a picture, or with 3D printing, a CAD file) of the first layer to be assembled.[14] Once the builder has created the first layer, the builder reads the schematic for the second layer and assembles it over the first layer.[15] This process is then repeated until the entire structure is finished.[16] In both cases, the structure is created layer by layer until finished.[17] Thus, the process is considered additive, because the process starts with nothing and ends with a finished product.

In contrast, traditional manufacturing methods utilize castings, forgings, or other raw materials as the base from which the final object is created by removing material using a variety of machining methods.[18] For example, in the machining process, a block of metal is carved down to its final form by a series of drillings or cuttings.[19] As the first step a material block must be selected, which is larger than the finished product.[20] This is comparable to making cookies using a cookie cutter, where the flattened dough must have a larger area than the shape to be cut out.[21] Next, the rough shape of the finished part is machined out of the block by cutting.[22] Again, this is similar to cutting out the cookie shape

13. *Id.*

14. *Free 3D Printing Guide*, *supra note* 1, at 20.

15. *Id.*

16. *Id.*

17. *Id.*

18. Crawford, *How 3-D Printing Works,* HOWSTUFFWORKS, http://computer.howstuffworks.com/3-d-printing.htm (contrasting CNC and AM manufacturing methods)(last visited May 5, 2014).

19. Koichi Hirata, *Machining Flowchart*, National Maritime Research Institute (last visited Aug. 11, 2014), http://www.nmri.go.jp/eng/khirata/metalwork/basic/intro/index_e.html.

20. *See id.*

21. *Using Cookie Cutters*, BETTY CROCKER (May 23, 2010), http://www.bettycrocker.com/how-to/tipslibrary/baking-tips/using-cookie-cutters.

22. *See* Hirata, *supra* note 20.

from the dough.[23] Then, the block is finished by making the precision cuts needed to produce the final form.[24] Over the course of the machining process, the initial block may lose a substantial portion of its mass.[25] Thus, the machining process is considered a subtractive process, because the initial raw material block is larger than the finished product.

By creating parts from nothing, the 3D printing process offers several advantages over traditional machining. First, 3D printing uses much less raw material, because it only uses the material needed to create a part.[26] In contrast, machining always requires the raw material to be larger than the finished part, sometimes substantially so.[27] Thus, 3D printing requires and wastes much fewer raw materials.

Second, 3D printing can result in substantial time saving during the manufacturing process.[28] Using a 3D printer, a finished or nearly finished part can be produced in several hours.[29] In contrast, using traditional machining, the raw material for the part must be produced, the machine must be set-up for the raw material, and then the machining process can finally begin.[30] Each step can take hours, depending on the process, which results in a full process time significantly longer than the time required to produce the same part by 3D printing.[31]

Third, 3D printing can create parts that cannot be produced by traditional methods or are prohibitively expensive using those

23. *Using Cookie Cutters, supra* note 21.

24. Hirata, *supra* note 19.

25. Dr. Philip Reeves, *Additive Manufacturing-A supply chain wide response to economic uncertainty and environmental sustainability,* ECONOLYST *(2008),* available at, http://www.econolyst.co.uk/resources/documents/files/Paper%20-%20Oct%202008-%20AM%20a%20supply%20chain%20wide%20response.pdf

26. *Id.*

27. *Id.*

28. *Cost reduction and time saving blow mold production with 3D printing,* DIY 3D Printing (Jul. 9, 2014), available at, http://diy3dprinting.blogspot.com/2014/07/cost-reduction-and-time-saving-blow.html.

29. *Id.*

30. *See* Hirata, *supra* note 19.

31. *Id.*

methods.[32] For example, creating voids inside a casting is extremely difficult to do, as part of the mold must remain in the void until the material cools.[33] Once the material is cool, the mold piece must be removed from the part.[34] This process is similar to trying to make a hole in an ice cube by placing a toothpick in the water, allowing the water to freeze around it and then trying to remove the toothpick. Thus, voids are difficult to make successfully or precisely, especially when the casting quality must be high, as in aircraft engine parts.[35] In contrast, using 3D printing, a portion of the void can be created in each layer, with the final part containing the entire void.[36] This process would be similar to punching holes in a sheet of paper, and stacking the sheets with the holes aligned to create a tube shaped void, as commonly seen in 3-ring binders.[37]

Finally, 3D printing requires no specialized skills.[38] Using traditional machining methods, the raw material shape, and machining process must be carefully selected.[39] If the raw material shape is wrong, there may not be enough material to finish the part.[40] If the machining process is improper or the machining steps are done in the wrong order, the finished part may be unusable.[41] For exam-

32. *3D printing: helping to shape the future of gas turbines*, MODERN POWER SYSTEMS, (March 26, 2014), http://www.modernpowersystems.com/features/feature3d-printing-helping-to-shape-the-future-of-gas-turbines-4204249/.

33. D.C. Power, *Palladium Alloy Pinning Wires for Gas Turbine Blade Investment Casting*, Platinum Metals Rev. 1995, 117, 118 (1995) available at, www.technology.matthey.com/pdf/pmr-v39-i3-117-126.pdf.

34. *Id.*

35. *See 3D printing: helping to shape the future of gas turbine, supra* note 32.

36. *See* Chris Waldo, *10 3D printed objects that defy traditional manufacturing*, 3DPRINTER.NET (Jul. 16, 2012), http://www.3dprinter.net/10-3d-prints-that-defy-traditional-manufacturing (showing a variety of hollow 3D objects).

37. *3D printing: helping to shape the future of gas turbines, supra* note 32.

38. *See* Simon Rockman, Gary Sheinwald, *How Hard is 3D printing?*, THE REGISTER (Sep. 20, 2012), http://www.theregister.co.uk/2012/09/20/how_hard_is_3d_printing/?page=1, (Amateur authors demonstrating the basic process).

39. Hirata, *supra* note 19.

40. *Id.*

41. *Id.*

ple, a later cut may ruin an earlier cut.[42] Even almost fully automatic machines require this knowledge.[43] In contrast, using a 3D printer, the operator only needs to be able to load the appropriate file onto the printer and start the printing process.[44] Some newer printers even include a 3D scanner, which allows an operator to essentially "photocopy" a 3D object.[45]

In brief, the advantages of 3D printing allow it to be used at home by amateur operators. In fact, "advances in 3D printing technology are launching an Industrial Counter-Revolution."[46] This amateur use in turn increases the potential for infringement by increasing access to a technology that can easily be used to infringe.[47] However, the process entails more than just the printing of parts.

B. How The Printing Process Works.

The process begins with a 3D CAD file, which describes the surface geometry of a 3D object.[48] The CAD file is generally in the Stereolithography or Standard Tessellation Language ("STL") format, a file format which may be created in most modern CAD programs.[49] In each CAD file, the surface of an object is tessellated, or broken down logically, into a series of small triangles called facets.[50] A perpendicular direction and three points representing

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42. *Id.*

43. *Id.*

44. *See Free 3D Printing Guide*, *supra note* 1, 6-9.

45. Eric Mack, *Up close with Zeus, the first consumer all-in-one 3D printer, scanner, and fax*, GIZMAG (Jun. 2, 2014), http://www.gizmag.com/aio-robotics-zeus-3d-printer-scanner/32360/.

46. Deven Desai, Gerard Magliocca, *Patents, Meet Napster: 3D Printing and the Digitization of Things*, GEORGETOWN LAW JOURNAL (forthcoming) available at, http://ssrn.com/abstract=2338067.

47. *See* Graves, *supra* note 10.

48. John Excell, Nathan Stuart, *The rise of additive manufacturing*, THE ENGINEER (May 24, 2010), http://www.theengineer.co.uk/in-depth/the-big-story/the-rise-of-additive-manufacturing/1002560.article.

49. *The StL Format: Standard Data Format for Fabbers*, FABBERS.COM, http://www.ennex.com/~fabbers/StL.asp (last visited Apr. 14, 2014).

50. *Id.*

the vertices (corners) of the triangle describe each facet.[51] When combined, the facets describe the surface features of the object.[52] Once tessellated, the CAD file is segmented by a slicing algorithm into the cross sections of the 3D shape to be created by the 3D printer.[53] Once the file is segmented, the data is transferred to the 3D printer, which "prints" each segment, layering them to form the final object.[54]

Currently, four printing processes exist in widespread use. These processes include: extrusion printing, granular printing, lamination printing, and stereolithography. The first of these processes is extrusion printing. Extrusion printing or fused deposition modeling (FDM) is the most wide spread variant of the 3D printing, with a large open-source development community, as well as commercial and Do It Yourself (DIY) variants.[55]

In fused deposition modeling (FDM), the model, or part, is produced by extruding small beads of material that harden to form layers.[56] A thermoplastic filament or metal wire that is wound on a coil is unreeled to supply material to an extrusion nozzle head.[57] The extrusion nozzle head heats the material to its melting point and controls the material flow, similar to the operation of a hot glue gun.[58] Typically electric motors are employed to move the extrusion head in both the horizontal and vertical directions.[59] The movement is controlled by a computer-aided manufacturing (CAM) software package running on a microcontroller or other computer hardware.[60]

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51. *Id.*
52. *Id.*
53. *Id.*
54. *Id.*
55. *See generally RepRap*, available at, http://reprap.org/ (last visited Sept. 21, 2014).
56. Joe Hiemenz, *3D Printing with FDM*, STRATASYS WHITE PAPER 1, 2 (2014), available at, http://www.stratasys.com/~/media/Main/Secure/White%20Papers/Rebranded/SSYS_WP_3d_printing_with_fdm.pdf.
57. *Id.*
58. *Id.*
59. *Id.*
60. *See id.*; *See generally* Crawford, *supra* note 18.

FDM has some restrictions on the shapes that may be fabricated, however.[61] For example, FDM usually cannot produce stalactite-like structures (cones with the point down), since they would be unsupported during the build, causing them to sag as the material cools.[62] These shapes have to be avoided or a thin, temporary auxiliary support must be designed into the structure, which can be broken away once the object is finished.[63]

The second method, Granular printing, is the selective fusing (sintering or melting) of granular material in a granular bed.[64] The granular bed is similar to a sandbox, into which powdered (granular) material (metals or plastics) is poured.[65] First, the granular material is added to the granular bed until a thin layer across the bottom of the bed is formed.[66] Alternatively, instead of raising the granular material around the part, a working area, which supports the part, is lowered into the granular bed until a thin layer of granular material is formed across the surface of the working area.[67] Then a heat source, typically a laser or an electron beam, selectively fuses the material granules to form the first layer of the part.[68] Once a part layer is created, the level of the granules is raised to create a thin layer of granular material across the surface of the part.[69] The material is again selectively fused to create the next layer of the part and the process continues to repeat itself until the final layer of the part is completed.[70] Once the part is completed, it is removed from the granular bed. During the process, the part is submerged in the un-fused granular material, which supports over-

61. *Free 3D Printing Guide*, *supra* note 1, at 31-2.

62. *See id.*

63. *3D Printing with FDM* at 2.

64. Lindsey Frick, *Aluminum-powder DMLS-printed part finishes race first*, MACHINE DESIGN (Mar. 3, 2014), http://machinedesign.com/metals/aluminum-powder-dmls-printed-part-finishes-race-first.

65. Carl Deckard, *Method and apparatus for producing parts by selective sintering*, U.S. Patent 4,863,538, filed Oct. 17, 1986, published Sept. 5, 1989.

66. *Id.*

67. *Id.*

68. *Id.*

69. *Id.*

70. *Id.*

hangs and thin walls in the part being produced, reducing the need for temporary auxiliary supports.[71]

Examples of this process include selective laser sintering (SLS), direct metal laser sintering (DMLS), Selective Laser Melting (SLM), and Electron beam melting (EBM).[72] These processes allow both metals and polymers to be used to create objects with similar mechanical properties to conventional manufactured metals or plastics.[73]

The third process, lamination printing, utilizes a continuous sheet of material, usually plastic or adhesive coated paper. [74] The material is drawn across a print head that cuts cross sections out of the material using tungsten carbide blade.[75] As each layer is stacked a heated roller is passed over the material, laminating it to the layer below it.[76] This process is repeated until all layers are bonded and the part is of the right thickness. [77] Once all layers are bonded, the laser trims the material into its final shape.[78] The process is similar to creating a papier-mâché object, where the object is created by layering and bonding paper together.[79]

The final common process is the use of light to produce a solid part from a liquid.[80] This process cures (hardens) a liquid polymer

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71. *Id.*

72. *Free 3D Printing Guide*, *supra* note 1, at 24-39.

73. Deckard, *supra* note 65.

74. Elizabeth Palermo, *What is Laminated Object Manufacturing?*, LIVESCIENCE (Aug. 10, 2014), http://www.livescience.com/40310-laminated-object-manufacturing.html; *Free 3D Printing Guide*, *supra* note 1, at 36-7.

75. *Free 3D Printing Guide*, *supra* note 1, at 36-37; Julie Reece, *How Selective Deposition Lamination (SDL) 3D Printing and Rapid Prototyping Technology Works, Part 2 of 3: Printing the Prototype*, MCOR TECHNOLOGIES (Apr. 29, 2013) available at, http://www.mcortechnologies.com/how-selective-deposition-lamination-sdl-3d-printing-and-rapid-prototyping-technology-works-part-2-of-3-printing-the-prototype.

76. *See id.*

77. Palermo, *supra* note 74.

78. *Id.*

79. *How to Paper Mache*, DLTK'S HOME (last visited Sept. 21, 2014), http://www.dltk-kids.com/type/how_to_paper_mache.htm.

80. Charles Hull, *Apparatus for production of three-dimensional objects by stereolithography*, U.S. Patent 4,575,330, filed Aug. 6, 1984, published Mar. 11, 1986.

by directing a light beam at it.[81] The most common variants are Stereolithography or Digital Light Processing (DLP).[82] For example, in DLP, a vat of liquid polymer is exposed to light from a DLP projector.[83] Similar to granular printing, the light from the DLP projector hardens the liquid polymer, with a thin layer of the liquid polymer covering the surface of the part.[84] Once each layer is formed, a build plate, on which the object is supported, moves down in small increments allowing the liquid polymer to cover the top of the object.[85] After the object is immersed, the liquid polymer is again exposed to light.[86] The process repeats until the object has been created.[87] Finally, when the part is finished, the liquid polymer is drained from the vat, leaving a solid object.[88]

3D printing is not confined to these four methods. For example, some methods of printing allowing for the creation of human tissue.[89] However, these four methods are the most accessible to public, making them the most likely methods used to infringe patents or copyrights.[90] Each method is useful for creating a different type of object. For example, FDM printing is limited to plastic or small metal parts, like phone cases or money clips.[91] In contrast, granular printing may be used to create larger complex metal parts, like jet engine components or car tire rims.[92] Lamination printing

81. *Id.*

82. *Free 3D Printing Guide*, *supra* note 1, at 25-7.

83. *Id.* at 27.

84. *See id.*; Hull, *supra* note 80 (describing the process of stereolithography, which is very similar to DLP, except for the light source used).

85. *Id.*

86. *Id.*

87. *Id.*

88. *Id.*

89. University of Sydney, *Bio-printing transplantable tissues, organs: Another step closer.* Science Daily (Aug. 26. 2014) http://www.sciencedaily.com/releases/2014/06/140630103136.htm.

90. *See* Graves *supra* note 10.

91. *See Free 3D Printing Guide* at 40-7.

92. Frick *supra* note 64; Martin LaMonica, *Additive Manufacturing GE, the world's largest manufacturer, is on the verge of using 3-D printing to make jet parts,* MIT TECHNOLOGY REVIEW (Apr. 3, 2013), available at, http://www.technologyreview.com/featuredstory/513716/additive-manufacturing/.

allows for the creation of simple objects more quickly and with less expensive materials than the other processes.[93] Finally, Stereolithography allows for the creation of translucent parts.[94] Together, these four processes allow home operators to create a wide variety of objects, which in turn increases the scope of possible infringement.

In addition to allowing widespread infringement, 3D printing stands to disrupt traditional manufacturing.

C. Why it Will Disrupt Traditional Manufacturing.

3D printing has the potential to disrupt traditional manufacturing for many reasons, from increasing production speed to allowing for mass customization. [95] First, it allows for faster production of complex shapes, with less waste.[96] During the traditional manufacturing process, significant amounts of the raw material are removed during the process and generally must be recycled to be reusable.[97] In contrast, 3D printing generally only uses the material necessary to create the part.[98]

Second, using 3D printing reduces initial tooling costs and investment.[99] Using traditional methods, a manufacturer must purchase the equipment or tools needed to create each part, most of which is used only for that type of part.[100] In contrast, 3D printing

93. *See* Reece *supra* note 75; *See also* How *Paper-based 3D Printing Works: The Technology and Advantages,* mcor technologies (2013) http://www.mesa-cad.com/Portals/0/Mcor/how-paper-based-3d-printing-works.pdf.

94. *Somos Stereolithography Materials Selector Guide: Property Summary,* Curbell Plastics, available at, http://www.curbellplastics.com/technical-resources/pdf/stereolithography-selector-guide.pdf.

95. Lyndsey Gilpin, *10 Industries 3D printing will disrupt or decimate,* TECHREPUBLIC (Feb. 12 2014), http://www.techrepublic.com/article/10-industries-3d-printing-will-disrupt-or-decimate/ (last visited Apr. 14, 2014).

96. *See* CSC, Leading Edge Forum, *3D Printing and the Future of Manufacturing* 3, 11 (2012).

97. Reeves, *supra* note 25.

98. Excell, *supra* note 48.

99. Gilpin, *supra* note 95.

100. Reeves, *supra* note 25.

only requires the purchase of the printer, which is capable of creating a wide variety of parts.[101]

Third, 3D printing also allows for mass customization and mass manufacturing, two things not traditionally associated with each other.[102] Traditional manufacturing methods focus on creating uniformity between each product of the same type, as this allows manufacturing costs to be reduced and quality increased.[103] 3D printing, on the other hand, allows for each product to be customized to the purchaser, because each product is created to order.[104]

Also stemming from being created to order, 3D printing allows for on demand manufacturing, where the parts are not created until needed.[105] Traditionally, manufacturers had to forecast the expected demand and number of non-conforming products or wait until an order was placed before setting up the production process.[106] This approach leads to surpluses or shortages of parts, or to long delays in manufacturing while the necessary number of parts are produced.[107] In contrast, 3D printing can reduce set-up times to almost nothing, and by creating parts on demand, the required numbers of parts can be produced as needed.[108]

Finally, 3D printing allows for the creation of organs using bioprinting.[109] While still an emerging field, organ printing has the potential to allow human organs to be created as needed for individual patients.[110]

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101. *Id.*

102. Reeves, *supra* note 25; Gilpin, *supra* note 95.

103. *Id.*

104. *Id.*

105. *Inventory Control and On-Demand Manufacturing, 4imprint Blue Papers* (2009), available at, http://info.4imprint.com/wp-content/uploads/Blue%20Paper%20JIT.pdf.

106. *Id.*

107. *Id.*

108. *See* Jerrod Windham, *The Present and Future of On-Demand Manufacturing*, iDSA (2012), http://www.idsa.org/present-and-future-demand-manufacturing.

109. Reeves, *supra* note 25 at 12-13; *See also, 3D Printing, supra* note 12.

110. Brandon Griggs, *The next frontier in 3-D printing: Human organs*, CNN Tech (Apr. 2, 2014), http://www.cnn.com/2014/04/03/tech/innovation/3-d-printing-human-organs/.

In addition to disrupting the traditional manufacturing process, 3D printing has the potential to disrupt how consumer products are manufactured.[111] For example, 3D printing allows any individual to become a manufacturer simply by purchasing or building a printer.[112]

Currently, there are two main ways for individuals to access 3D printing. The first is buying or building a small printer for personal use.[113] The second is uploading a file to a 3D printing company, such as Shapeways or Thingiverse, which prints the part and ships it to the customer.[114]

This unprecedented level of access to small-scale manufacturing has the potential to revolutionize modern manufacturing by allowing anyone to create almost any product he or she needs on demand, but it has some downsides. First, it will compete with the existing manufactures.[115] This competition will add further pressure to an industry that is already struggling against the effects of globalization.[116] Second, 3D printing will enable anyone with access to either a modeling program or a printer to become a copyright or patent infringer.[117] This potential for infringement raises serious concerns about the scope of existing intellectual property protection, and whether it will adequately protect intellectual property owners.[118]

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111. CSC, *supra* note 96, at 14.

112. *See id.* at 14-16.

113. *See RepRap*, *supra* note 55.

114. CSC, *supra* note 96, at 14.

115. *See* Peter Friedman, *The Achilles' Hell of 3D Printing*, Innovation Investment Journal (Dec. 30, 2012), http://www.iijiij.com/2012/12/30/the-achilles-heel-of-3d-printing-015281.

116. John Manzella, *The Impact of Globalization and New Technologies on Manufacturing*, The Manzella Report (Jul. 1, 2001) http://www.manzellareport.com/index.php/manufacturing/180-the-impact-of-globalization-and-new-technologies-on-manufacturing.

117. Brean, *supra* note 3.

118. *Id.*

III. THE PROBLEM: WIDESPREAD INFRINGEMENT FACILITATED BY SHARING CAD FILES

While revolutionizing access to digital manufacturing, 3D printing has the potential to create widespread patent infringement, by allowing anyone with access to a computer, the internet, and a 3D printer to make infringing products.[119] Because of this, the new breed of patent infringer is likely to be an individual who obtains the digital files from a third party, via a website, bit torrent or other file sharing method.[120] Unlike a copyright infringer, the patent infringer will not be infringing by simply downloading the file, as was the case with music piracy.[121] To be a patent infringer, the downloader must make, use, or sell the patented product.[122] This makes the patent infringer an unappealing target, because any enforcement action must show production, whereas a copyright holder only needs to show copying of the file.[123] However, many of the problems faced by copyright holders provide valuable insight into the types of infringement that 3D printing creates.

A. The Ease of CAD File Sharing.

As was the case with the creation of the MP3, the rise of 3D modeling has changed the ways in which information may be conveyed.[124] In the case of MP3s, the new file format allows sound recordings to be stored as compressed data.[125] In turn, the small size of the new files allows them to be easily shared using the Internet.[126] The same is now true of the 3D CAD file.[127]

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119. *See* Graves, *supra* note 10.

120. *Id.*

121. Brean, supra note 3 (reasoning that the offer for sale of a CAD file is not a "sale" of the infringing product, because the CAD file is not tangible).

122. 35 U.S.C. 271 (2010).

123. *Contra* 35 U.S.C. § 271 (2003), 17 U.S.C. § 501 (2002).

124. Brean, *supra* note 3.

125. *See RIAA v. The People: Five Years Later*, Electronic Frontier Foundation (Sept. 30, 2008), https://www.eff.org/wp/riaa-v-people-five-years-later.

126. *See id.*

127. *See* Graves, *supra* note 10.

Current technology allows for the creation of 3D CAD files that are small enough in size to be easily shared using the Internet.[128] For example, the 3D CAD file for a phone case is only 183 kb.[129] Even at this small size, the file contains all the data necessary to create the physical part.[130] Thus, to share infringing files, infringers may use any online service, which allows the transfer of small files, including email, file sharing sites, and bit torrent. As IP theft has caused considerable losses to many industries, it has increasingly become an international issue.[131]

B. The Potential Growth of Patent Infringement from the Spread of 3D Printing.

Intellectual Property theft has become so widespread that it has become a concern to most industrialized countries.[132] Of the three major forms of IP, copyrights and trademarks have been the most affected thus far.[133] Patents, in contrast, have suffered less so, because many of the patented technologies require manufacturing expertise that intellectual property infringers lack.[134] 3D printing has the potential to change this, as it allows more complex products to be manufactured more quickly and cheaply than traditional manufacturing methods.[135]

The increase in access to 3D printing, when combined with new technologies, has the potential to exponentially increase the population of potential infringers.[136] Using files shared over the Inter-

128. *See* iPhone 5 Case for customization and 3D printing, available at, http://www.thingiverse.com/thing:31174/#files.

129. *See id.*

130. *See id.*

131. *International IP Theft*, available at, http://www.iacc.org/assets/iacc_whitepaper.pdf; *WIPO Intellectual Property Handbook: Policy, Law and Use, Chpt. 4, Enforcement of Intellectual Property Rights*, available at, http://www.wipo.int/export/sites/www/about-ip/en/iprm/pdf/ch4.pdf.

132. *Id.*

133. *Id.*

134. *Id.*

135. CSC, *supra* note 96, at 2 (explaining that 3D printing is more flexible, and economical than older manufacturing methods).

136. *See* Graves, *supra* note 10.

net, anyone, anywhere in the world, may produce infringing products quickly and cheaply, even if they lack engineering or manufacturing expertise.[137] Worse, some emerging technologies will allow users to recreate existing patented or copyrighted parts without having to download files from the Internet.[138]

For example, several apps are now available for smart phones that allow 3D printing directly from the phone.[139] This ability, combined with new phone technologies, could conceivably allow users in the near future to copy and print objects using only 3D scanners on their smart phones.[140] For example, Google's Project Tango allows a smart phone to create a 3D map of a room and could be modified to scan and digitize 3D objects.[141] Then, once the object is digitized, it can be printed directly from the phone.[142] This type of smart phone use will likely increase as consumers in many developing countries are going directly to smart phones, without buying personal computers or computer software.[143]

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137. *See 3D Printing Basics*, 3ders, http://www.3ders.org/3d-printing-basics.html (last visited Sept. 1, 2014).

138. *Up close with Zeus*, *supra* note 45.

139. Michael Molitch-Hou, *Go Bananas-Windows 8 3DP App Released by South African Teens*, 3D Printing Industry (Jan. 16, 2014), http://3dprintingindustry.com/2014/01/16/go-bananas-windows-8-3dp-app-released-south-african-teens/ (last visited May 4, 2014) (reporting on the creation of new 3D printing apps for smartphones).

140. Davide Sher, *Google Wants to Give your Smartphone Native 3D Modeling Capabilities*, 3D Printing Industry (Mar, 14, 2014), http://3dprintingindustry.com/2014/03/14/google-smartphone-3d-modeling/ (describing the possibilities for 3D scanning by smart phones).

141. *Id.*

142. *Id.*; *see also Go Bananas*, *supra* note 139.

143. *See* Shira Ovide, *Global PC Shipments Fell 10% Last Year, Gartner and IDC say*, The Wall Street Journal (Jan. 9, 2014), http://online.wsj.com/news/articles/SB10001424052702303754404579310950982181302 (last visited May 4, 2014) (reporting on the causes of the fall in PC sales); *Smartphones becoming critical in developing nations*, Intelsat Blog, http://www.intelsat.com/broadband-telecom-infrastructure/smartphones-becoming-critical-in-developing-nations-2/ (last visited May 4, 2014) (describing the importance of smartphone in the developing world).

C. The Failure of the Laws to Act as a Deterrence

This situation, a consequence of rapidly changing technology, is very similar to the one faced by the recording industry in the late 1990's.[144] The rise in ownership of personal computers, the ability to record sound files in MP3 format, and access to the Internet allowed consumers to quickly copy and share music.[145] This change helped to disrupt the traditional recording industry, which could previously rely on the limitations of copying technology to limit the ease and speed of copying music.[146] Hence, the "nature itself protected that interest." [147] The net effect was a dramatic increase in copyright piracy.[148]

To combat the increase in piracy, the entertainment industries launched massive rights enforcement campaigns.[149] In addition, Congress passed the Digital Millennium Copyright Act or DMCA, to make United States law World Intellectual Property Organization (WIPO) compliant.[150] However, even with the increased protection, enforcement alone was not enough to stem online piracy.[151] The rate of piracy did not begin to quickly decline until the appearance of iTunes, which allowed consumers to purchase the works in a digital format for a reasonable price.[152] Thus, any potential long-term solutions to 3D printing piracy will need to combine the deterrence of modernized law with the benefits of the online marketplace.

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144. *Piracy Deliberate Infringement of a Copyright*, DJSummit, http://www.computerdjsummit.com/members/documents/piracy.html (last visited Sept. 1, 2014).

145. *Id.*

146. *See* Desai, *supra* note 46.

147. *See,* LAWRENCE LESSIG, CODE 2.0, 172 (2006).

148. *Id.*

149. *RIAA supra* note 125.

150. Executive Summary, *Digital Millennium Copyright Act Section104 Report*, http://www.copyright.gov/reports/studies/dmca/dmca_executive.html (last visited May 6, 2014).

151. Bart Cammaerts and Bingchun Meng, London School of Economics, *Creative Destruction and Copyright Protection* 9 (2011) *available at* http://www.scribd.com/doc/51217629/LSE-MPPbrief1-creative-destruction-and-copyright-protection (last visited May 5, 2014).

152. *Id.*

IV. THE SOLUTION: COMBINE PROTECTIONS TO STOP THE SPREAD OF CAD FILES

If the problem is the potential for widespread infringement of some patents by 3D printing infringing parts from CAD files obtained online, then the obvious solution is to stop the online sharing of CAD files. However, the need for protection must be balanced against the benefits of widespread access to this valuable new technology.[153]

One way to achieve this is to combine the protections offered by copyrights with those offered by patent protection. Doing so would allow the patentee to use the mechanisms afforded by copyrights, and the DMCA, to curtail the online sharing of infringing 3D CAD files.[154] This, in turn, would reduce the level of patent infringement by reducing access to the 3D CAD files. Additionally, combining protections would allow for the creation of a new online market for the CAD files, which would reduce the demand for pirated files. Finally, the solution should be easy to implement, as most affected companies already have 3D CAD files, which should already benefit from copyright protection.[155]

For the solution to be viable, only two things are required: (1) a valid patent on a part that may be 3D printed and (2) a valid copyright in the 3D CAD file that represents the patented part. Once both are obtained, the patentee is protected from traditional patent infringement by the patent, and from online file sharing and printing by the copyright.[156]

The first component, patent law, protects new, useful, and non-obvious technologies for a limited time in return for public disclo-

153. *See id.; See also* Metro-Goldwyn-Mayer Studios Inc. v. Grokster, Ltd., 545 U.S. 913 (2005).

154. *See generally* 17 U.S.C. §§ 501-13 (2008); 35 U.S.C. §§ 281-99 (2011).

155. *Engineering Design Technology CAD/CAM Technician*, Pasadena City College, http://webcms.pasadena.edu/display_program.asp?program_id=890. (last visited Sept. 1, 2014) (Class listing illustrating the demand for CAD skills); *see generally List of Mechanical CAD Softwares,* Beyond Mech, http://www.beyondmech.com/pro-e/cad-topic-33.html (last visited Sept. 21, 2014) (listing available CAD programs).

156. *Infra* Part IV.C.i.

sure of the technology.[157] However, this protection only gives the patentee the right to exclude others from making, using or selling the patented technology.[158] Unlike copyrights, which grant the right of reproduction, a showing of patent infringement requires making using or selling of the part itself, not just sharing of the CAD file.[159]

This brings up an interesting question: Can a copyright be obtained on a 3D CAD file of a patented part, when patent protection equates to functionality, and functional works are excluded from copyright protection? The answer is not only can it be protected, but it should be protected. A 3D CAD file is a graphical work, depicting the patented part, very similar to a technical drawing.[160] Additionally, the files are non-functional and original. Finally, the 3D CAD files do not monopolize the underlying idea in a way that is inconsistent with copyright law.[161]

This is not the only solution, of course, as others including *sui generis* protection, licensing, contributory infringement, or lawsuits against individual infringers exist.[162] Unlike the other solutions, the proposed solution, which combines protections, does not require rewriting existing law, burdensome changes to company practices, or expensive litigation.[163]

157. 35 U.S.C. §§ 101-03 (2014).

158. 35 U.S.C. § 271 (2003).

159. *Contra* 35 U.S.C. § 271 (2003), 17 U.S.C. § 501 (2002).

160. 17 U.S.C. § 101 (2010).

161. *See infra* Part IV.C.i.3 (explaining why the merger doctrine should not apply in cases where the underlying idea is patented).

162. Jonathan Bailey, *5 Major Types of Copyright Enforcement Strategies*, Plagiarism Today (Jul. 1, 2014), https://www.plagiarismtoday.com/2014/07/01/5-major-types-copyright-enforcement-strategies/; 35 U.S.C. (2010).

163. *Id.*

A. Benefits of Combined Protection

Combining patent and copyright protection allows the patentee to use the mechanisms afforded by copyrights and the DMCA, to curtail the online sharing of infringing 3D CAD files. In addition, it allows for statutory remedies, like statutory damages, which are not available under patent law.[164] The copyright protection of CAD files also allows for the creation of a new online market for the CAD files, and should be easy to implement, as most affected companies already have 3D CAD files.[165] Together these additional protections help to increase the patentee's defense against online piracy, even if the new protection only protects the non-functional ornamental aspects of the patented product.[166]

To achieve this protection, the company should create a 3D CAD file that covers the patented part and its closest variants, or create several CAD files, with each one covering a single variant of the part.

However, in some cases there may be so few ways to model a part—given its functional constraints—that the part is likely to be considered as having merged the expression of the idea underlying the part and the underlying idea itself.[167] Normally, this would lead a court to apply the "merger" doctrine and find the part uncopyrightable.[168] In the case of combined protection, however, the merger doctrine should not apply, because the underlying invention—even if it is the only way to express an idea—is protected by the patent.[169] Thus, the additional protection granted by the copyright does not extend the protection beyond that which already ex-

164. 17 U.S.C. §§ 501-13 (2002).

165. *See Engineering, Scientific &CAD/CAM Software Industry Overview*, Hoovers, http://www.hoovers.com/industry-facts.engineering-scientific-cad-cam-software.1133.html (last visited Sept. 21, 2014) (discussing the state of the CAD industry).

166. 17 U.S.C. § 101-122 (2010).

167. *See Mazer v. Stein*, 347 U.S. 201, 217 (1954).

168. *Id.*

169. *See,* Consolidated Electric Light Co. v. McKeesport Light Co., 159 U.S. 465 (1895) (stating that a claim to all types of paper suitable for a purpose would not be extravagant).

ists.[170] Stated differently, allowing copyright protection here does not "take" anything from the public, which is the major concern underlying the merger doctrine.[171]

1. Copyright Protection Allows for Statutory Remedies under the Copyright Act

Copyright ownership allows the patentee to access remedies that are unavailable under patent law.[172] While both copyright law and patent law allow for injunctions and recovery of actual damages, copyright law also allows for recovery of an infringer's profits and statutory damages.[173] In addition, the DMCA allows the patentee to request the removal of infringing 3D CAD files from websites.[174] Unlike, the Patent Act, the DMCA was written with the digital sharing of files in mind, which makes it a far better tool for combating online piracy.[175] These copyright specific protections give the rights holders' powerful tools to combat digital piracy.[176]

By copyrighting the CAD files, the patent holder can control the online sharing of the files used to produce infringing parts, without having to prove actual patent infringement occurred.[177] Not having to show production represents a significant improvement to the protection afforded by the Patent Act.[178] However, the protections offered by copyrights do far more than just allow for better remedies.

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170. *See, e.g.*, Baker v. Selden, 101 U.S. 99, 103, 25 L. Ed. 841 (1879) (describing the purpose of publishing to spread knowledge of the art, which can only be protected by patent law).

171. *See Consolidated Electric Light, supra* note 169; *Baker, supra* note 170.

172. *Contra* 35 U.S.C. §§ 281-99 (2003), 17 U.S.C. §§ 502-5 (2002).

173. 35 U.S.C. § 284 (2012); 17 U.S.C. § 502 (2012); 17 U.S.C. § 504(2012).

174. *See generally The Digital Millennium Copyright Act of 1998, U.S. Copyright Office Summary*, (Dec. 1998), available at, http://www.copyright.gov/legislation/dmca.pdf.

175. *Id.*

176. *Id.*

177. *See* 17 U.S.C. §§ 501-13 (2002).

178. *Contra* 35 U.S.C. §§ 281-99 (2003), 17 U.S.C. §§ 502-5 (2002).

2. Incentivizing Distribution of CAD Files by Patentees.

Having copyright protection allows the patentee to enter into the 3D CAD file market by preventing others from copying the 3D Cad file.[179] With this protection, the patentees can sell 3D CAD files of their patented products, in a secure, accessible way, via a mechanism similar to iTunes. Using an iTunes like mechanism to offer the files for sale allows the patentee to tap into the emerging market for 3D printer ready CAD files.[180] One need only look to the fate of the music industry to understand why entering this market early is beneficial.[181]

By creating easy access to legal, high quality files, the patentees can reduce the prevalence of piracy and the incentive to design around existing designs.[182] As has happened in the music industry, people prefer to acquire goods legitimately, if the goods are easily accessible and reasonable in price.[183]

As a secondary benefit, the patentees would no longer need to stock large quantities of replacement parts, as they could just sell the CAD file to the consumers, who would then produce it themselves. In essence, the patentee could transfer the cost of manufacture to the consumer, without significantly lowering the price charged for the file. For example, a two-dollar plastic part could still be sold to the consumer for two dollars in file format, then the consumer has to pay the manufacturing cost, and the patentee is left with pure profit.

3. Ease of Implementation.

Acquiring copyright protection should be easy to implement, as many companies already use 3D CAD files in the design pro-

179. 17 U.S.C. § 106 (2002).

180. *See* Bobby Owsinski, *The Lie That Fuels the Music Industry's Paranoia*, Forbes (Nov. 27, 2013), http://www.forbes.com/sites/bobbyowsinski/2013/11/27/the-lie-that-fuels-the-music-industrys-paranoia/.

181. *Id.* (describing the reduction in piracy because of the ease of access to free content).

182. Luckerson, *supra* note 7.

183. *See id.*

cess.[184] In the modern design process, the 3D CAD file has largely replaced the technical drawing.[185] Under current law, copyright protection begins at the time of creation, which means that any CAD files created during the design process already have copyright protection.[186] By having these files, the patentee has already begun the process of augmenting their patent protection. Even though the patentee may have to create some additional files to cover every possible variation of the patented part and register the files, the expense incurred in doing so will be far less than litigation.[187]

B. Patents, the First Component

Like copyright law, patent law stems from Article I Section 8 of the Constitution.[188] Both are meant to promote progress in science and the arts, but whereas copyright law is concerned with the arts, patent law is concerned with science.[189] At its most basic, patent law protects new, useful, and non-obvious technologies for a limited time in return for public disclosure of the technology.[190]

Patent protection comes in two forms, utility patents, which protect functional ideas, and design patents, which protect ornamental designs.[191]

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184. *Engineering Design Technology CAD/CAM Technician*, *supra* note 155.

185. *Computer-Aided Design (CAD) and Computer-Aided Manufacturing*, Reference for business, http://www.referenceforbusiness.com/encyclopedia/Clo-Con/Computer-Aided-Design-CAD-and-Computer-Aided-Manufacturing-CAM.html (last visited Sept. 1, 2014).

186. 17 U.S.C. § 101 (2010).

187. *Contra Computer-Aided Design*; Chris Neumeyer, *Managing Costs of Patent Litigation*, (Feb. 5, 2013), http://www.ipwatchdog.com/2013/02/05/managing-costs-of-patent-litigation/id=34808/.

188. U.S. Const. art. I, § 8, cl. 8.

189. 17 U.S.C. (2010); 35 U.S.C. (2012) (It should be noted that at the time the Constitution was written, arts meant the useful arts whereas science meant knowledge).

190. 35 U.S.C. §§ 101-03 (2014).

191. 35 U.S.C. (2012).

1. Utility Patents for 3D Printing

Unlike copyrights, utility patents protect functional works, thereby preventing any technology protected by patents from also being protected by copyrights.[192] This follows the long established legal notion that patent terms should not be extended by other forms of Intellectual Property protection.[193]

Utility patents allow for protection in the 3D printing field in several ways. First, it allows for protection of the actual 3D printing technology.[194] Second, it allows for protection of patented parts that can be manufactured using 3D printing. This allows for substantial protection during the patent term, and thus far, many companies have patented 3D printing technology.[195] This has resulted in some litigation between manufacturers, but none against individual infringers to date.[196] There are many possible reasons for this, from lack of detection of infringement, to cost of litigation, to the design constraints on home printing.[197]

Even with utility patent protection, there are several problems with enforcing the protection against individual infringement. First, patents confer an exclusive right to make, use, or sell, a product, with infringement requiring a violation of these rights.[198] Creating a CAD file is not a manufacture, use, or sale of a patented product, but it may create indirect liability, such as contributory liability.[199] Even a showing of indirect infringement, however, re-

192. *See, e.g.*, Bonito Boats, Inc. v. Thunder Craft Boats, Inc., 489 U.S. 141 (1989); TrafFix Devices, Inc. v. Mktg. Displays, Inc., 532 U.S. 23, 29 (2001).

193. *See Bonito Boats, Inc.*, 489 U.S. 41; *TrafFix Devices, Inc.*, 532 U.S. 23.

194. *See* Deckard, *supra* note 65; Hull, *supra* note 80 (illustrations of patents on 3D printing technology).

195. Gridlogics Technologies Pvt. Ltd., *3D Printing Technology Insight Report*, (2014), available at, http://www.patentinsightpro.com/techreports/0214/Tech%20Insight%20Report%20-%203D%20Printing.pdf.

196. Bryan Vogel, *Casting 3D Printing's Coming IP Litigation: Usual Suspects and Dark Horses;* BLOOMBERG BNA (Oct. 11, 2013); http://www.bna.com/casting-3d-printings-coming-ip-litigation-usual-suspects-and-dark-horses//.

197. *See* Neumeyer, *supra* at note 187.

198. 35 U.S.C. § 271 (2012).

199. *See infra* Part IV.D.iv (discussing other liability theories).

quires the patentee to go beyond merely showing the copying of the CAD files to a showing of actual manufacture, use, or sale of the patented part.[200]

Second, 3D printing allows anyone to become a potential infringer, something that was not contemplated by Congress when the current patent regime was created.[201] An example of this is the way damages are calculated. Damages are equated to the profits lost when losing a sale, because of the infringement.[202] Additionally, damages may be trebled, if the infringement was willful, and may be increased to include attorney's fees.[203] In the case of an individual infringer who only makes one part, the damages would be minimal, even if willful, as the lost profit would only be tens or hundreds of dollars.[204] However, if attorney's fees are granted, it may cover some litigation expenses.

While the patentee may also get injunctions or reasonable royalties, the patentee would need to get one for each individual infringer, which is impractical as there are likely to be hundreds or even thousands of infringers.[205] However, if the infringer shared the files, reasonable royalties may allow the patentee to recover a royalty covering every shared file, though the total number may be impossible to prove and the infringer may be unable to pay the full costs.[206] Thus, in general, it would cost the patentee more than it could recover to sue each individual infringer.[207] Therefore, the patentee is left with the choice of losing money on lawsuits or allowing infringement.

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200. *Medtronic,* 134 S. Ct. at 849 ("It is well established that the burden of proving infringement generally rests upon the patentee.").

201. Eric Weibel, *Legislative Intent and the Patent Act of 1952*, THE EXAMINER (Dec. 6, 2013), http://www.examiner.com/article/legislative-intent-and-the-patent-act-of-1952 (describing the passage of the 1952 patent act without debate).

202. 35 U.S.C. § 284 (2012).

203. *Id.*

204. *Id.*

205. *See RIAA v. The People*, *supra* note 125.

206. *See Minnesota Woman Ordered to Pay $222,000 in Music Piracy Case*, ROLLING STONE, (Sept. 12, 2012), http://www.rollingstone.com/music/news/minnesota-woman-ordered-to-pay-222-000-in-music-piracy-case-20120912.

207. *See id.*

Without the strong individual infringer deterrents of copyright law, like statutory damages, utility patents alone do not provide adequate protection against the type of infringement that 3D printing makes possible.

2. Design Patents for 3D Printing

Design patents protect the ornamental design of an article of manufacture for a limited time.[208] In most respects a design patent is more similar to a copyright than a utility patent, as the design patent does not protect functionality.[209] Both design patents and copyrights protect the ornamental design of a product, exclude functional items from the protection, and have limited terms.[210] Though unlike copyrights, which have a very long term, design patents have a relatively short term of fifteen years.[211]

However, design patents suffer from the limitations of both patents and copyrights. A design patent protects the non-functional aesthetic components of a part, if it is new and original.[212] These requirements mean that the part must be new to the public, unlike copyrights, which only require the design to be original,[213] and include creative expression, unlike utility patents, which require functionality.[214] Further, the term of protection for design patents is shorter than both the utility patent term and the copyright

208. 35 U.S.C.A § 171 (West 2013).

209. *Id.*

210. *Compare* 35 U.S.C.A § 173 (West 2014), *with* 17 U.S.C. § 302 (2012) (compare the terms of design patents and copyrights).

211. 35 U.S.C.A § 173.

212. *Id.* §171.

213. Novelty generally describes something that has not been thought of or done before; whereas originality means the work is new to the creator and not copied from another. *See,* Hoover Grp., Inc. v. Custom Metalcraft, Inc., 66 F.3d 299, 302 (Fed. Cir. 1995); Feist Publ'ns v. Rural Tel. Serv. Co., 499 U.S. 340, 345-46 (1991).

214. *Compare* 35 U.S.C.A. § 171, *with* 35 U.S.C. § 101 (2012), *and* 17 U.S.C. 102 (2012) (compare the subject matter requirements of design patents, utility patents, and copyrights).

term.[215] Finally, damages for design patent infringement are calculated differently from those for utility patents or copyrights.[216]

To be granted design patent protection the ornamental design must be new or "novel."[217] Unlike the originality requirement of copyright law, novelty requires the design be new, not just creative.[218] However, the term of protection for design patents is fifteen years, which contrasts sharply with the lifetime of the author plus seventy years term for copyrights.[219] To offset these limitations, design patent protection extends to include any "colorable" imitation of the design.[220]

Thus, the Patent Act provides that:

> Whoever during the term of a patent for a design, without license of the owner, (1) applies the patented design, or any colorable imitation thereof, to any article of manufacture for the purpose of sale, or (2) sells or exposes for sale any article of manufacture to which such design or colorable imitation has been applied shall be liable to the owner to the extent of his total profit, but not less than $250 . . .[221]

This allows for the patentee of a design patent to recover an infringer's entire profit as damages, which could potentially be very large.[222] However, in the case of an individual infringer who has only made the parts or shared them without payment, the damages are likely to be minimal. Therefore, having a design patent would still not effectively deter the use of the 3D model, because the damages would be minimal and still require suits against every individual infringer.[223] Again, it may be possible to pursue file host-

215. 35 U.S.C. § 173; 35 U.S.C. § 154 (2012), 17 U.S.C. § 302.

216. *Compare* 35 U.S.C. § 284, with 35 U.S.C. § 289 (2012).

217. 35 U.S.C.A. § 171.

218. *Id. See also* 35 U.S.C.A. § 171; 35 U.S.C. § 101 (2012),; 17 U.S.C. 102 (2012) (comparing subject matter requirements).

219. *Compare* 35 U.S.C.A. § 173, *with* 17 U.S.C. § 302.

220. 35 U.S.C. § 289.

221. *Id.*

222. *Id.*

223. *See id.*

ing sites for contributory infringement; however actual infringement must still be proved.[224] For these reasons, design patents make a poor choice to defend against infringement by 3D printing, as was the case for utility patents.

C. Copyrights, the Second Component

At its most basic, copyright law is meant to protect expressive works, embodied in a tangible medium.[225] The level of and limits on the scope of protection are defined by the Copyright Act of 1976.[226] The Act defines the elements required to gain a copyright, such as being sufficiently original, but without being an idea, a fact, or a useful article.[227] For example, a fictional novel is copyrightable, but facts in an encyclopedia are not.[228] In addition, the Act grants specific rights, such as the right of reproduction or the right to create derivative works.[229] While expansive, these rights are not absolute.[230] For example, the Act allows for the "fair use" of copyrighted material for things like news reporting or teaching.[231]

In addition, to cope with the changes wrought by the Internet, Congress passed the Digital Millennium Copyright Act (DMCA), which expanded copyright protection in the digital world.[232] This legislation criminalizes the production and dissemination of technology, devices, or services intended to circumvent measures (commonly known as digital rights management or DRM) that control access to copyrighted works.[233] It also criminalizes the act of circumventing an access control, whether or not there is actual infringement of copyright itself.[234] In addition, it heightens the

224. 35 U.S.C. § 284.
225. 17 U.S.C. §102.
226. *See generally* 17 U.S.C. §§ 101-1332 (2012).
227. 17 U.S.C. § 102 (2012).
228. *Feist*, 499 U.S. at 347-48.
229. 17 U.S.C. § 106 (2012).
230. *Id.* § 107.
231. *Id.*
232. Executive Summary, *supra* note 150.
233. 17 U.S.C. §1201(a) (2012).
234. *Id.*

penalties for copyright infringement on the Internet.[235] Finally, the DMCA provides a safe harbor defense for service providers with a notice and takedown system.[236]

A notice and takedown system is one in which the copyright holder may notify the Internet service provider that it is hosting infringing material.[237] The service provider then takes down the infringing content, and notifies the person who posted the content.[238] The poster may then challenge the takedown and have the content reposted.[239] For example, a DMCA take down notice was filed against a miniature replica of the Iron Throne, from the *Game of Thrones* series, which was subsequently removed from the hosting website.[240]

Regardless of the number of take downs filed, 3D printing allows for the widespread infringement of copyrights, both by posting the files online and by unauthorized reproductions at home.[241] This will likely lead to an increase in the number of DMCA take down notice cases. However, to request the removal of a 3D CAD file, the file must be protected by a copyright.

1. Treatment of 3D CAD Files under Copyright law

3D printing potentially allows for the widespread infringement of copyrights in two ways. First, 3D printers allow the part to be physically reproduced, albeit sometimes only on a smaller scale.[242]

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235. *Id.* § 506(a)(1)(C).

236. *Id.* § 512.

237. *Id.*

238. *Id.*

239. 17. U.S.C. §512.

240. Nathan Hurst, *HBO Blocks 3-D Printed Game of Thrones iPhone Dock*, WIRED (Feb. 13, 2013, 1:57 PM), http://www.wired.com/design/2013/02/got-hbo-cease-and-desist/all (reporting how
HBO sent a cease and desist letter to an individual who designed a CAD file for an iPhone dock resembling the Iron Throne from the *Game of Thrones* television series).

241. *See supra* Part III (discussing the possibility of widespread infringement).

242. *3D Touch Single Head*, TOPTENREVIEWS, http://3d-printers.toptenreviews.com/3dtouch-review.html (last visited May 6, 2014) (comparison of 3D printer capabilities).

Secondly, the copyrighted work may be recreated as a 3D CAD model file and shared online.[243] Assuming copyright protection in the physical model and the CAD file, unauthorized copying would constitute infringement.[244] However, as 3D CAD files are relatively new in legal terms, their protection cannot be assumed.

Physical reproductions of copyrighted works are protected as either copies or derivative works of the original. [245] This allows for the rights holder to recreate miniatures of the original work or to create sculptures from a photograph.[246] Additionally, the protection from the right to create derivative works extends to reproductions that are substantially similar to the original works.[247] For example, a sculpture of a couple holding their puppies, with minor variations, made using a photograph was found to be a derivative work.[248] These rights give "traditional" works fairly broad protection.[249]

In contrast, the precise status of a digital 3D model is unclear.[250] The 3D CAD file itself may be viewed in several ways because it is digital. [251] The first way is to view the file as a computer program (i.e. code and data).[252] Alternatively, the file may be viewed as a digital model, or sculpture, that only exists on the computer screen, and conveys the information necessary to reproduce the model.[253] There is also a third possible subcategory, adding ornamental design, but this falls under pictorial, graphical, or sculptural

243. *See* Graves, *supra* note 10; Brean, *supra* note 3.

244. *See* Galiano v. Harrah's Operating Co., Inc., 416 F.3d 411, 414 (5th Cir. 2005) ("To prove copyright infringement, a plaintiff must show ownership of a valid copyright and actionable copying.").

245. 17 U.S.C. § 106. *See also id.* § 101.

246. *See* 17 U.S.C. § 106; *Id.* §101; Rogers v. Koons, 960 F.2d 301 (2d Cir. 1992).

247. *See Rogers*, 960 F.2d at 307.

248. *Rogers* 960 F.2d 301.

249. *See id.*

250. *See* 17 U.S.C. § 102(a); *Id.* §101. *See also* Dolinsky, *supra* note 3.

251. *See* 17 U.S.C. §102(a)..

252. Dolinsky, *supra* note 3 at 639.

253. *See id.*

work.[254] How these components are treated will determine if there is a valid copyright.

Should the CAD file components be viewed separately, together, or some other way? To be treated as a computer program, the 3D CAD file must be fall into one of two types of computer programs, operating systems or application programs.[255] Operating systems perform internal computer functions without user input, whereas application programs perform a specific task for the user at the user's request.[256] A CAD file is unlikely to be considered an operating system, because the program only operates at the user's request.[257] During operation, a CAD program converts the user created digital model into the computer code necessary to recreate the model when the file is reopened.[258] In this, it operates almost identically to a Microsoft Word document, wherein the text and format are converted into code and saved. By requiring user inputs, the CAD file fits well under the definition of an application program.[259] However, the question of who is the author of the code, which can determine who will receive a copyright, still remains.[260]

There are two possible options as to who is the author of the code.[261] One, the user authored the code by using the program. Or, two, the program and, therefore by proxy, the programmers authored the code.[262] A computer-generated work is authored by the

254. *See* James Grimmelmann, *Indistinguishable from Magic: A Wizard's Guide to Copyright and 3D Printing,* WASH. & LEE L. REV. (forthcoming 2014) (available at http://ssrn.com/abstract=2358233) (manuscript at 10).

255. *See, e.g.*, Apple Computer, Inc. v. Franklin Computer Corp., 714 F.2d 1240 (3d Cir.1983).

256. Brian Rideout, *Printing the Impossible Triangle: The Copyright Implications of Three-Dimensional Printing*, 5 J. BUS. ENTREPRENEURSHIP & L. 161, 167 (2011).

257. Dolinsky, *supra* note 3, at 639 (describing how a CAD file creates code from user inputs).

258. *Id.*

259. *See Apple Computer,* 714 F.2d 1240; Dolinsky, *supra* note 3.

260. Dolinsky, *supra* note 3, at 639.

261. *Id.* at 640.

262. *See id.* (citing the findings of *Stern Elecs., Inc. v. Kaufman*, 669 F.2d 852 (2d. Cir 1982)).

user, who created the work itself, not the underlying program.[263] For example, in a Word document, the "work" is the text, and the code is directly derived from the text. Thus, the user is author, as the code was created at the direction of the user and is only incidental to the expression of the work.[264]

In contrast, program outputs can be authored by the programmers who created the underlying program, even if the specific expression is created by the user.[265] For example, courts have found that in a video game the programmers hold the copyright, even though the specific experience (i.e. route through the gaming world) is created by the player.[266] The court reasoned that "[t]he repetitive sequence of a substantial portion of the sights and sounds of the game qualifies for copyright protection as an audiovisual work."[267] In other words, because the programmers created the game world, they own the copyright to any version of the world, even one modified by the player during normal game play.[268]

Which type, then, does the CAD file fit under? CAD files seem to fit more easily into the computer-generated work mold, as the CAD file code does nothing more than describe the geometry of the user-created model.[269] In this capacity, the user authors the code, as the code is unique to that specific user-created work.[270] Additionally, unlike video games, opening a CAD program creates a "blank slate," without a model, whereas the video game recreates substantially the same world every time.[271] Thus, a CAD file is more readily defined as a computer-generated work.

Alternatively, the file may be viewed as a digital model or sculpture, which will receive pictorial or sculptural work protection.[272] Under this view, the CAD file is very similar to a photograph tak-

263. *Id.* at 639.
264. *Id.*
265. *Id.* at 640 (citing the findings of *Stern*, 669 F.2d 852).
266. *Stern*, 669 F.2d at 856.
267. *Id.*
268. *See id.*
269. *See The StL Format, supra* note 49.
270. *Id.*
271. *Id.*
272. *See* 17 U.S.C. § 102.

en with a digital camera. As the picture is taken, the scene in the photo is converted into computer code and stored.[273] The photo may then be displayed at will by the user.[274] Digital photos have received copyright protection for the photographic image depicted, because copyright protection extends to "original works of authorship fixed in any tangible medium of expression, now known or later developed, from which they can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device."[275] Thus, like a digital photo, a CAD file should receive copyright protection, because a 3D CAD file is not created for the code contained in the file, but for the work that it depicts when displayed.[276]

Just as the digital photo is a new tangible medium for photographic images, CAD files are a tangible new medium for technical drawings. For example, in the modern design process, the CAD file has replaced the technical design drawing.[277] Previously, reducing the 3D representation to a 2D drawing was necessary to have the part manufactured.[278] However, a CAD file contains the technical information needed to create and display the model.[279] This allows current 3D printers and CNC (Computer Numerical Control) machines to produce the part directly from the 3D CAD model.[280]

Existing in a variety of formats, CAD files all use some type of computer code to store the information necessary to display or

273. Karim Nice, Tracy V. Wilson & Gerald Gurevich, How Digital Cameras Work, HOW STUFF WORKS, http://electronics.howstuffworks.com/cameras-photography/digital/digital-camera.htm (last visited Sept. 21, 2014).

274. *Id.*

275. 17 U.S.C. § 102. *See also* Ronald H. Brown Intellectual Property and the National Information Infrastructure: The Report of the Working Group on Intellectual Property Rights (1995), http://www.uspto.gov/web/offices/com/doc/ipnii/ipnii.txt.

276. *See* 17 U.S.C. §102.

277. *See Engineering Design*, *supra* note 155.

278. *See* Hirata, *supra* note 19.

279. Excell, *supra* note 48.

280. Haresh Khemani, *What is the CNC Machine? How CNC Machine Works?*, BRIGHT HUB ENG'G (Nov. 13, 2009), http://www.brighthubengineering.com/manufacturing-technology/55787-what-is-the-cnc-machine-how-cnc-machine-works/.

produce the represented model.[281] The first variety, 2D CAD files, are digital versions of 2D technical drawings (i.e. blueprints).[282] These CAD files are essentially projections of a 3D object onto a 2D plane, with all dimensional information added as text.[283] For example, a technical drawing for a disc would contain a top view of the disc, with the radius indicated, and a side view of the disc with the thickness indicated. The manufacturer would then read these dimensions and produce the part as specified.[284]

In contrast to 2D CAD files, 3D CAD files display a three-dimensional model of the represented part, and contain all surface geometry information (i.e. dimensions).[285] Unlike the 2D CAD file, the 3D file is not in the traditional technical drawing format and is more like a digital sculpture than a 2D drawing or photograph.[286] It achieves this by visually depicting the represented part as a three-dimensional object, rather than a two-dimensional projection.[287] Thus, the represented part may be viewed as it will appear in its physical form.[288] However, like technical drawings, the 3D file contains all necessary information to create the part.[289] Therefore, by combining the technical information with a true to life representation, the 3D CAD file is best described as a three-dimensional technical model.

In addition, court cases have found that the purpose of the work is irrelevant, as long as it meets the thresholds for copyright eligibility, which, when combined with a 3D CAD file being a three-

281. *See Engineering Software- CAD, CAM, FEA-CAD Software Programs: Types of CAD,* ENGINEER'S HANDBOOK, http://engineershandbook.com/Software/cad2.htm#3dp (last visited May 3, 2014).

282. *See* DAVID A. MADSEN & DAVID P. MADSEN, ENGINEERING DRAWING & DESIGN 4 (5th ed. 2012), available at, http://books.google.com/books?id=qdtJDEPZrrkC&pg=PA2#v=onepage&q&f=false.

283. *Id.* at 78-79 (describing a solid model generally).

284. Khemani, *supra* note 280.

285. *See Engineering Software- CAD*, *supra* note 281.

286. *See* MADSEN, *supra* note 282.

287. *Contra* MADSEN, *supra* note 282 *and* Engineering Software- CAD, *supra* note 281.

288. *See* Engineering Software- CAD, *supra* note 281.

289. Excell, *supra* note 48.

dimensional technical model, point towards 3D CAD files being treated as graphical works.[290] This is further bolstered by the inclusion of "technical drawings, diagrams, and models" in the Copyright Act,[291] and under the *MAI* doctrine, the temporary versions of the CAD file used by the printer are potentially infringing copies.[292] Taken together, these court findings, statutory law, and doctrines imply that the law was not meant to be confined to technology as it existed in at the time of the Act's implementation, but is meant to be flexible to embrace the progress of technology.[293] Thus, as the form of the industry's technical drawings has changed, so too should the law change to embrace the new form.

However, the CAD file does more than just depict the part. It also contains all the code necessary to display or create the part using a computer.[294] If a CAD file has a design component and a computer program component, both of which are copyrightable, how should it be treated? One suggestion is to form a composite test for CAD files, which examines each component separately.[295] Another is to extend copyright protection to the CAD file, as a whole, if either component receives copyright protection.[296] Of the two, the latter is easier to implement, and allows copyright law to

290. 17 U.S.C. § 101 (2012); *See* Schrock v. Learning Curve Int'l, Inc., 586 F.3d 513, 520 (7th Cir. 2009) ("The purpose of the photographs, however, is irrelevant."); Bleistein v. Donaldson Lithographing Co., 188 U.S. 239, 251-52, 23 S.Ct. 298, 47 L.Ed. 460 (1903); SHL Imaging, Inc. v. Artisan House, Inc., 117 F. Supp. 2d 301, 311 (S.D.N.Y. 2000) ("That the photographs were intended solely for commercial use has no bearing on their protectibility.").

291. *See* 17 U.S.C. § 101.

292. *See* MAI Sys. Corp. v. Peak Computer, Inc., 991 F.2d 511 (9th Cir. 1993) (finding copies loaded into RAM were sufficiently permanent to constitute "copying"). *But see* Cartoon Network LP, v. CSC Holdings, Inc., 536 F.3d 121, 127–30 (2d Cir. 2008) (distinguishing *MAI* for very short term copies stored in a buffer).

293. *See generally, id.*

294. See *How to check your .stl files before 3d printing them,* 3dfizz (Aug. 5, 2013), http://3dfizzr.wordpress.com/2013/08/05/how-to-check-you-stl-files-before-3d-printing-them/.

295. *See* Dolinsky, *supra* note 3, at 642-54 (describing and examining the copyrightability of the design, code, and whether the "expression has merged with the idea").

296. Grimmelmann, *supra* note 254 at 692.

more closely track the changes from digital technology, as it more clearly captures the idea of expressing a work in "any tangible medium."[297] By allowing copyright protection if either component meets the threshold, copyright law will allow protection for new works in new mediums, without the concern of the work being excluded because of the functionality of the technology used to create the work.[298]

2. 3D CAD Files and Copyright Law Thresholds

While the Copyright Act gives broad protection to literary, pictorial, graphic, or sculptural works, the other provisions of the Act limit the protection.[299] These limitations exclude from eligibility works that are unoriginal, functional or monopolize an idea, and to receive protection, 3D CAD files must overcome these limitations.[300]

a. Overcoming the Non-Functionality Requirement.

First among these limits is the "useful article" doctrine, which excludes from copyright eligibility "an article having an intrinsic utilitarian function that is not merely to portray the appearance of the article or to convey information."[301] This limitation is meant to exclude from copyright functional items, which are protected under Patent law.[302] In the case of 3D printing, the question becomes whether 3D CAD files are functional, and therefore excluded from copyright protection. The question of functionality itself has two

297. 17 U.S.C. § 102 (2012).
298. *Id.*
299. *Id.* § 101.
300. *Id.* § 102.
301. *Id.* § 101.
302. *See* Chosun, Int'l, Inc. v. Chrisha Creations, Ltd., 413 F.3d 324, 328 (9th Cir. 2005) (noting that functional items are excluded from copyright protection); Traffix Devices, Inc. v. Mktg. Displays, Inc., 532 U.S. 23, 29–30 (2001) (holding that where trade dress was previously protected under the Patent Act by an expired utility patent, the dress is presumed to stand outside the Lanham Act's scope).

parts, whether the CAD file itself is functional, and whether the part it represents functional.

The CAD file itself is functional, but the functionality is incidental to the representation.[303] Functionally, CAD files act as virtual representations of real objects, from which real objects can be created using the included geometrical information.[304] Similarly, technical or architectural drawings represent a physical object in a 2D drawing, with the information necessary to reproduce the represented object (i.e. blueprints).[305] Under current copyright law, technical drawings are accorded copyright protection as pictorial works.[306] However, copyright protection for technical drawings does not extend to the functional aspects of the part underlying the drawing.[307] Thus, a 3D CAD file, like a 2D technical drawing, is non-functional as a representation of the part, regardless of whether the part itself is functional.

The determination of whether the underlying part is functional is made using the traditional functionality tests as applied to sculptural works.[308] Under the traditional tests, "'useful articles,' taken as a whole are not eligible for copyright protection, unless individual design elements, viewed separately, meet the Copyright Act's requirements."[309] Specifically, if a useful article incorporates a design element that is physically or conceptually separable from the underlying part, the element is eligible for copyright protection.[310] For example, the general shape of a lamp, i.e. the light bulb, switch, and base stand, is not copyrightable, because "its overall shape contributes to its ability to illuminate a room."[311] However, fanciful designs on the lamp's base stand are copyrightable, "so

303. *See infra* Part IV.C.ii.1 (explaining the functionality of a CAD file).

304. Excell, *supra* note 48.

305. *See supra* Part IV.C.i (explaining the use of CAD files in the modern design process).

306. 17 U.S.C. § 101 (2012).

307. *Id.*; *see also* H.R. REP NO. 94-1476, at 5667 (1976) (stating that works of "artistic craftsmanship" are not protected by the Act where their utilitarian aspects are concerned).

308. *See* Mazer v. Stein, 347 U.S. 201 (1954).

309. *Chosun*, 413 F. 2d at 328.

310. *See* 17 U.S.C. §101.

311. *Chosun*, 413 F.3d at 328; *see also Mazer*, 347 U.S. 201.

long as the designs are unrelated to the lamp's utilitarian function as a device used" to light up a room.[312] Thus, a base stand in the shape of a person is copyrightable, but the protection only extends to base stands in the form of a person, not all base stands.[313]

In the case of 3D CAD files, as in technical drawings, the functionality of the part should be treated separately from that of the underlying part.[314] By doing so the court can consider the copyrightability of the file as a digital expression of the underlying work and consider the extent to which the CAD file protects the ornamental, non-functional aspects of the underlying work using the traditional tests.[315] Separating the underlying work allows the court to more easily apply the traditional "useful article" doctrine directly to the work without needing to consider the incidental functionality of the CAD file itself.[316] Therefore, it would be to the court's benefit to treat a 3D CAD file as a technical drawing. However, even if non-functional, the 3D CAD file must still meet the originality threshold of copyright law to gain protection.[317]

b. Overcoming the Originality Requirement.

The next hurdle to overcome is whether a CAD file has enough originality to be copyrighted. Under current copyright doctrine, "[o]riginal . . . means only that the work was independently created by the author (as opposed to copied from other works), and that it possesses at least some minimal degree of creativity."[318] In the context of 3D CAD files, the most important case on originality is *Meshwerks v. Toyota*, which held that 3D models created using scans of Toyota vehicles lacked sufficient creativity to be copy-

312. *See id.*

313. *See Mazer*, 347 U.S. 201.

314. *See* Forest River, Inc. v. Heartland Recreational Vehicles, LLC, 753 F. Supp. 2d 753, 760 (N.D. Ind. 2010) (considering the technical drawing separately from the recreational vehicle).

315. *See id.*

316. *See id.*

317. *See* 17 U.S.C. §101; *Id,*

318. *Feist*, 499 U.S. at 345.

righted.[319] The court in *Meshwerks*, reasoned that because the models were copied from the real vehicles in exacting detail, the works were not creative.[320] In this respect, the court was correct: a scanned model lacks originality because it is just a copy, in the same way that a photocopy of a book usually lacks the creativity of the original.[321] However, there is a distinction between a scanned model, which is a copy, and one created during the design process, which is an original.

A scanned model is just that. Using lasers, or other measuring devices, a map of the surface of a given object is created, by creating data points for each surface feature.[322] Once the data points are collected, a mesh is created by connecting each point with a line, which approximately represents the surface of the part.[323] Meshes are then created of the object from several angles, and are then combined to create the final 3D representation of the surface.[324] This process can be completed with almost no human intervention and the final model is a close copy of the original.[325] By being almost completely automatic, the scanning process is unlikely to be considered original because no creativity is required.[326]

However, not all 3D models are created this way in the design process.[327] The original models are generally the first representation of the part to be created by the engineers.[328] For example, consider the design process for a paperclip.

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319. Meshwerks, Inc. v. Toyota Motor Sales U.S.A., Inc., 528 F.3d 1258, 1260 (10th Cir. 2008).

320. *See id.* at 1267.

321. *See id.* at 1267

322. University of Michigan, *How Does It Work?: 3D Laser Scanner*, UNIVERSITY OF MICHIGAN 3D LAB (2012), http://um3d.dc.umich.edu/portfolio/how-it-works-scan/.

323. *Id.*

324. *Id.*

325. *See id.*

326. *See Meshwerks*, 528 F.3d at 1260.

327. Sayyed Khandani, *Engineering Design Process,* INDUSTRY INITIATIVES FOR SCIENCE AND MATH EDUCATION (IISME), 6 (August 2005), http://www.saylor.org/site/wp-content/uploads/2012/09/ME101-4.1-Engineering-Design-Process.pdf.

328. *See id.*

The first step in the design process is determining the intended use of the paperclip.[329] For this example, the clip is meant to hold several sheets of paper together, without damaging them. Next, the design of the clip must be decided upon.[330] To do this the engineers will run simulations by creating models.[331] To do so, they need a model of a proposed paperclip. To create this model, the engineer must conceptualize a design and then create a representation of it using a computer 3D CAD modeling program.[332] This step is substantially the same process as creating any digital 3D artwork.[333]

After creating the model, a simulation is created by subjecting the model to the expected operating conditions.[334] After running the simulation, the engineers modify the paperclip design as needed, until the design meets their criteria.[335] Once the design is finalized, a technical drawing may be created from the CAD model.[336] Then the paperclip is manufactured as described by the drawing or, using 3D printing, directly from the model, without the use of a technical drawing.[337] This design process can be used to manufacture anything from simple items, like paperclips, to complex ones, like aircraft carriers.[338]

Unlike a scanned 3D model file, a 3D model created in the design process requires creativity, first in conceptualizing the design and again in rendering a model of the design.[339] By requiring this level of creativity, the designed CAD file is certain to meet the

329. *See id.*

330. *See id.* at 11.

331. *See id.* (test and implement solution).

332. *See id.* (generate multiple solutions).

333. *See How to Apply 3D Printing to Create Bronze Sculpture,* instructables, http://www.instructables.com/id/How-to-Apply-3D-Printing-to-Create-Bronze-Sculptur/.

334. *See id.* at 20 (test and implement solution).

335. *See id.*

336. *See* Khandani, *supra* note 327 at 21.

337. *See id; supra* Part II (describing 3D printing technology).

338. *See, Design,* Gerald R. Ford (CVN 78), http://www.thefordclass.com/design.html (last visited Sept. 21, 2014) (describing the design of the newest generation of aircraft carriers).

339. *See supra* Part C.ii.2.

"minimal degree" of creativity required for copyright protection.[340] However, copyright protection does not extend to the ideas underlying the work.[341]

c. Overcoming the Merger Doctrine.

The Copyright Act denies copyright protection to the ideas embodied in a copyrighted work.[342] It specifically excludes "any idea, procedure, process, system, method of operation, concept, principle, or discovery, regardless of the form in which it is described, explained, illustrated, or embodied."[343] In addition to this principle, courts have "produced a corollary maxim that even expression is not protected in those instances where there is only one or so few ways of expressing an idea that protection of the expression would effectively accord protection to the idea itself."[344] This corollary maxim is the known as the "merger doctrine," and is meant to prevent an author from monopolizing the underlying idea of an expression using a copyright.[345] Thus, a court will deny copyright protection if it finds the merger doctrine applies.[346]

The courts have created a variety of ways to apply the merger doctrine,[347] but all generally work as follows. To apply the merger doctrine, the court must first determine the idea underlying the expression.[348] The idea may be identified at differing levels of abstraction.[349] For example, is the idea a lamp or a lamp shaped like the Statue of Liberty? Depending on the level of abstraction, the idea may be lamp for a high level of abstraction or it may be a

340. *Feist,* 499 U.S. at 346.
341. 17 U.S.C. § 102(b) (2012).
342. *Id.*
343. *Id.*
344. Kregos v. Associated Press, 937 F.2d 700, 705 (2d Cir. 1991).
345. *Id.*
346. *Id.*
347. *See* Educ. Testing Servs. v. Katzman, 793 F.2d 533 (3d Cir. 1986); Apple Computer, Inc. v. Franklin Computer Corp., 714 F.2d 1240 (3d Cir. 1983); Nichols v. Universal Pictures Corp., 45 F.2d 119 (2d Cir. 1930).
348. *See id.*
349. *Nichols,* 45 F.2d 119.

lamp shaped like the Statue of Liberty at a low level of abstraction.[350]

Once the idea is identified, the court determines the number of possible expressions of the idea and examines the practicality of producing the expressions.[351] Based upon the number of available expressions and the difficulty of making each one, the court will determine whether the merger doctrine applies.[352] If the doctrine applies, then the court will deny copyright protection to the disputed work.[353] Thus, if there are many ways to express the idea and the expressions are easy to make, then the court is unlikely to find the merger doctrine applies.[354] If, however, there is only one or two ways to express the idea, the court will find that the expression has merged into the idea and the merger doctrine applies.[355]

The merger doctrine is a particular concern when attempting to copyright the ornamental aspects of a functional work.[356] In this situation, the copyrighted aspect of the work may be non-functional and original, but it may be the only practical way to produce the work.[357] In this case, the idea is considered to have "merged" with the expression.[358]

However, this is less of a concern with 3D printing. 3D printing allows for almost any shape to be created.[359] In turn, this makes features that previously would have been impractical to make, not only possible, but also simple to manufacture.[360] By expanding the number of possible designs, 3D printing reduces the chance that a work will monopolize the underlying idea.[361]

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350. *See* Computer Associates v. Altai, 982 F,2d 693, 706-7 (2d. Cir. 1992) (explaining the abstraction-filtration test).

351. *See Apple Computer,* 714 F.2d at 1253.

352. *Id.* at 1253.

353. *See Kregos*, at 705.

354. *See Apple Computer,* 714 F. 2d at 1253-4.

355. *See id.*

356. *See Mazer* 374 U.S.

357. *See Apple Computer,* 714 F. 2d at 1253-4.

358. *See id.*

359. *See 3D printing: helping to shape the future of gas turbine*, *supra* note 32.

360. *Id.*

361. *See Apple Computer,* 714 F. 2d at 1253.

Additionally, by applying the merger doctrine to the CAD files, the courts would be going against the rationale behind the merger doctrine.[362] Under current doctrines, copyright law is meant to protect expressive works, and patent law is meant to protect functional ideas.[363] In the case of a "merger," the underlying idea is indistinguishable from the expression of the idea.[364] However, in the case of a patented product, the underlying innovation (idea)[365] is protected by a patent.[366] So, while copyright law does not allow a copyrighted work to protect the underlying idea, in this case it would not have to.

The copyright would protect the 3D CAD file as an expression of the patented part, and the patent itself would protect the underlying idea, as expressed in the invention. Therefore, during the patent term, the patent would prevent others from copying the idea and the copyright would protect the digital expression of the idea.[367] The dual protection upholds the rationale behind the merger doctrine, because no one can access the idea without the permission of the patentee during the patent term, which makes the application of the merger doctrine unnecessary, because the "monopoly on an idea," with which the merger doctrine is concerned, already exists in the form of a patent.[368] Thus, during the patent

362. *See generally; Mazer,* 375 U.S.; *Apple Computer,* 714 F.2d at 1253; *Nichols,* 45 F.2d.

363. Crume v. Pac. Mut. Life Ins. Co., 140 F.2d 182, 184 (7th Cir. 1944) (stating that "[t]he object of [copyrights] is explanation, the object of [patents] is use.).

364. *See Kregos,* 937 F.2d at 705

365. To be clear, a patent does not protect an idea as an idea, the idea must be embodied in an innovation. Then, the patent protects the disclosed embodiment and any others claimed in the patent. Thus, a broadly written patent may monopolize an idea by claiming every possible embodiment of the idea and in effect monopolize the idea itself.

366. 35 U.S.C. §§ 101-3, 271 (2011).

367. 17 U.S.C. Chapt. 1 (2010); 35 US.C. Part III (2012)

368. Herbert Rosenthal Jewelry Corp. v. Kalpakian, 446 F.2d 738, 742 (9th Cir. 1971) (reasoning that "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"); *See also* Baker v. Selden, 101 U.S. 99, 103 (1879)

term, allowing copyright protection for the expression of the patent part does not take anything from the public, as the public does not yet have access to the idea expressed.[369]

For example, there are many ways to create a lamp. All that is required is a base with a light source attached to the top of the base. The base with attached light source is the idea underlying the lamp. All variations of the shape, style, or color of the light or base are just expressions of this basic idea. If someone owns a patent on a lamp, that is, any light source attached to the top of a base, every expression of the lamp falls within the scope of the patent.[370] Even though anyone who manufactured a lamp they designed would own the copyright to that expression of a lamp, they would still infringe the patent, because it grants a monopoly over the idea underlying the expression.[371] Thus, allowing the patentee to copyright all expressions of the lamp covered by the patent during the patent term would not reduce the public's access to lamps, as the patentee already has a monopoly on this access.[372]

In reality, the merger doctrine would not apply, because so many variations of the lamp exist, but what if there were only a few ways to design a lamp? Then the merger doctrine would apply, because of the limited number of expressions, but would making the designs un-copyrightable further benefit anyone? Clearly, it would not, until the end of the patent term, because the patent, regardless of copyright protection, covers all lamps.[373]

Once the patent expires, however, the rationale behind the merger doctrine applies, because the patent no longer grants a monopoly on the idea underlying the expression.[374] The courts could then evaluate the CAD file under the merger doctrine and strip it of copyright protection, if it violates the merger doctrine.[375]

(reasoning that "[i]f he desires to acquire such exclusive right, he must obtain a patent" as his copyright only protects the book expressing the idea).

369. *See id.*

370. *See* 35 U.S.C. Part III (2012).

371. *See id.*

372. *See id.*

373. *Id.*

374. *Id.*

375. *See Kalpakian*, 446 F.2d at 742.

While the copyright act excludes works that are unoriginal, functional, or monopolize an idea, 3D CAD files are unlikely to be excluded by these limitations.[376] First, CAD files are non-functional expressions of the underlying work, similar to a technical drawing.[377] Second, creating the CAD files requires some degree of creativity, satisfying the originality requirement.[378] Finally, the nature of 3D printing reduces the likelihood of the there being so few ways to express something that the idea merges with the expression, and in the cases where it does not, the merger doctrine should not apply.[379] Since CAD files are likely to receive copyright protection, the next question becomes how much protection?

3. Scope of Copyright Protection

How much protection will 3D CAD models receive if copyrights only protect the original, non-functional aspects of the work?[380] The Copyright Act confers several rights to copyright owners, including the right of reproduction and right to create derivative works.[381] These rights allow the copyright holder to control creation of copies of the CAD file and control the creation of variants, or derivative works.[382]

Between the right of reproduction and the right to control derivative works, the copyright holders of the rights to 3D CAD files have considerable protection against infringement.[383] It is conceivable that almost any variation of the model embodied in the 3D

376. *See supra* Part C.ii.3.

377. *Supra* Part IV.C.ii.1 (discussing the functionality of CAD files).

378. *Supra* Part IV.C.ii.2 (discussing the CAD files and originality).

379. *Supra* Part IV.C.ii.3 (discussing the merger doctrine).

380. 17 U.S.C. § 101 (2012).

381. 17 U.S.C. § 106 (2012) ("Subject to sections 107 through 122, the owner of copyright under this title has the exclusive rights to do and to authorize any of the following: **(1)** to reproduce the copyrighted work in copies or phonorecords; **(2)** to prepare derivative works based upon the copyrighted work.")

382. *See id.*

383. *See id.*

CAD file will be considered as either a reproduction or a derivative work.[384]

For example, in the case of "scanning" or otherwise copying a physical object to create a 3D CAD file, the copyrighted model is substantially similar to the resultant part.[385] When scanning a part, the resulting CAD file is virtually identical to the physical object, which in turn, is nearly identical to the copyrighted CAD file, making the two CAD files virtually identical.[386] Additionally, if the infringing model were used to create more physical objects, then those objects created from the scanned file of the part would also infringe the copyright as a reproduction.[387]

Alternatively, if the copied CAD file is not identical to the original, it may still violate the right of reproduction as a derivative work.[388] The Copyright Act defines a derivative work as "a work based upon one or more preexisting works, such as a translation, musical arrangement, dramatization, fictionalization, motion picture version, sound recording, art reproduction, abridgment, condensation, or any other form in which a work may be recast, transformed, or adapted."[389] Based upon the statutory definition, a derivative work must add new expressive elements and serve different markets from the original work.[390] Additionally, courts have found that the Copyright Act permits a broad construction of infringing derivative works.[391] However, the courts have limited the breadth of derivative works by requiring a derivative work to incorporate a protected work in some concrete or permanent form.[392] Even if it must include some of the original design, the scope of protection for a 3D CAD file is likely to be broad, because any

384. *See id.*

385. *See* Mack, *supra* note 45.

386. *See supra* Part C.ii.2.

387. *See id.*; 17 U.S.C. § 106.

388. 17 U.S.C. § 106 (2012).

389. 17 U.S.C. § 101 (2012).

390. Paul Goldstein, *Derivative Rights and Derivative Works in Copyright*, 30 J. COPYRIGHT SOC'Y U.S.A. 209, (1983).

391. *See* Micro Star v. Formgen Inc., 154 F.3d 1107, 1109 (9th Cir. 1998).

392. Lewis Galoob Toys, Inc. v. Nintendo of Am., Inc., 964 F.2d 965, 969 (9th Cir. 1992).

minor variations are likely to be derivative works.[393] In these cases, minor variations in the design could be considered as adding new expressive elements to the original work, thus making them derivative works.[394]

As an added benefit, these rights preclude someone other than the copyright holder from creating CAD files of a copyrighted physical object. This is for the simple reason that the 3D CAD file needed to create the object is likely to be either a reproduction or a derivative work, because it expresses the same work or a variation of it in a new medium.[395] Even if the CAD file is not a derivative work or copy, someone else obtaining the copyright is unlikely, because as a copy of the object, the 3D CAD file would likely lack the originality required to obtain a copyright.[396] Even if it met the originality requirement, most modern manufacturing methods use a CAD file in the design process, so the copyright holder should already have a CAD file of the object.[397] Therefore, it is unlikely that someone other than the patentee could obtain a copyright on a patented part.

Together, with the inherent copyrightability of 3D CAD files, these rights give broad protection to the expressive aspects of 3D CAD files. However, the idea underlying the part from which the CAD file is created is not protected by copyrights. To protect these ideas, patent protection is necessary. Thus, both types of protection are needed for enhanced protection.

D. Alternative Forms of protection

The proposed solution is not the only way to stop the online sharing of CAD files. Other potential solutions including sui generis protection, licensing, contributory infringement, or lawsuits against individual infringers exist and could offer some protection.

393. 17 U.S.C. § 106; Goldstein, *supra* note 390.

394. *See id.*

395. *See id.*

396. *Supra* Part IV.C.ii.2 (discussing the originality requirement for CAD files).

397. *See Engineering Design, supra* note 155.

These solutions however, require rewriting existing law, burdensome changes to company practices, or expensive litigation.

1. Sui Generis Protection

One possible form of protection is for Congress to create special rules just for 3D printing. To do so, Congress could extend a type of *sui generis*, or unique, protection to the 3D CAD files of patented parts. S*ui generis* protection is not unheard of in U.S. law, though it is more common in European law.[398] The most notable U.S. *sui generis* law is the Semiconductor Chip Protection Act, which extends copyright like protection to some functional aspects of chip design.[399] The Act is meant to encourage investment in the development of chip technology by granting a form of *sui generis* protection specifically tailored to the needs of the semi-conductor industry.[400]

In particular, it extends protection to "mask works," which are a series of related patterns etched into or added onto the surface of the semiconductor chip.[401] The "mask" is essentially a stencil used to create a pattern on the surface of the chip by either adding or removing material.[402] Thus the masking process is a relatively straightforward application of the stencil when it is needed.[403] However, the patterns created by the stencil require extensive research to develop, making protection useful in incentivizing their creation.[404]

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398. Richard H. Stern, *Chapter 13: Sui Generis Protection of Software,* GEORGE WASHINGTON UNIVERSITY LAW SCHOOL: CASES AND MATERIALS, 6, *http://docs.law.gwu.edu/facweb/claw/ch-13.htm* (last visited Nov. 22, 2014).

399. 17 U.S.C. § 902 (2005); *See also* Stern, *supra* note 398.

400. Stern, *supra* note 398.

401. 17 U.S.C. § 901 (1984).

402. Intel Corporation, *Microprocessor Chip Mask*, INTEL TEACH PROGRAM, available at, http://www.intel.com/content/dam/www/program/education/us/en/documents/the-journery-inside/microprocessor/mp-chipmask.pdf (last visited May, 4, 2014).

403. *Id.* (this may be something of an oversimplification).

404. *See generally* Holger Sailer & Jorg Butschke, Institut fur Mikroelektronik Stuttgart, *IMS CHIPS Photo Mask Technology: Overview and Classification*, http://www.ims-

Unlike traditional patents, which require novelty, the mask work only needs to be original, and not a staple of the industry.[405] Like other parts of the Copyright Act, the protection does not extend to the underlying idea.[406] However, the duration of the protection is only ten years, making it shorter than both patents and copyrights.[407] While not as expansive as general copyrights, this form of protection helps to fill the gap between patent and copyright law by allowing protection of both the function and expression of a semiconductor mask.

A similar type of protection could be made in the copyright law pertaining to 3D CAD files, which represent a patented part. Under the new protection, the 3D CAD representation of the part could have copyright-like protection, free from the constraints of the merger doctrine, until the end of the patent term. After the end of the protection term, the CAD file could either automatically lose protection, or be subject to the constraints of the merger doctrine.

While this type of protection is attractive, being tailored to a specific technology, it requires enactment by Congress. Without extensive, and expensive, lobbying it is unlikely that Congress will create this type of protection for the 3D printing industry.[408] Even if they do consider protection, it may be years before any meaningful action is taken.

2. Protection Using Licenses

Licenses are another potential way for the protection of intellectual property rights. By contracting between themselves, private parties can arrange for temporary and limited access to one another's property. [409] However, for licensing to be effective the licen-

chips.de/content/pdftext/IMS%20CHIPS%20Photo%20Mask%20Technology.pdf (last visited May, 4, 2014).

405. 17 U.S.C. § 902(b).

406. 17 U.S.C. § 902(c).

407. 17 U.S.C. § 904 (1984).

408. Lee Hamilton, *You Need to Understand Lobbying,* The Center on Congress, http://www.centeroncongress.org/you-need-understand-lobbying (last visited Nov. 23, 2014).

409. JOSEPH WILLIAM SINGER, PROPERTY LAW RULES, POLICIES AND PRACTICES 425 (5th ed. 2010).

sor must "own" an exclusive right to license.[410] This stems from the notion that one cannot give access to something that they do not own.[411] In the case of both copyrights and patents, the rights holder "owns" the rights and may control access via a license.[412]

As an added benefit, the protection can be extended to products owned by the manufacturer, but not fully protected under either patents or copyrights. Computer software is a good example of this, as the process is unlikely to be patentable and only the code as written is protected by copyrights.[413] In most cases, computer software includes a license, which must be agreed to before the software may be used, even if the entire program is neither copyrighted nor patented. [414] Protection by licensing requires both a license agreement to be included with the product and the assent of the purchaser to the terms of the agreement.[415] If extended to cover physical goods or CAD files, licenses may not be well received, as consumers are not accustomed to having use restrictions on physical goods.[416] In addition, creating licensees for physical goods would be expensive to implement.[417] Additionally, consumers generally do not read the agreements, and being unaware of the terms, are unlikely to follow them.[418]

Should a company wish to enforce the license, the consumers must be taken to court or arbitration.[419] In addition to the normal

410. *Id.*

411. *See* Gilliam v. Am. Broad. Companies, Inc., 538 F.2d 14, 21 (2d Cir. 1976).

412. *See generally 17 U.S.C. § 201-205; 35 U.S.C. § 261 (2013).*

413. *See Apple Computer,* 714 F. 2d.

414. *See Vangie Beal, EULA - End-User License Agreement,* Webopedia, http://www.webopedia.com/TERM/E/EULA.html; *See also* Brian W. Carver, *Why License Agreements Do Not Control Copy Ownership: First Sales and Essential Copies*, 25 BERKELEY TECH. L.J. 1887, 1889 (2010).

415. MICHAEL D.SCOTT, SCOTT ON INFORMATION TECHNOLOGY LAW §12.03 (3rd ed. 2014).

416. *See* Rainer Bohme, *et al., Trained to accept?* (2010) http://dl.acm.org/citation.cfm?doid=1753326.1753689.

417. *See id.*

418. Jeff Sauro, *Do Users Read License Agreements?,* Measuring Usability, Jan 11, 2011, http://www.measuringusability.com/blog/eula.php.

419. *See* David L. Hayes, *The Enforceability of Shrinkwrap License Agreements On-line and Off-line*, 1 No. 7 CYBERSPACE LAW. 5 (1996).

problems associated with bringing suit, companies must also ensure that the license terms are enforceable.[420] Unlike statutory rights, the terms of the license may be considered invalid if the terms do not conform with local laws.[421] This makes it difficult to accurately predict the outcome of an enforcement suit.[422] For all these reasons, the use of licenses to broaden the scope of patent protection against 3D printing can be problematic.

3. Lawsuits against Individual Infringers

Alternatively, companies may sue infringers directly. However, suing an individual infringer gives rise to many challenges.[423] First, the infringers may be difficult to locate.[424] Second, the files are widespread and easy to access.[425] Third, the cost of the suit is likely much higher than the damages received from these individual infringers.[426] Finally, suing customers can badly damage a company's brand and reputation.[427]

Infringers, in most cases, will be difficult to locate, as they may be protected by several layers of anonymity.[428] For example, the rights holder will often have to find out which users are downloading the file, file papers with a court to subpoena the ISP, request

420. *Id.* at 10.

421. Hayes, *supra* note 419; *See also* Con Zymaris, *A Comparison of the GPL and the Microsoft EULA*, 27, Cybersource (May 5, 2003), http://asyd.net/docs/misc/comparing_the_gpl_to_eula.pdf (last visited May 4, 2014).

422. *See generally* Scott, *supra* note 415 (discussing the utility of various software license types).

423. *See* Kim Natividad, *Stepping It Up and Taking It to the Streets: Changing Civil & Criminal Copyright Enforcement Tactics*, 23 BERKELEY TECH. L.J. 469 (2008).

424. *Id.* at 472.

425. *See, The Pirate Bay*, www.thepiratebay.se/music (illustrates the ease of finding popular music to download).

426. *See,* Natividad, *supra,* note 423 at 478..

427. *Id* at 477.

428. *See id.* at 472 (illustrating one layer of anonymity); *See Tor: Overview*, https://www.torproject.org/about/overview.html.en (last visited Nov. 22, 2014) (illustrating multiple layers of anonymity on the internet).

the IP address from the ISP, then find the user.[429] Finally, the rights holder must show the litigant infringed the copyright or the patent by copying, making, using, or selling the part.[430] This makes bringing suit an unattractive and expensive proposition.[431] In addition, in the case of patent infringement, the infringer is likely to have only made a few parts, which would reduce the amount of damages that can be received to a minimal sum.[432]

Another obstacle is the availability of the files.[433] Even if the rights holder prevails in a lawsuit and obtains an injunction against one infringer, others will quickly appear.[434] This can make lawsuits something like a "whack a mole" game, where a replacement appears as soon as one files disappears. Even the DMCA has a limited impact on the availability of the files, as many of the hosting sites are located outside the United States and thus beyond the reach of is laws.[435]

Damages may have some deterrent effect, but even if the rights holder prevails in a lawsuit and is awarded significant damages, the infringer is unlikely to be wealthy, so any damage award may not be recoverable.[436] Without the ability to collect adequate awards, any lawsuits will be a net loss for the company.[437] Moreover, mass lawsuits against infringers have not significantly stemmed the rate at which music files are shared, nor have they led

429. Sean B. Karunaratne, *The Case Against Combating Bittorrent Piracy Through Mass John Doe Copyright Infringement Lawsuits*, 111 MICH. L. REV. 283, 284-85 (2012).

430. Markman v. Westview Instruments, Inc., 517 U.S. 370, 374 (1996).

431. *See generally* William R. Towns, *U.S. Contingency Fees: A Level Playing Field?*, 1 WIPO Magazine, 3, 3 (2010) (discussing the high cost of patent litigation in the United States).

432. *See The Pirate Bay*, *supra* note 425.

433. *See* Natividad, *supra* note 423.

434. Columbia Pictures Indus., Inc. v. Fung, 710 F.3d 1020, 1028 (9th Cir. 2013) (noting that different torrent sites tend to have largely overlapping collections of torrents).

435. Paul Gil, *The 30 Best Torrent Download sites of 2014*, About.com, http://netforbeginners.about.com/od/peersharing/a/torrent_search.htm (a list of torrent sites) (last visited May 5, 2014).

436. *See* Natividad, *supra* note 423 at 474; RIAA, *supra* note 125 at 4-6.

437. Natividad, *supra* note 423 at 478.

to a decrease in the popularity of the record labels among consumers.[438]

Finally, the infringer may be a customer or prospective customer, whose brand perception may be changed by frequent litigation.[439] This was the case with the RIAA, which created a public backlash with its heavy-handed tactics.[440] In response to online piracy, the recording industry initiated an expansive campaign to stop the digital transfer of music, spearheaded by the Recording Industry Association of America (RIAA).[441] At the height of this campaign, the RIAA initiated thousands of lawsuits, combined with a massive public awareness campaign, which likened sharing music to terrorism.[442] Unfortunately, the campaign was unsuccessful in eliminating copying and sharing of digital music.[443] The failure was in large part due to the difficulties of trying to stem infringement at the individual consumer level.[444]

4. Indirect Infringement

Even if mass lawsuits are unlikely to be effective, other litigation based deterrents are available. Rather than targeting the individual infringers, the patentee may try to target the technology companies, under the theories of vicarious liability, contributory liability, or inducement. By extending liability, the infringer's source of materials, technology, or other support can be cut off.[445] Potentially, this allows the rights holder to stop infringement

438. *RIAA, supra* note 125, at 11.

439. *See id.* at 6-7.

440. *Id.*

441. *Id.* at 3.

442. Nate Anderson, *U.S. Attorney General: Piracy funds Terror*, arstechnica (Mar 31 2008, 1:12 AM), http://arstechnica.com/tech-policy/2008/03/us-attorney-general-piracy-funds-terror/.

443. *RIAA, supra* note 125, at 14.

444. *Id.* at 16.

445. Charles W. Adams, *Indirect Infringement from A Tort Law Perspective*, 42 U. RICH. L. REV. 635, 650 (2008) (". . . the manufacture or sale of the component is not infringing by itself, the component is susceptible to the purchaser's combining it with other components, thereby infringing the patent for the combination.").

through one lawsuit, which could cut off many infringers' abilities to infringe.[446] However, it also has the potential to cut off the access to useful technologies.[447]

a. Vicarious Liability

Under the theory of vicarious liability, the defendant is liable if the defendant had the right and ability to supervise the infringer, and had a direct financial interest in the infringement, even if the defendant had no knowledge of the infringement.[448] However, under the patent law system, courts have generally added a knowledge requirement.[449]

This makes it difficult to show vicarious liability, as the patentee must show control, direct financial interest, and knowledge.[450] The ability to do so is likely to require substantial discovery, which will be slow, difficult, and expensive.[451] Thus, vicarious liability is not an attractive option, as it requires a substantial investment in litigation, which is uncertain to achieve meaningful results.

b. Contributory Liability

Contributory liability is another possible way for a rights holder to try to reduce infringement. Under this theory of liability, "one who, with knowledge of the infringing activity, induces, causes or materially contributes to the infringing conduct of another, may be liable as a 'contributory' infringer."[452] By extending liability to

446. *Id.*

447. *See id.* at 655 ("By excluding the sale of staple articles from the scope of contributory infringement, § 271(c) avoids the abuses of the doctrine of contributory infringement" thus allowing more access to technology).

448. Shapiro, Bernstein & Co. v. H.L. Green Co., 316 F.2d 304, 307 (2d Cir. 1963).

449. Hewlett-Packard Co. v. Bausch & Lomb, 909 F.2d 1464, 1469 (Fed. Cir. 1990); Moba v. Diamond Automation, 325 F.3d 1306, 1318 (Fed. Cir. 2003).

450. *Hewlett-Packard* 909 F.2d at 1469.

451. *See* Natividad, *supra* note 423 at 473-86.

452. Gershwin Publ'g Corp. v. Columbia Artists Mgmt., Inc., 443 F.2d 1159, 1162 (2d Cir. 1071).

one who has knowledge of the infringement and materially contributes, the infringer's source of materials, technology, or other support can be cut off.[453]

The tension between access to useful technology and the protection of rights was most clearly addressed by the Supreme Court in *Sony v. Universal*.[454] In the case, the Court explained that "[t]he sale of copying equipment, like the sale of other articles of commerce, does not constitute contributory infringement if the product is widely used for legitimate, unobjectionable purposes, or, indeed, is merely be capable of substantial non-infringing uses."[455] The effect of the case was to give manufactures a defense against contributory infringement, if their product was capable of substantial non-infringing uses.[456] While *Sony* is a copyright case, the Court imported the "staple article of commerce doctrine" from patent law in creating the above defense.[457] Therefore, the rationale applies to both copyrights and patents.

The case creates barriers that must be overcome if a patentee wishes to reduce infringement by individuals using the theory of contributory infringement against 3D printer manufacturers. To sue a 3D printer manufacturing company under contributory infringement, the patentee would have to show that there was actual infringement, that the 3D printer does not have substantial non-infringing uses, and that the company had knowledge of the infringement.[458]

Alternatively, contributory infringement could be used against companies that print products from user supplied files. The difficulty in suing these companies arises from the knowledge re-

453. Adams, *supra* note 445, at 650 (discussing the staple article doctrine, which allows for more access to technology by limiting Intellectual Property protections on certain goods).

454. Sony v. Universal City Studios, 464 U.S. 417 (1984).

455. *Sony*, 464 U.S. 417, 418 (1984).

456. Veronica Corsaro, *From Betamax to YouTube: How Sony Corporation of America v. Universal City Studios Inc. Could Still Be a Standard for New Technology*, 64 Federal Communications Law Journal 449, 461 (2012).

457. *Sony*, 464 U.S., at 442.

458. *Id.* at 442; 35 U.S.C. § 271 (2010).

quirement of contributory infringement.[459] The patentee must prove that the company knew or should have known the part was patented.[460] This places the burden on the patentee to show actual infringement and knowledge of the infringement, both of which may be difficult.[461] Thus, contributory infringement may be difficult and expensive to show. Contributory infringement, then, may not be an effective solution.

c. Inducement

The third possible way theory of indirect infringement is inducement. The Patent Act provides that "Whoever actively induces infringement of a patent shall be liable as an infringer."[462] To induce infringement the company must do more than merely distribute a component of a patented device, if the component is suitable for use in other ways.[463] The inducing company must be taking active steps to encourage direct infringement.[464] However, if the product is "good for nothing else but infringement," it may be presumed that there is an intent to infringe.[465]

In the case of 3D printing, the patentee must show either that there was active encouragement to infringe or that 3D Printing has only infringing uses. Either will be difficult to prove. The former will likely require significant discovery, and may turn up some incriminating documents, i.e. emails.[466] In contrast, the latter will be almost impossible, because the majority of 3D printing is for industrial manufacturing, and many things can be printed that are not

459. Global-Tech Appliances, Inc. v. SEB S.A., 131 S. Ct. 2060, 2068 (2011).

460. *Id.*

461. *Id.*at 2070 ("a willfully blind defendant is one who takes deliberate actions to avoid confirming a high probability of wrongdoing and who can almost be said to have actually known the critical facts").

462. 35 U.S.C. 271(b) (2010).

463. Metro-Goldwyn-Mayer Studios Inc. v. Grokster, Ltd., 545 U.S. 913, 932 (2005).

464. *Id.* at 936.

465. *Id.* at 932.

466. *See generally Id.* at 922-4 ("internal company documents indicate that StreamCast hoped to attract large numbers of former Napster users").

protected by patents.[467] Therefore, suing under the theory of inducement will be expensive, and not necessarily successful.

Thus, the theories of vicarious liability, contributory liability, and inducement are not well suited to stopping widespread infringement, because each requires a substantial showing by the patentee to create liability.[468] In addition, the cost of protection through using these theories may be the loss of access to a valuable new technology, and any attempts by courts to reduce the burden on the patentee will certainly constrain the free use of 3D printing. Therefore, an alternative solution is required to balance the free use of technology, against the rights of patent holders.

V. CONCLUSION

While the current patent system offers adequate protection against infringement through older manufacturing methods, it was not written with a technology like 3D printing in mind.[469] In order to compensate for these inadequacies, patentees should leverage the copyright protections on 3D CAD files to enhance their protection.[470]

While courts may be reluctant to allow copyright protection for files that monopolize the underlying idea, the unique combination of copyright and patent protection created by the 3D CAD file and the patent already offer a monopoly on the idea. As the idea is effectively already monopolized, the threat of a "merger" of the idea and the expression is less concerning.[471] While there is a discontinuity in duration between the copyright and the patent, this is easily overcome by applying the "merger doctrine" after the expiration of the patent term.[472]

By granting patent owners this type of protection, courts can vastly expand the scope of remedies available to patent owners for

467. *See generally* CSC, Leading Edge Forum, *3D Printing and the Future of Manufacturing,* 9-24 (Fall 2012).

468. *Supra* Part IV.D.iv (discussing indirect infringement).

469. *Supra* Part IV.B.i.

470. *Supra* Part IV.A.

471. *Supra* Part IV.C.ii.3.

472. *Id.*

defending their rights against online piracy.[473] Taking this path also allows for a new technology to flourish, with the potential to create new markets for the rights holders.[474] Failure to adapt current laws could stifle innovation and fuel online piracy, by forcing rights holders to aggressively pursue infringers in expensive and inefficient ways.[475] Thus, unless the legislature acts, courts should expand patent protection to include the 3D CAD files used in the manufacture of the patented product.

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473. *Supra* Part IV.A.

474. *Id.*

475. *Supra* Part III.

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