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ABSTRACT

From lithium-ion batteries to human organs, the boundaries of additive manufacturing innovation are rapidly expanding. Traditionally reserved for industrial applications, additive manufacturing (also known as three-dimensional ("3D") printing) is creeping into mainstream and consumer use. With larger scale adoption comes a significant increase in intellectual property ("IP") disputes among those seeking to benefit from this transformative technology. To survive these inevitable clashes over valuable IP assets, rights holders need to understand the relevant, complex, and rapidly-evolving legal landscape, including its multiple opportunities and pitfalls. This Article reviews the advantages and limitations of legal strategies used to create, protect, attack, and defend stakeholders' IP in this burgeoning field. Specifically, it examines the increasing difficulties faced in seeking protection under current patent laws and doctrines. It further explores how patent, trade secret, copyright, and other IP laws assist and challenge those seeking to prosper from additive manufacturing.

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INTRODUCTION

Additive manufacturing is reimagining how and what objects are made in both commercial and consumer sectors.[1] A widening list of industries from manufacturing, aviation, and life sciences are adopting the technology with increasing frequency.[2] Consumer use also has grown, though at a slower rate.[3] Home users now can fabricate objects traditionally made

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1. *See, e.g.*, David Rotman, *Microscale 3-D Printing*, MIT TECH. REV. (2014), https://www.technologyreview.com/s/526521/microscale-3-d-printing ("A group at Princeton University has printed a bionic ear, combining tissue and electronics . . . while a team of researchers at the University of Cambridge has printed retinal cells to form complex eye tissue . . . . Last year, Lewis and her students showed they could print the microscopic electrodes and other components needed for tiny lithium ion batteries."); *see also* Ke Sun et al., *3D Printing of Interdigitated Li-Ion Microbattery Architectures*, 25 ADVANCED MATERIALS 4539 (2013) (discussing the procedure and specifications for 3D printing Li-ion microbatteries).

2. *See* Lyndsey Gilpin, *3D Printing: 10 Companies Using It in Ground-Breaking Ways*, TECHREPUBLIC (Mar. 26, 2014, 4:00 A.M.), http://www.techrepublic.com/article/3d-printing-10-companies-using-it-in-ground-breaking-ways/; Rotman, *supra* note 1.

3. *Gartner: 3D Printing to Result in $100 Billion IP Losses per Year*, 3DERS.ORG (Oct. 14, 2013), http://www.3ders.org/articles/20131014-gartner-3d-printing-to-result-in-100-billion-ip-losses-per-year.html (implying how, due to the high price, most 3D printers are currently being used by industrial companies, and stating that the consumer market for additive manufacturing is starting to grow as the price of 3D printers is dropping).

in factories.[4] Just in the last decade, those engaged in additive manufacturing filed more than 6,800 patent applications with the U.S. Patent and Trademark Office ("PTO").[5] Expiring patents, cheaper components, open-source software, and robotics play significant roles in fueling this technology explosion.[6]

This revolutionary manufacturing innovation drastically reduces time and costs associated with practically all traditional production processes, including prototyping, mold and die creation, milling, lathing, assembly, and shipping.[7] While lacking the mass volume capabilities of traditional manufacturing, additive manufacturing's mass customization provides new dimensions to product development and fabrication.[8]

As additive manufacturing continues to invade the research and development process and traditional manufacturing, more and cheaper supply chains likely will

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4. Michael Weinberg, It Will Be Awesome if They Don't Screw It up: 3D Printing, Intellectual Property, and the Fight over the Next Great Disruptive Technology 2 (Nov. 2010), https://www.publicknowledge.org/files/docs/3DPrintingPaperPublicKnowledge.pdf (discussing different items able to be constructed by 3D printers, including electronics, wrenches, bicycles, and skateboards).

5. Lyndsey Gilpin, *3D Printing: 10 Factors Still Holding It Back*, TECHREPUBLIC (Feb. 19, 2014, 11:33 A.M.), http://www.techrepublic.com/article/3d-printing-10-factors-still-holding-it-back/ ("During the last decade, the Patent and Trademark Office has . . . received more . . . than 6800 3D printing patent applications.").

6. *See Gartner: 3D Printing To Result in $100 Billion IP Losses per Year*, *supra* note 3 (discussing some of these factors, including cheaper components, and their likely influence on the future of 3D printing); Sahiti Uppada, *Expiry of Patents in 3D Printing Market to Decrease Product Costs and Increase Consumer Orientation*, 3DPRINTING.COM (Sept. 24, 2015), http://3dprinting.com/news/expiry-of-patents-in-3d-printing-market-to-decrease-product-costs-and-increase-consumer-orientation/ (discussing the effect of expiring patents and decreased component costs on consumer 3D printing).

7. Kathleen Hall, *How 3D Printing Impacts Manufacturing*, COMPUTERWEEKLY.COM (Feb. 2013), http://www.computerweekly.com/feature/How-3D-printing-impacts-manufacturing (discussing the time, money, and flexibility benefits of 3D printing to traditional production processes).

8. *Id.* (explaining that for motorsport technologies designer Prodrive, 3D printing has been "transformative," although for a large company with a huge manufacturing base, such as Aston Martin, the technology will need to improve before making parts for cars on that scale).

enter the marketplace.[9] Enhanced production capability, coupled with increased technology accessibility and adoption, bring more players into the additive manufacturing arena.[10] These expanding supply chains and stakeholders increasingly fight to achieve and defend competitive market advantages.[11]

The technology's critical intellectual assets often are at the heart of these battles.[12] The very nature of additive manufacturing technology, including digital supply chains, renders much of its valuable IP vulnerable to exploitation and theft.[13] While digitalization provides greater technology portability and promotes cross-border collaboration, it also raises significant IP security concerns.[14] With minimal effort, resources, and accountability, potential infringers can use 3D printers, scanners, and CAD software files to replicate objects and components with varying degrees of precision and scale.[15]

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9. *See, e.g.*, Complaint and Demand for Jury Trial at 1–20, Stratasys, Inc. v. Microboards Tech., LLC, (D. Minn. Nov. 25, 2013) (No. 13-CV-03228-DWF-JJG) (complaining that a lower cost printer sourced from a Chinese manufacturer is infringing on some of Stratasys Inc.'s 3D printing patents).

10. *See Gartner: 3D Printing to Result in $100 Billion IP Losses per Year*, *supra* note 3 ("The plummeting costs of 3D printers, scanners and 3D modelling technology, combined with improving capabilities, makes the technology for IP theft more accessible to would-be criminals . . . .") (internal quotes omitted).

11. *See* Bryan J. Vogel, *Casting 3D Printing's Coming IP Litigation: Usual Suspects and Dark Horses*, 86 PAT. TRADEMARK & COPYRIGHT J. (BNA) 1209, 1210 (Oct. 11, 2013) [hereinafter Vogel, *Casting 3D*].

12. *See, e.g.*, Butamax Advanced Biofuels LLC v. Gevo, Inc., 746 F.3d 1302, 1302 (Fed. Cir. 2014) (concerning the potential infringement of a patent for a "method of producing isobutanol from recombinant yeast microorganism expressing that particular biosynthetic pathway"); Transclean Corp. v. Bridgewood Servs., Inc., 290 F.3d 1364, 1364 (Fed. Cir. 2002) (concerning the potential infringement of a patent for an "automatic transmission fluid changing device").

13. *See* Vogel, *Casting 3D*, *supra* note 11, at 1210 ("Given the multiple articles that 3D printers can produce and the countless possible users, establishing actual knowledge of a specific, infringing patent may be difficult. As a result, though consumer use of 3D printers may create multiple instances of patent infringement, policing and protecting patent rights in inventions copied on 3D printers may present significant challenges for patent holders.").

14. *Id.*

15. *See Gartner: 3D Printing to Result in $100 Billion IP Losses per Year*, *supra* note 3 ("The plummeting costs of 3D printers, scanners and 3D modelling technology, combined with improving capabilities, makes the technology for IP theft more accessible to would-be criminals . . . . Importantly, 3D printers do not have to produce a finished good in order to enable IP theft. The ability to make a wax mould from a scanned object, for

Not surprisingly, this turbulent environment brings with it the potential for significant financial losses.[16] One industry analyst projects that, by 2018, global IP losses due to additive manufacturing will approximate $100 billion.[17] To survive these inevitable rights disputes and their accompanying financial drains, stakeholders must use the most protective means available to safeguard their valuable intellectual assets.

While patent law historically provided the most robust safeguards for proprietary technical IP, the full strength of its protections struggle to squarely cover additive manufacturing innovations. With novel rights creation and previously unimagined infringement means, additive manufacturing presents unprecedented challenges to traditional IP laws and doctrines.[18] Multiple patent law principles impede rights holders from enjoying full patent protections.[19] Stakeholders must understand and anticipate these vulnerabilities to maximize security of their valuable IP. Those seeking to safeguard additive manufacturing's critical IP must carefully analyze their options under traditional patent law, as well as under trade secret, copyright, and other IP laws, to determine the most cost-effective, predictable legal theories for securing their IP.

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instance, can enable a thief to produce large quantities of items that exactly replicate the original.").

16. *See id.* ("By 2018, 3D printing will result in the loss of at least US$100-billion per year in intellectual property globally, according to Analyst group Gartner.").

17. *Id.*

18. *See* Davis Doherty, *Downloading Infringement: Patent Law as a Roadblock to the 3d Printing Revolution*, 26 HARV. J.L. & TECH. 353, 362–64 (2012) (discussing the new types of IP infringement made possible by 3D printing, arguing that the current IP law realm may not be able to cope well with these challenges, and proposing changes to the existing law to better meet these new challenges).

19. *See, e.g.*, Aro Mfg. Co. v. Convertible Top Co., 365 U.S. 336, 344–45 (1961) (holding that when an object contains both patented and non-patented parts, typically the consumer is free to duplicate/replicate/reproduce the non-patented parts); Dana Corp. v. Am. Precision Co., 827 F.2d 755, 758–59 (Fed. Cir. 1987) (holding that reasonable repair and replacements of parts of patented materials is sometimes allowed).

I. THE UTILITY AND CHALLENGE OF PATENT PROTECTION

Patent law protects new, useful, non-obvious inventions from copying, but only after the invention holder files an application, which is then granted by the PTO.[20] Patent protections can help safeguard additive manufacturing's valuable inventions, including those relating to materials, scanners, objects, and themselves. Each unauthorized use or replication of a patented invention, whether deliberate or not, constitutes an act of infringement.[21] Patent law proves to be a useful, yet precarious tool for protecting against free riders seeking to profit from additive manufacturing's easily accessible and portable digital assets.[22]

In all technology contexts, proving patent infringement can be difficult and costly.[23] In the current legal climate, patent holders, who bear the burden of proving infringement and damages, face increased judicial scrutiny of their claims and awards.[24] These substantial challenges hold true and are enhanced in the increasing complex additive manufacturing realm.[25] While an additive manufacturing patent's validity and claims ultimately turn on its unique facts, certain prevalent hurdles can make patent protection of this technology's inventions increasingly difficult.[26] Stakeholders may need to

20. *See* 35 U.S.C. §§ 101–103, 112 (2012).

21. *See id.* § 271.

22. *See* Vogel, *Casting 3D*, *supra* note 11 (discussing the applicability of patent law to 3D printers, but highlighting many of the difficulties associated with enforcing these protections).

23. *Id.* ("[P]atent infringement litigation can be very expensive as inventors and alleged infringers battle over each requisite element of patentability, and the patent holder bears the burden of proving appropriate equitable relief and/or the monetary damages suffered.").

24. *See, e.g.*, Transclean Corp. v. Bridgewood Servs., Inc., 290 F.3d 1364, 1376–79 (Fed. Cir. 2002) (discussing, with great scrutiny, the claims and awards of Transclean Corp. against Bridgewood Servs., Inc. finding infringement for some of Transcleans trademarks and no infringement for others, as well as upholding a lower court ruling that "declined to award Transclean enhanced damages and attorney's fees" and reversed a "jury's award of damages based on" royalties).

25. *See* Vogel, *Casting 3D*, *supra* note 11 (discussing the obstacles involved in bringing a patent infringement suit in the 3D printing realm).

26. *Id.*; *see* Doherty, *supra* note 18 (discussing the problems associated with litigating patent infringements in 3D printing suits).

consider novel claim strategies to avail themselves of traditional patent protections.

A. THE "INVENTIVE CONCEPT" REQUIREMENT

A significant amount of additive manufacturing's IP exists in the "build" files and software that run the printers and scanners that power the technology.[27] While the U.S. Supreme Court has upheld software patentability generally, it requires an "inventive concept" apart from the computer implementation of an abstract idea.[28] Divining what will be sufficient to constitute an "inventive concept" in the additive manufacturing context may prove difficult and expensive, depending on the technology involved.[29] The more additive manufacturing software improves an existing printing-related process or solves an existing printing-related problem, the more likely it will be patentable.[30]

B. LACK OF PRIOR ART

The lack of preexisting art also challenges those seeking patent protection of additive manufacturing technologies.[31] To obtain a patent, an IP holder must describe the art sufficiently to contain all aspects of the invention.[32] The specification must be sufficient so that a person of "ordinary skill in the art" can

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27. Kim Walker, *The Intellectual Property Challenges from 3D Printing*, COMPUTERWEEKLY.COM (Sept. 2013), http://www.computerweekly.com /opinion/The-intellectual-property-challenges-from-3D-printing (discussing how 3D printing opens up significant risk to designers' IP rights to be easily abused to the ease and prevalence of file sharing).

28. Alice Corp. Pty. Ltd. v. CLS Bank Int'l, 134 S. Ct. 2347, 2348, 2350, 2357 (2014) (concluding that method claims must include an "'inventive concept' sufficient to 'transform' the claimed abstract idea into a patent-eligible application," and holding that "method claims requiring generic computer implementation failed to transform the abstract idea of intermediated settlement into a patent-eligible invention").

29. *Id.* at 2357.

30. *See id.* (describing how a claim of patent must contain an "inventive concept," in order to be patent-eligible, and stating that when an idea utilized is abstract, it must "supply a 'new and useful' application of the idea in order to be patent eligible.").

31. *See* Bryan J. Vogel, *3D Printing, Materials Development, and IP: Protecting What's in the Printer*, 88 PAT. TRADEMARK & COPYRIGHT J. (BNA) 502 (June 13, 2014) [hereinafter Vogel, *3D Printing*] ("Prior art and other background information that provides guidance on the sufficiency of the language of the specification may simply not exist.").

32. 35 U.S.C. § 102(a) (2012).

practice the claimed invention.[33] Technical aspects not fully explained may jeopardize a technology's patentability.[34] In the context of a revolutionary technology, this description requirement may prove difficult to meet.[35] Given the transformative nature of additive manufacturing and, in some cases, the lack of preexisting relevant technology, prior art guidance on suitable plain language simply may not exist.[36] As additive manufacturing innovation continues to leapfrog the capabilities and boundaries of previous technologies, stakeholders must tackle the difficult task of sufficiently describing the novel four corners of their inventions. The lack of prior art also can impede damage assessments in infringement actions.[37]

C. INHERENCY DOCTRINE

The inherency doctrine can also impede additive manufacturing innovators seeking patent protection. Under this doctrine, a single prior art reference can be found to anticipate a patented invention without expressly declaring each aspect of the earlier creation, if the missing aspect is an inherent part of the anticipating reference.[38] Specifically, this doctrine instructs that "discovery of a previously unappreciated property of a prior art composition, or a scientific explanation for the prior art's functioning, does not render the old

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33. *See, e.g.*, Bos. Sci. Corp. v. Johnson & Johnson, 647 F.3d 1353, 1366 (Fed. Cir. 2011) ("When determining whether a specification contains adequate written description, one must make an 'objective inquiry into the four corners of the specification from the perspective of a person of ordinary skill in the art.'"(quoting Ariad Pharm., Inc. v. Eli Lilly & Co., 598 F.3d 1336, 1351 (Fed. Cir. 2010))).

34. *See* Butamax Advanced Biofuels LLC v. Gevo, Inc., 746 F.3d 1302, 1309–11 (Fed. Cir. 2014) (finding that the scope of the patent only covered what was described particularly in the claims specification).

35. *See, e.g.*, *id.* Patent holder's claimed innovation relied on use of recombinant yeast microorganism "comprised of inactivated genes" that disabled a competing synthetic pathway. While prior art agreed deactivation was desirable, it provided only one reference to describe the process. *Id.*

36. *Id.*

37. *Cf.* Jake Holdreith et al., *Using Regression Models to Isolate the Value of a Patented Feature*, INTELL. ASSET MGMT., May/June 2013, at 19, 20 (discussing the difficulties of quantifying damages in patent infringement cases).

38. Schering Corp. v. Geneva Pharms., Inc., 339 F.3d 1373, 1377 (Fed. Cir. 2003).

composition patentably new to the discoverer."[39] Similarly, claiming a novel use, new function, or unknown property inherently present in the prior art may not be sufficient to claim patent validity under this doctrine.[40] No requirement exists that a person of ordinary skill in the art would recognize the inherent disclosure at the time of invention, but only that the subject matter is inherent in the prior art reference.[41]

This doctrine may make patent protection in the additive manufacturing space particularly difficult. For instance, revolutionary materials innovation critical to additive manufacturing advancement may be found to rely on potentially inherent aspects of prior art.[42] Patent invalidity may result even though the inherent aspects were not explicitly considered at the time of the prior art's discovery.[43] The Federal Circuit has required that the inherent aspect be "*necessarily* present" in the prior art reference.[44] Of course, what will be considered "necessarily present"[45] will depend on the specific invention and claims.

D. PRODUCT-BY-PROCESS INVENTIONS

Product-by-process inventions may impose another patentability hurdle affecting additive manufacturing innovators. Product-by-process inventions use different types of materials for a single fabrication.[46] These claims "developed in response to the need to enable an applicant to claim an

39. Atlas Powder Co. v. Ireco, Inc., 190 F.3d 1342, 1347 (Fed. Cir. 1999).

40. *In re* Best, 562 F.2d 1252, 1254–55 (C.C.P.A. 1977).

41. *Schering*, 339 F.3d at 1377.

42. *See* Vogel, *3D Printing*, *supra* note 31 (indicating temperature stabilization, molecular reformation, necessary pathway openings, and inactivation or accelerations may be found to rely on inherent aspects of prior art).

43. *Id.*

44. Rexnord Indus., LLC v. Kappos, 705 F.3d 1347, 1354–55 (Fed. Cir. 2013) (emphasis added); *see, e.g.*, Toro Co. v. Deere & Co., 355 F.3d 1313, 1320–21 (Fed. Cir. 2004).

45. *Rexnord*, 705 F.3d at 1354–55.

46. *See In re* Thorpe, 777 F.2d 695, 697–98 (Fed. Cir. 1985); Bryan J. Vogel, *Beyond Patents: 3D Printing and IP*, N.Y.L.J. (Aug. 4. 2014), http://www.robinskaplan.com/resources/articles/beyond-patents-3d-printing-and-ip.

otherwise patentable product that resists definition by other than the process by which it was made."[47]

This doctrine presents novel impediments in the additive manufacturing context when a new technology is used to make an old object.[48] An old product does not become patentable by virtue of being made by a new process.[49] These unique claims are treated differently for validity and infringement purposes.[50] In assessing patentability of a product-by-process claim, the focus rests on the product rather than the process by which it is made.[51] "[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production."[52] The validity of a product-by-process claim continues to require an inventive concept, even if a novel process is used.[53] Significantly, only the claimed process can infringe the patent.[54]

Under these more restrictive requirements, innovators claiming product-by-process inventions must realize that, while they must still fulfill traditional requirements for patentability, only a product created by their same process can infringe their claims.[55] Because a similar product lawfully may be made using a different process, a patent granted under product-by-process theory confers less protection against infringement.[56] To maximize IP protection, a rights holder asserting a product-by-process patent claim should carefully scrutinize the products, materials, and process structure involved, particularly if these can only be defined by their respective process steps.

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47. *Thorpe*, 777 F.2d at 697.

48. *See* Vogel, *3D Printing*, *supra* note 31.

49. *Id.*; *See* Abbott Labs. v. Sandoz, Inc., 566 F.3d 1282, 1292–93, 1307 (Fed. Cir. 2009).

50. *See* Vogel, *3D Printing*, *supra* note 31.

51. *Thorpe*, 777 F.2d at 697.

52. *Id.* (first citing *In re* Brown, 459 F.2d 531, 535 (C.C.P.A. 1972); then citing *In re* Pilkington, 411 F.2d 1345, 1348 (C.C.P.A. 1969)); *see also* Amgen, Inc. v. F. Hoffman-La Roche Ltd., 580 F.3d 1340, 1370 n.14 (Fed. Cir. 2009).

53. *Abbot Labs.*, 566 F.3d at 1292 (quoting *Thorpe*, 777 F.2d at 697).

54. *Id.*

55. *Id.* at 1292–93 (quoting Cochrane v. Badische Anilin & Soda Fabrik, 111 U.S. 293, 310 (1884)).

56. *See id.* at 1292.

E. PERMISSIBLE REPAIR OR IMPERMISSIBLE RECONSTRUCTION

Additive manufacturing patent holders also must be wary of the repair and reconstruction risks created by doctrines allowing for lawful copying of a patented object's elements.[57] While a complete reconstruction is likely impermissible, an unrestricted owner of a patented object may lawfully fabricate replacement parts to protect the patented object's useful life.[58] This means that, under certain circumstances, rather than purchase a new part or product from the patent holder, product holders may bypass the patent holder by "printing" (or having another party "print") a new part. This reproduction may be permissible even if conducted on a commercial scale.[59] Non-patented components of a patented invention also generally can be lawfully reproduced.[60] In practice, this doctrine may permit various types of repairs, refurbishments, overhauls, and salvage remanufacturing.

Patent holders should be aware that this right to certain repairs may not necessarily be contractually restricted.[61] Single-use restrictions accompanying the sale of a patented object may not always be upheld.[62] Such restrictions may prevent the initial purchaser of the product, but not a distributor—so particular care must be taken in crafting any contractual restrictions and where in the distribution chain those restrictions are placed.[63] As for unrestricted sales of a patented object, a patent holder's rights may be found to be exhausted within the United States, while sales of patented products outside the United States would not exhaust those rights.[64]

While permissible repair gravely threatens patent holders, stakeholders have yet to challenge these doctrines by claiming

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57. *See* Dana Corp. v. Am. Precision Co., 827 F.2d 755, 758–59 (Fed. Cir. 1987) (discussing the difference between repair and reconstruction in the law).

58. Aktiebolag v. E.J. Co., 121 F.3d 669, 672 (Fed. Cir. 1997).

59. *See Dana Corp.*, 827 F.2d at 759.

60. Aro Mfg. Co. v. Convertible Top Co., 365 U.S. 336, 344–45 (1961).

61. *See, e.g.*, Lexmark Int'l, Inc. v. Ink Techs. Printer Supplies, LLC, 9 F. Supp. 3d 830, 833, 838 (S.D. Ohio 2014) (holding that the initial sale of the patented product did not foreclose resale of that product).

62. *See, e.g.*, *id.* at 833.

63. *See id.* at 832–33.

64. *See id.*

patent infringement by virtue of a printed object.[65] Identifying alleged infringers, preventing them, and seeking redress require massive policing efforts and extensive costs, particularly given the expanding scope of consumer use.[66] Industry commentators anticipate these claims will emerge when consumer reproduction reaches broader commercial scale.[67]

F. INTENT REQUIREMENT FOR INDIRECT INFRINGEMENT CLAIMS

Additive manufacturing stakeholders also should anticipate the difficulties faced in adjudicating indirect infringement cases. As patent doctrines complicate and potentially hinder direct infringement suits, printer manufactures, file-sharing sites, and "build" file providers become more attractive litigation targets under theories of indirect infringement.[68] Notably, while these parties appear to be more viable litigation candidates for identification and recovery purposes, these cases can be difficult and expensive to prove.[69]

The proof of intent required to successfully claim induced or contributory infringement can be a high hurdle.[70] In recent cases before the Supreme Court, the Court required knowledge of the underlying patent-in-suit, as well as knowledge of

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65. *See* Vogel, *Casting 3D*, *supra* note 11 ("[P]atent infringement litigation for an object or objects made on a 3D printer has yet to occur.").

66. *See* Vogel, *Casting 3D*, *supra* note 11 (discussing the costs and efforts associated with litigating patent infringement in 3D printing cases, and positing that litigation will grow as consumer use continues to expand).

67. *See, e.g.*, WEINBERG, *supra* note 4; Doherty, *supra* note 18, at 354–55. The article identifies potential patent infringers and infringement contexts arising from consumer use of 3D printers. Doherty proposes a solution similar to the Digital Millennium Copyright Act, 17 U.S.C. § 512 (2012) (discussed *infra*), to address the challenges of patent infringement enforcement in the consumer sector. *See* Doherty, *supra* note 18, at 365.

68. *See* Vogel, *Casting 3D*, *supra* note 11 (noting that "to date, patent infringement litigation in 3D printing has been mostly limited to contests between printer manufacturers," but identifying a lawsuit where Kickstarter was named a defendant under an untested-at-the-time legal theory).

69. *See id.* ("[T]he level of actual knowledge required to hold an entity responsible under the indirect infringement doctrines of induced and contributory infringement may potentially present a high hurdle.").

70. *Id.*

infringement.[71] Given the far-reaching adoption of additive manufacturing, identifying infringers, much less demonstrating their intent, may make proving indirect infringement claims cost-prohibitive for some IP rights holders.[72]

G. NOVEL PATENT STRATEGIES TO CONSIDER

Given this challenging environment where long-standing patent principles may fall short, additive manufacturing innovators must pursue novel avenues for protecting their valuable digital assets.[73] While this task may prove difficult for some, particularly in the face of patent law's historic uncertainty surrounding patentability,[74] additive manufacturing stakeholders must plunge forward to maximize their ability to protect their bedrock technologies.

Often at the heart of this uncertainty is the patent eligibility of 3D digital models. These files often provide easy targets to free riders, who readily capitalize on their accessibility to freely print components and parts.[75] Certain strategies may be considered to help bolster protection of these vulnerable assets. For instance, innovators should consider patent claims directed at (1) the creation of distribution of 3D

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71. *See, e.g.*, Global-Tech Appliances, Inc. v. SEB S.A., 131 S. Ct. 2060, 2068 (2011) (stating that induced infringement of a patent, like contributory infringements, requires knowledge that the induced acts constitutes patent infringement); Commil USA, LLC v. Cisco Sys., 135 S. Ct. 1920, 1928 (2015) (stating that belief as to invalidity of a patent cannot negate the scienter requirement for infringement).

72. *Cf.* Timothy R. Holbrook & Lucas S. Osborn, *Digital Patent Infringement in an Era of 3D Printing*, 48 U.C. DAVIS L. REV. 1319, 1332 (2015) (stating that suing individuals for indirect infringement would be an impractical strategy). For a much more in depth discussing on indirect infringement claims, see *id.* at 1332–53.

73. *See* Vogel, *Casting 3D*, *supra* note 11, at 1210–12 (outlining the litigation possibilities available under trade secret, trade dress, design patent, copyright, and antitrust laws, and even FDA regulations).

74. *See, e.g.*, Matthew Sag & Kurt Rohde, *Patent Reform and Differential Impact*, 8 MINN. J.L. SCI. & TECH. 1, 50 (2007) ("[E]mpirical uncertainty surround[s] optimal patent scope.").

75. *See* Holbrook & Osborn, *supra* note 72, at 1364 (noting the protection gap when a digital file is gifted rather than sold). *See also id.* at 1364 n.225 (discussing use of the CAD file as another possible, if unlikely, avenue for enforcement). *But cf.* 35 U.S.C. § 271(a) (2012) (listing the unauthorized making of the patented invention as acts of infringement).

digital model files intended for use in additive manufacturing,[76] (2) the scanning of genuine articles or products to create 3D digital model files,[77] and (3) importation of offshore-origin 3D digital model files.[78] While the ability to claim patent rights in a 3D digital model itself remains unclear, this ambiguity is likely to decrease as the matter becomes more frequently litigated.[79]

Innovators may also consider *Beauregard*-style claims to protect their 3D digital models.[80] Notably, these claims require that the innovation be embodied in a tangible medium, such as floppy disks.[81] Additive manufacturing stakeholders also may contemplate using method claims to protect scanning or "printing" certain 3D digital model files. [82] Patent method protection may be available to the extent the 3D digital model constitutes a creation produced by practicing each step of a patented process.[83]

Design patents may present another useful tool for rights holders, particularly in the context of protecting vulnerable parts and components of objects. A design patent protects the novel, ornamental aspects of a product's appearance.[84] While

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76. *See, e.g.*, Digitech Image Techs., LLC v. Elecs. for Imaging, Inc., 758 F.3d 1344 (Fed. Cir. 2014).

77. *E.g.*, ClearCorrect Operating, LLC v. Int'l Trade Comm'n, 810 F.3d 1283, 1286 (Fed. Cir. 2015).

78. *E.g.*, Microsoft v. AT&T, 550 U.S. 437, 454–55 (2007).

79. *See, e.g.*, *id.* (construing narrowly the Patent Act's § 271(f) infringement exception for combination abroad); *Digitech Image Techs*, 758 F.3d at 1348 (affirming the district court's conclusion that a device profile does not meet patent eligibility criteria because it did not exist in some physical or tangible form); Certain Digital Models, Inv. No. 337-TA-833, USITC Pub. 4555 (Apr. 9, 2014) (finding digital data sets to be articles in § 1337 proceeding), *rev'd on other grounds sub nom.* ClearCorrect Operating, LLC v. Int'l Trade Comm'n, 810 F.3d 1283, 1286 (Fed. Cir. 2015); *see also* Ormco Corp. v. Align Tech., 609 F. Supp. 2d 1057, 1067–77 (C.D. Cal. 2009) (analyzing indirect and direct infringement claims).

80. *See In re* Beauregard, 53 F.3d 1583, 1584 (Fed. Cir. 1995).

81. *See id.* at 1584 (confirming "that computer programs embodied in a tangible medium, such as floppy diskettes, are patentable subject matter," and dismissing the appeal due to lack of case or controversy).

82. *See, e.g.*, *Ormco*, 609 F. Supp. 2d at 1076 ("[The] 3D digital model [in question was] not a mere package of information, but a 'creation' produced by 'practicing each step' of a patented process.").

83. *Id.*

84. *See* 35 U.S.C. § 171 (2012) ("Whoever invents any new, original and ornamental design for an article of manufacture may obtain a patent therefor, subject to the conditions and requirements of this title.").

the protection extends only to the specific descriptions and illustrations contained in the design patent, [85] this coverage may provide additional security to rights holders when their traditional utility patents fail or exhaust.

Often, patented products include parts and components susceptible to wear and necessary replacement or repair.[86] As previously discussed, in some circumstances, third parties may bypass the patent holder to lawfully create their own replacement parts.[87] In the additive manufacturing context, in certain situations, this concept may allow third parties to "print" their own replacement parts or components.[88] If, however, the parts or components at issue are subject to utility or design patents, the third-party repair may be protected and considered an infringing reconstruction.[89] By strategically seeking an extension of patent rights to cover replacement parts or components through a design patent, rights holders may expand their proprietary coverage, while potentially protecting their object's vulnerable parts and components.

In addition to claim strategies directed at 3D digital model files, components, and the like, innovators should not lose sight

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85. *See generally Design Patent Application Guide*, U.S. PAT. & TRADEMARK OFF., http://www.uspto.gov/patents-getting-started/patent-basics/types-patent-applications/design-patent-application-guide (last visited Feb. 27, 2016) (explaining the differences in subject matter between design and utility patents, and noting that "[a]rticles of manufacture may possess both functional and ornamental characteristics").

86. *See* P. Andrew Riley & Elizabeth D. Ferrill, *Using Design-Patent Protection for Replacement Parts*, FINNEGAN (June 19, 2014), http://www.finnegan.com/resources/articles/articlesdetail.aspx?news=0f2a81f3-7963-4fa8-a92a-3046e1ed30de (describing litigation over Gillette razor-head replacements, and the ensuing congressional response).

87. *See, e.g.*, Aktiebolag v. E.J. Co., 121 F.3d 669, 672 (Fed. Cir. 1997) (finding infringement when a patent licensee offered re-tooling services for the patent holder's drill bits after the drills' useful lives, while at the same time acknowledging that customers purchased "an implied license to use the drill *for its useful life*," and that this implied license includes "the right to repair the patented drill") (emphasis added)); *see also* Lexmark Int'l, Inc. v. Ink Techs. Printer Supplies, LLC, 9 F. Supp. 3d 830, 832 (S.D. Ohio 2014) ("The patent exhaustion doctrine generally provides that once a patentee has made an unrestricted sale of a patented article, the patentee loses its right to control the sale, offer for sale, or use of the article.").

88. *See* Aro Mfg. Co. v. Convertible Top Co., 365 U.S. 336, 346 (1961) ("Mere replacement of individual unpatented parts, one at a time, whether of the same part repeatedly or different parts successively, is no more than the lawful right of the owner to repair his property.").

89. *See id.*

of traditional notions of patent protection, particularly in the materials being developed and used, as well as in the products themselves. With additive manufacturing's use of tools like topology optimization and online process feedback control, innovators are seeing unprecedented reductions in costs and manufacturing times, increases in strength/mass ratios and use of less material, all of which is leading to higher added value and functionality.[90]

II. THE BENEFITS AND LIMITATIONS OF TRADE SECRET PROTECTION

Given the rising uncertainties, difficulties, and expense faced in securing and defending patents,[91] additive manufacturing innovators should consider other, potentially more predictable, cost-effective forms of IP protection. Trade secret law is a ripe alternative. In addition to easier burdens of proof[92] and no filing requirement,[93] trade secret provides ample protection against the potential exploitation of the industry's valuable proprietary information.

Trade secret law defines broadly what constitutes protectable information.[94] Designs, compilations, instruments, formulas, or practices may be protectable under trade secret law.[95] As patents age, newer innovators can use trade secret laws to protect additive manufacturing's adaptations, modifications, and processes to scale their technologies for

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90. *See* Brian H. Jaffe, *Topology Optimization Key to Additive Manufacturing*, ON3DPRINTING (Apr. 23, 2013), http://on3dprinting.com/2013/04/23/3d-printing-conference-5-topology-optimization.

91. *See* Holbrook & Osborn, *supra* note 72.

92. *Compare* 35 U.S.C. § 271 (2012) (making patent infringement illegal with certain exceptions), *with* UNIF. TRADE SECRETS ACT § 1 cmt. (UNIF. LAW COMM'N 1985) (providing a broad definition for "trade secret" to extend the protection of the act).

93. *See Patents or Trade Secrets?*, WORLD INTELL. PROP. ORG., http://www.wipo.int/sme/en/ip_business/trade_secrets/patent_trade.htm (last visited Feb. 27, 2016) ("Trade secrets involve no registration costs (though there may be high costs related to keeping the information confidential).").

94. UNIF. TRADE SECRETS ACT § 1 cmt. (UNIF. LAW COMM'N 1985) ("A complete catalogue of improper means is not possible. . . .").

95. *Id.* at § 1(4) (requiring that such secrets derive economic value from the fact of their secrecy, and that the secrets be subject to reasonable efforts to maintain continued secrecy).

commercial applications.[96] Trade secret law also provides a viable alternative for protecting "build" files and software code after the U.S. Supreme Court put this technology's patentability in question.[97]

While the criteria for establishing trade secret protection may differ slightly, some form of trade secret protection exists in each state in the United States (including Washington, D.C., Puerto Rico, and U.S. Virgin Islands).[98] States either rely on a version of the Uniform Trade Secrets Act[99] or have a common law that provides similar protections.[100] Currently, Congress is working on passing a uniform, federal trade secret cause of action.[101]

To receive protection under the law, a trade secret holder is not required to prove usefulness, novelty, or non-obviousness.[102] Generally, trade secret protection attaches when whatever is claimed as a secret is not generally known in the industry; the owner or holder of the trade secret has made appropriate efforts to keep it secret; and the secret confers a competitive advantage.[103] To successfully claim misappropriation of a trade secret, a rights holder must prove that someone other than the trade secret owner knowingly

96. *See Patents or Trade Secrets?*, *supra* note 93 ("Trade secret protection has the advantage of not being limited in time (patents last in general for up to 20 years). It may therefore continue indefinitely as long as the secret is not revealed to the public.").

97. Alice Corp. Pty. Ltd. v. CLS Bank Int'l, 134 S. Ct. 2347, 2359–60 (2014) (noting that software lacking an element of technological improvement may not be sufficient to qualify for patent protection); *cf.* Ritani, LLC v. Aghjayan, 880 F. Supp. 2d 425, 450–51 (S.D.N.Y. 2012) (refusing to dismiss a trade secret claim under New York trade secret law when defendants allegedly wrongfully appropriated a jewelry design computer-aided manufacturing (CAM) file).

98. *See Legislative Fact Sheet-Trade Secrets Act*, UNIFORM L. COMM'N, http://www.uniformlaws.org/LegislativeFactSheet.aspx?title=Trade%20Secrets%20Act (last visited Feb. 27, 2016) (identifying the vast majority of states that have specifically adopted the Uniform Trade Secrets Act in some form).

99. *See* UNIF. TRADE SECRETS ACT §1 *et seq.*, (UNIF. LAW COMM'N 1985).

100. RESTATEMENT (FIRST) OF TORTS §§ 757–61 (AM. LAW INST. 1939).

101. *See* Trade Secrets Protection Act of 2014, H.R. 5233, 113th Cong. (2014); Defend Trade Secrets Act of 2015, H.R. 3326, 114th Cong. (2015).

102. *See* UNIF. TRADE SECRETS ACT § 1(4) (UNIF. LAW COMM'N 1985); *cf.* 35 U.S.C. §§ 101–03 (2012) (defining patentability in terms of newness, usefulness, and non-obviousness).

103. *See* UNIF. TRADE SECRETS ACT § 1(4) (UNIF. LAW COMM'N 1985); RESTATEMENT (FIRST) OF TORTS § 757 (1939).

acquired the trade secret directly or indirectly through improper means or duty breach.[104]

In the current work climate, increased employee mobility creates greater risks of leaked proprietary disclosures in all industries.[105] This concern is exacerbated in the quickly evolving, growing, and consolidating field of additive manufacturing.[106] Those with additive manufacturing expertise are attractive recruiting targets, resulting in mass migration of sensitive proprietary information and concurrent risks of trade secret misappropriation.[107] Additive manufacturing stakeholders susceptible to these risks are wise to ensure robust data security, confidential agreements, and enforcement procedures.

Significantly, trade secret protection does have its limitations.[108] While trade secret law can protect against misappropriation of proprietary processes and methods, this protection is less robust than that available under patent law.[109] For instance, no protection against reverse engineering exists under trade secret law.[110] Additionally, detecting and proving misappropriation in the complex and rapidly changing additive manufacturing arena can be challenging.[111]

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104. *See, e.g.*, Medspring Grp., Inc. v. Feng, 368 F. Supp. 2d 1270, 1276 (D. Utah 2005) (analyzing misappropriation of trade secrets under Utah's adoption of the Uniform Trade Secrets Act).

105. *See* Fisher/Unitech, Inc. v. Comput. Aided Tech., Inc., No. 13 C 02090, 2013 U.S. Dist. LEXIS 50744, at *3–*6 (N.D. Ill. Apr. 9, 2013) (dealing with an employee resigning from his sales position and joining a similar company despite a noncompete agreement).

106. *See, e.g.*, *Fisher/Unitech*, 2013 U.S. Dist. LEXIS 50744 (involving the aftermath of a merger between rival 3D printer manufacturers where the 3D printer reseller brought a trade secret misappropriation claim against its rival 3D printer reseller).

107. *See, e.g.*, *id.*

108. *See Patents or Trade Secrets?*, *supra* note 93 (noting the enforcement difficulties, and the inability to prevent reverse-engineering or concurrent patentability).

109. *See id.*

110. *Id.*

111. *See, e.g.*, *Fisher/Unitech*, 2013 U.S. Dist. LEXIS 50744, at *28 (issuing a preliminary injunction while the parties jointly investigate whether trade secrets were misappropriated).

III. THE PROS AND CONS OF COPYRIGHT PROTECTION

Copyright law provides another viable source of additive manufacturing IP protection. Stakeholders can rely on copyright law to protect their assets from being unlawfully "printed" by customers, consumers, or competitors.[112] In the additive manufacturing context, copyright protections are particularly useful where digitalization has revolutionized the world of illicit reproductions, significantly enabling and simplifying the replication of copyrighted works.[113]

Generally, copyright protection extends to writings, drawings, musical compilations, sculptures, and other original designs.[114] Unlike patents, copyright attaches automatically once a creative work is "fixed" in a form that allows it to be viewed or replicated by others.[115] While copyright protection does not require registration of the work,[116] doing so confers multiple benefits.[117] Significantly, copyright protection does not cover a copyrighted work's function or expressed idea.[118] Copyright does likely cover purely design-oriented objects

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112. *See* 17 U.S.C. § 106(1) (2012) (identifying one exclusive right held by copyright holders: "to reproduce the copyrighted work in copies or phonorecords").

113. *See* Christopher Coble, *3 Things That are Illegal to 3D Print*, FINDLAW (Oct. 8, 2015, 12:21 PM), http://blogs.findlaw.com/law_and_life/2015/10/3-things-that-are-illegal-to-3d-print.html ("[J]ust by seeking legal protection, [patent holders] may be giving counterfeiters the means by which to copy [their] invention.").

114. *See* 17 U.S.C. § 102(a) (listing protectable categories for works of authorship).

115. *See id.* ("Copyright protection subsists . . . in original works of authorship fixed in any tangible medium of expression . . . .").

116. *See Copyright in General*, U.S. COPYRIGHT OFF., http://copyright.gov/help/faq/faq-general.html (last visited Feb. 27, 2016) ("In general, registration is voluntary. Copyright exists from the moment the work is created.").

117. *Id.* ("Registration is recommended for a number of reasons. Many choose to register their works because they wish to have the facts of their copyright on the public record and have a certificate of registration. Registered works may be eligible for statutory damages and attorney's fees in successful litigation. Finally, if registration occurs within five years of publication, it is considered prima facie evidence in a court of law.").

118. *See* 17 U.S.C. § 102(b) ("In no case does copyright protection for an original work of authorship extend to 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 in such work." (emphasis added)).

reproduced by a 3D printer.[119] The reproduced objects would likely infringe the original work.[120] Similarly, a scan of a copyrighted object would be an infringing replication.[121]

More complex copyright issues arise when stakeholders seek to protect functional objects that include design elements. While functional works are ineligible for copyright protection, courts apply a "separability" test to determine whether copyright protection extends to certain design elements of a work.[122] Though this test may provide some protection to additive manufacturing copyright holders, it is not clearly defined and can prove costly to litigate.[123]

From a software perspective, a "build" file that directs a printer to create unique, nonfunctional works should receive copyright safeguards.[124] The unique works "printed" by such a "build" file also may be entitled to copyright protection as derivative works of a copyrighted object.[125] Asserting this principle, additive manufacturers of easily replicable decorative home designs and toy figurines may be able to rely on copyright laws to prevent others from unlawfully reproducing their products, to the extent those products are nonfunctional.[126]

The structure, sequence, and source code organization of "build" files also may be copyrightable, even with the inclusion of functional coding elements, so long as they "qualif[y] as an

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119. *Cf.* Mazer v. Stein, 74 S. Ct. 460, 471 (1954) (finding copyright protection for the ornamental elements of a functional lamp).

120. *See* 17 U.S.C. § 106(1) (stating a copyright holder has an exclusive reproduction right).

121. *Id.*; *see also* 17 U.S.C. § 103 (stating that unauthorized derivative works are illegal).

122. *See* Chosun Int'l v. Chrisha Creations, 413 F.3d 324, 328 (2d Cir. 2005) ("[I]f a useful article incorporates a design element that is physically or conceptually separable from the underlying product, the element is eligible for copyright protection.").

123. *See, e.g.*, *id.* at 329–30 (declining to grant summary judgment because a possibility of separability exists under these facts).

124. *See* 17 U.S.C. § 102(a) (defining copyright as subsisting in original works of authorship fixed in a medium from which communication and reproduction are possible).

125. *See* § 103 (stating the derivative works definition and limitations).

126. *See* Kieselstein-Cord v. Accessories by Pearl, Inc., 632 F.2d 989, 995–96 (2d Cir. 1980) (providing protection for nonfunctional design of fashion belt buckle).

expression of an idea, rather than the idea itself."[127] An open question remains whether the actual "build" file of a functional object elicits copyright protection.[128] The aspects of the "build" file that contain the author's original expression may be copyrightable.[129] These copyrights, however, include significant limitations.[130] Unfortunately for additive manufacturing stakeholders, copyright protection may not preclude others from manufacturing or "printing" objects from a copyrighted "build" file, if the objects represented in the file are functional and non-architectural.[131] Given that additive manufacturing "build" files often consist of functional products, particularly in the industrial realm,[132] this may constitute a significant limitation.

With regard to online exposure, those seeking copyright protection of additive manufacturing IP rely on the Digital Millennium Copyright Act ("DMCA").[133] Congress passed this legislation to adapt copyright law to address the evolving

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127. Oracle Am., Inc. v. Google Inc., 750 F.3d 1339, 1366 (Fed. Cir. 2014), *cert. denied*, 135 S. Ct. 2887 (2015).

128. There are colorable arguments on both sides of the issue. On one hand, the Federal Circuit has held that Copyright Act Section 102(b) "does not . . . automatically deny copyright protection to elements of a computer program [like "build file" instructions] that are functional." *Id.* at 1367. On the other hand, however, copyright law "provides that, when there are a limited number of ways to express an idea, the idea is said to 'merge' with its expression, and the expression becomes unprotected." *Id.* at 1359. Thus, once a build file crosses over from creative expression to mere mechanical reproduction, an additive manufacturing stakeholder may lose copyright protection.

129. *See, e.g.*, 17 U.S.C. § 102(a) ("Copyright protection subsists . . . in *original works of authorship* . . ." (emphasis added)).

130. *See, e.g.*, *id.* § 102(b) (denying copyright protection to "any idea, procedure, process, system, method of operation, concept, principle, or discovery").

131. *See, e.g.*, Gusler v. Fischer, 580 F. Supp. 2d 309, 315 (S.D.N.Y. 2008) (noting that, under the "useful articles" doctrine, a putative copyright holder's rights do not extend to purely functional or non-aesthetic elements of a product's design).

132. For just one example of the myriad functional applications of 3D printing, see the automotive industry case studies at *Automotive*, STRATASYS, http://www.stratasys.com/industries/automotive (last visited Feb. 28, 2016) (click "Case Studies" link).

133. *See* 17 U.S.C. § 512.

digital landscape.[134] The DMCA provides online service providers whose sites post potentially infringing content a safe harbor mechanism to limit their liability.[135] Upon suspicion of infringement, a rights holder gives the hosting service provider a notice and takedown order.[136] In response, the provider can either remove the alleged infringing material and avoid liability as an impartial intermediary, or ignore the notice and risk litigation.[137] The accused infringer also can either comply with the takedown notice or notify the online provider that no infringement exists and repost, similarly risking an infringement suit from the copyright holder.[138] While, to date, alleged infringers generally have complied with DMCA takedown notices,[139] it is only a matter of time before these requests are refused and costly copyright litigation ensues.[140]

While consumer adoption of additive manufacturing is slower than previously anticipated, consumer use of the

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134. *See* Digital Millennium Copyright Act, Pub. L. No. 105-304, pmbl. & § 103, 112 Stat. 2860, 2860 (1998) (implementing the World Intellectual Property Copyright Treat, as well as adding new copyright protection).

135. *See* 17 U.S.C. § 512(c).

136. *See id.* § 512(d)(1)(C) ("A service provider shall not be liable . . . [if] upon notification of claimed infringement as described in paragraph (3), [it] responds expeditiously to remove, or disable access to, the material that is claimed to be infringing or to be the subject of infringing activity.").

137. *See id.* § 512(b)(2)(E).

138. *See id.*

139. According to Google, in the past it has removed approximately 97% of all allegedly infringing content (which includes under DMCA notices) within about six hours of report. *FAQ*, GOOGLE TRANSPARENCY REP., https://www.google.com/transparencyreport/removals/copyright/faq (last visited Feb. 28, 2016). This may become more difficult as the number of requests increases. *See* Rob Price, *Google Gets 2.2 Million Piracy Takedown Requests Every Day*, BUS. INSIDER (Nov. 23, 2015, 4:34 AM), http://www.businessinsider.com/google-2-million-daily-piracy-takedown-requests-transparency-report-copyright-2015-11 (reporting statistics that takedown requests have increased from 2.2 million per week to 2.2 million per day—or 1,500 per minute—in just three years). *But cf.* Lauren C. Williams, *Kanye Unleashes Tidal Wave of Piracy*, THINK PROGRESS (Feb. 17, 2016, 3:50 PM), http://thinkprogress.org/culture/2016/02/17/3750291/kanye-plus-tidal-equals-piracy ("Unfortunately, while the system worked when isolated incidents of infringement occurred on largely static web pages—as was the case when the law was passed in 1998—it is largely useless in the current world where illegal links that are taken down reappear instantaneously.").

140. *See, e.g.*, Vernor v. Autodesk, Inc., 621 F.3d 1102, 1105–06 (9th Cir. 2010) (denying an eBay seller's attempt to block application of copyright doctrines when seller tried to sell software he purchased from licensees).

technology is steady and growing.[141] A leading industry researcher forecasts that large-scale consumer adoption is likely five to ten years away.[142] Regardless of when it occurs, inevitable wider consumer use of the technology will result in increased copyright infringement. While the DMCA does provide some security to additive manufacturing copyright holders, the process of policing the Internet to fish-out potential infringement proves to be an increasingly daunting and expensive endeavor.[143] Given the uncertainties and vulnerabilities associated with copyright protection, additive manufacturing stakeholders should take care to develop and enforce robust digital security measures and polices, including those affecting employee access to sensitive, easily portable digital information.

IV. LESS USED THEORIES OF TRADEMARK AND TRADE DRESS

The less frequently used IP protections of trademark and trade dress can assist those seeking to protect the appearance of a 3D printed object. These concepts protect rights holders, and their brands, from consumer confusion created by an infringing product.[144] Trade dress specifically refers to a product's overall appearance and image.[145] To receive trade dress protection, an object must either be inherently distinctive

141. *See Gartner Says Consumer 3D Printing is More Than Five Years Away*, GARTNER (Aug. 19, 2014), http://www.gartner.com/newsroom/id/2825417 (identifying some reasons why the consumer 3D printing market may lag behind other 3D printing uses).

142. *See id.* ("Consumer 3D printing is around five to 10 years away from mainstream adoption.") (internal quotations omitted).

143. *See* Holbrook & Osborn, *supra* note 72, at 1332 ("Like any other file, [build files] can be copied, emailed, posted online, and downloaded from the Internet. The upshot is that one can essentially multiply and share physical objects across the globe. . . . But it is worrisome for the patent holder that fears widespread, decentralized creation of her patented invention.").

144. *See* 15 U.S.C. § 1127 (2012) ("The intent of this chapter is to . . . protect persons engaged in such commerce against unfair competition [and] to prevent fraud and deception [in commerce] . . ."); *id.* § 1125 (imposing civil liability where consumer confusion would result from use of infringing marks).

145. *See id.* § 1125(a) (creating cause of action for trade dress infringement); *see also* Blue Bell Bio-Medical v. Cin-Bad, Inc., 864 F.2d 1253, 1256 (5th Cir. 1989) ("The 'trade dress' of a product is essentially its total image and overall appearance.").

or have developed a secondary meaning that helps consumers identify its source.[146]

With increasing frequency, infringers print objects with improper motives of deceiving consumers.[147] Attempts to pass infringing products off as the infringer's or, conversely, as those of a rights holder exacerbate potential consumer confusion.[148] Trademark and trade dress protection may arm stakeholders with defenses to this illicit activity, provided the rights holder proves the protectable objects are nonfunctional.[149]

V. CONCLUSION

While the full extent of additive manufacturing's impact remains to be seen, understanding the volatile legal landscape ahead is crucial to safeguarding the intellectual assets at the heart of this technology's evolution. Like previous disruptive innovations, additive manufacturing will challenge existing legal IP principles. As traditional laws strain to keep up with revolutionary innovations, ongoing litigation will continue to push the boundaries of the existing legal framework. Rights holders must understand and anticipate the evolving legal climate, including the benefits and limitations of the IP protection they seek. Thoughtful analysis of these issues, including realistic cost predictions, may prove invaluable. Stakeholders also must appreciate and acknowledge that despite the most strategic maneuvers to protect their IP, outcomes in this dicey and evolving climate remain

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146. *See* Two Pesos, Inc. v. Taco Cabana, Inc., 505 U.S. 763, 769 (1992) ("Marks which are merely descriptive of a product are not inherently distinctive. When used to describe a product, they do not inherently identify a particular source, and hence cannot be protected.").

147. *See generally* John Hornick, *How to Tell What's Real and What's Fake in a 3D Printed World*, 3D PRINTING INDUSTRY (Feb. 5, 2014), http://3dprintingindustry.com/2014/02/05/tell-whats-real-whats-fake-3d-printed-world (hypothesizing several possibilities for 3D printing infringement, and suggesting a novel means to combat knockoff products in crucial industries).

148. Of course, there are 3D printers using copyrighted designs without nefarious motives. *See* Rachel Feltman, *This 3-D Printed 'Iron Man' Prosthetic Will Make Kids Feel Super*, WASH. POST (Oct. 20, 2014), https://www.washingtonpost.com/news/speaking-of-science/wp/2014/10/20/this-3-d-printed-iron-man-prosthetic-will-make-kids-feel-super (reporting the medical, financial, and feel-good benefits of 3D printed prostheses for children who frequently outgrow them).

149. *See generally* 15 U.S.C. §§ 1125, 1127.

unpredictable. With this appreciation, understanding, and foresight, additive manufacturing stakeholders can select the most cost-effective and protective means for safeguarding this disruptive technology's valuable IP.

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