Trademarks and Brands in 3D Printing

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TRADEMARKS & BRANDS IN 3D PRINTING

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I. INTRODUCTION

"If you build it, he will come."[1] In the movie "Field of Dreams," Iowa farmer Ray Kinsella heard a voice whispering this phrase and also saw a vision of a baseball diamond in his field.[2] He interpreted this voice and the vision as an instruction to build a baseball diamond in his field.[3] After Ray built the baseball diamond, several deceased baseball players appeared and played on it.[4]

This model of utilizing the action of making something to entice the action of bringing customers has been utilized in traditional manufacturing.[5] The traditional model of delivering goods to customers has been focused on building and delivering goods to consumers at retail stores, online, or by direct delivery. This model is centered around manufacturers making, distributing, and marketing goods. Traditional manufacturers[6] have produced the goods on their own, filed trademarks to indicate the source of origin of those goods, and built globally linked manufacturing facilities with complex supply chains to deliver goods to retail channels and consumers. This model of "if you build it, then the consumer will come" has been utilized by traditional manufacturers.

However, 3D printing changes and redefines this model. In a 3D printing world, the consumer can become both the producer and the end customer.[7] Since 3D printing enables consumers to customize goods, marketers need to revise marketing, trademark, and branding strategies to cater to a new localized production model. Marketers should consider revising the application of the "Field of Dreams" voice to implement a new phrase of, "if *they* build it, *they* will come." In other words, traditional manufacturers of goods should seek to find new ways to engage a consumer who will also become the producer.

Traditional manufacturers of goods and the marketers they employ

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[1] FIELD OF DREAMS (Gordon Company 1989).

[2] *Id.*

[3] *Id.*

[4] *Id.*

[5] David M. Anderson, *The End of the Line for Mass Production: No Time for Batches & Queues,* BUILT-TO-ORDER CONSULTING, http://build-to-order-consulting.com/Mass%20Production.htm (last visited Sept. 14, 2016).

[6] This paper utilizes "traditional manufacturing" to refer to the production of goods where 3D printing is not implemented. In other words, the term "traditional manufacturers" is utilized throughout to refer to a party that produces goods without the use of 3D printing technology.

[7] This paper focuses on a type of manufacturing where the goods will be used by a consumer or where the consumer will personalize the goods. This paper does not investigate 3D printing for prototyping, pre-production, production, industrial, or bioprinting uses.

have begun to learn about the 3D printing revolution. Some are concerned about loss of sales due to counterfeit products produced from 3D printing. Others are unfamiliar with either the technology, are unaware of the complex intellectual property ("IP") issues, or are concerned about the impact of 3D printing on their business models and branding strategies. Yet others have not thought of a business strategy to address, capture, and grow adoption of 3D printing. This paper discusses each of these concerns, by providing an overview of 3D printing technologies, trademark law doctrine, and branding strategies.

In addressing these concerns, this paper focuses on trademarks and brands in the disruptive 3D printing world. The purpose of this paper is to introduce the reader to 3D printing, provide context to the concerns about trademarks and brands in 3D printing, and analyze the underlying trademark law doctrine in the lens of 3D printing. A suggestion is made that trademarks will be deemphasized in a 3D printing world, and therefore, traditional manufacturers and marketers should instead focus on building brand value. Traditional manufacturers and marketers should adopt new branding strategies in order to retain existing customers, engage new 3D printing enthusiast market segments, and align existing consumer engagement models to include new 3D printing applications. The strategic branding recommendations provided herein are a response to doctrinal IP legal analysis and are also grounded on business frameworks in the context of emerging 3D printing technologies that disrupt traditional models of manufacturing of goods.

Part II of this paper provides a brief introduction to 3D printing technology, new business entities, new business models, and markets segments.[8] In doing so, this section addresses new technological innovation and barriers to adoption in 3D printing to give readers who may be new to 3D printing an overview. This section delves into the reasons why certain market segments have ignored or been slow to adopt 3D printing. A discussion of the diminishing importance of IP and its impact on reducing the adoption gap among market segments is also provided.

Part III of this paper focuses on one form of IP—trademarks[9]—and provides an analysis of the interplay between 3D printing and trademark doctrine and policy. It analyzes trademark law issues from

[8] A reader who has a sufficient knowledge of the basics of 3D printing should feel free to skip ahead to Part II and Part III.

[9] The focus of this paper is on trademark and brands. This paper does not discuss 3D printing's effect on other forms of IP, such as copyrights, patents, and trade secrets.

the context of traditional manufacturers of goods, and suggests that trademarks are deemphasized in the era of 3D printing. This section seeks to advance Professor Mark Lemley's thesis that IP artificially imposes scarcity when digitization technologies (such as 3D printing, which digitizes physical goods into digital design files) enable zero marginal cost production.[10] As 3D printing develops, it is conceivable that traditional manufacturers' initial response will be to adopt protectionist strategies to protect their R&D investments, which may be jeopardized as 3D printing trends towards zero marginal cost production. Thus, traditional manufacturers will be inclined to pursue enforcement of their trademarks against 3D printing uses via infringement, dilution, and counterfeiting actions. The downsides to such protectionist strategies in the context of 3D printing are discussed, and a call is made to traditional manufacturers to focus instead on customer engagement and brand development strategies.[11]

Part IV of this paper provides a distinction between trademarks as property rights and brands as strategic business assets. A discussion of the de-emphasis of trademarks and the need for a re-emphasis of brands in the context of 3D printing is provided. This section suggests that traditional manufacturers deemphasize their trademark enforcement strategies and refocus on branding strategies in an era of 3D printing. Brand building (not the artificial scarcity created by IP) is proposed for encouraging creative activity through personal customization by consumers in a 3D printing world. The psychological principles underlying brands in traditional manufacturing economies and the changes needed for marketers in 3D printing are mentioned, and a proposal is made to traditional manufacturers to utilize brands' emotional and symbolic appeal in conjunction with 3D printing's ability of enabling consumers to become producers. Moreover branding via quality in digital design files is suggested to replace IP as a strategic business asset to distinguish among competitors in a post-scarcity world. This section applies Professor Deven Desai's observation [12] that brands, not trademarks, drive demand to generate equity.

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[10] Mark Lemley, *IP in a World Without Scarcity* (Stanford Pub. Law, Working Paper No. 2413974, 2014).

[11] Neil Wilkof, *Trademarks and Brands in the Competitive Landscape of the 3D Printing Ecosystem*, 104 THE TRADEMARK REP. 817, 820 (2014) (citing David Teece, who argued that when innovation is not protected by strong IP regimes, then complementary assets such as trademarks and brands determine economic returns from the innovation (citation omitted)).

[12] Deven R. Desai, *From Trademarks to Brands*, 64 FLA. L. REV. 981, 981 (2012).

II. INTRODUCTION TO 3D PRINTING TECHNOLOGIES & BUSINESS

Projections show a rapid growth for the 3D printing industry, with a Compound Annual Growth Rate ("CAGR") in the near term of nearly 35%[13] and an economic impact in the range of $230 to $550 billion by the year 2025.[14] Much of the expected growth of 3D printing stems from customers who will benefit from 3D printing's ability to enable them to create the physical goods, thereby eliminating the previous high cost-to-entry barrier in producing goods and eliminating the need to wait for the distribution function.[15]

However, there are some barriers that might keep 3D printing from attaining such rapid growth numbers. First, the physical processes of 3D printing are complex and time consuming and do not yield as high quality or precise subtractive manufacturing processes. While 3D printing hardware prices are dropping,[16] there is still a need for improvements and innovation in printing technologies involved to reach better quality print outputs. This section provides a brief introduction to the physical printing processes of 3D printing, and highlights new innovations, new business entities, and new business models that have arisen in 3D printing to capture and deliver the value to 3D printing customers.

Second, while 3D printing hands the ability to produce to the consumer, this very benefit is also a limitation. Some potential customers are hesitant to utilize 3D printing because it does not produce as high grade of a product or a prototype as performed by a traditional manufacturing process.[17] Others, who might still value the

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[13] TJ McCue, *$4.1 Billion Industry Forecast in Crazy 3D Printing Stock Market*, FORBES: TECH (July 30, 2015), http://www.forbes.com/sites/tjmccue/2015/07/30/4-1-billion-industry-forecast-in-crazy-3d-printing-stock-market/#52c2a51125df (discussing that market for additive manufacturing grew at a CAGR of 35.2% in 2014, had a CAGR from 2012 to 2014 of 33.8%, and expanded by over $1 billion in 2014 alone, including with 49 new manufacturers producing and selling industrial grade additive manufacturing machines).

[14] JAMES MANYIKA ET AL., *Disruptive Technologies: Advances That Will Transform Life, Business, and the Global Economy*, 2013 MCKINSEY GLOBAL INSTITUTE 105.

[15] *Id.* at 105, 110–11.

[16] Elizabeth Matias & Bharat Rao, *3D Printing: On Its Historical Evolution and the Implication for Business* PROCEEDINGS OF PICMET '15: MANAGEMENT OF THE TECHNOLOGY AGE, 551, 551-52 (2015), http://faculty.poly.edu/~brao/3dppicmet.pdf.

[17] Matthew Timms, *3D Printing Cannot Completely Replace Traditional Manufacturing, Say Experts*, WORLD FINANCE, (July 16, 2014), http://www.worldfinance.com/infrastructure-investment/3d-printing-cannot-completely-replace-traditional-manufacturing-say-experts.

lower cost and ease of access to 3D printing, are simply hesitant or unfamiliar with this emerging technology. This section analyzes the gaps, or chasms, in adoption that have arisen with 3D printing among specific market segments. The analysis suggests that a reduction in importance of IP in the 3D printing ecosystem also enables a quicker closing of market segment adoption gaps.

A. 3D Printing Technologies, Entities, & Business Models

3D printing utilizes an "additive manufacturing" process to build products by adding many very thin layers of material, layer on top of layer.[18] The brain of a 3D printing operation is an electronic Computer Aided Design ("CAD") file, which serves as a digital blueprint model for producing the output product.[19] This CAD file can be created from 3D modeling software, from scanning a 3D object, or from tweaking in modeling software a scanned object.[20] 3D printing offers the ability to make a physical object using an electronic file, which contains the printing instructions. In essence, a 3D printing machines enable users to turn a digital blueprint into a physical object with the press of a button.[21] There are multiple methods to achieve such conversion of digital to physical, and the major additive manufacturing processes that enable 3D printing are discussed herein.

1. Additive Manufacturing ("AM") Methods

Additive Manufacturing ("AM") is the formalized term for 3D printing, and its basic principle is that a model is initially generated using a three-dimensional CAD system and then fabricated directly without the need for process planning.[22] AM adds material in layers, with each layer being a cross-section of the part that is produced from

[18] *See* Matias, *supra* note 16, at 551.

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

[20] *Id.* at 3.

[21] *See id.* at 2.

[22] IAN GIBSON ET AL., ADDITIVE MANUFACTURING TECHNOLOGIES: 3D PRINTING, RAPID PROTOTYPING, AND DIRECT DIGITAL MANUFACTURING 1–2 (2d ed. 2015) (describing that AM significantly simplifies the process of producing complex 3D objects directly from CAD data, whereas other manufacturing processes require a more careful and detailed analysis of part geometry, the order in which different features can be fabricated, which tools and processes can be used, and what additional features are required to complete the part).

the CAD file.[23] All AM processes utilize a layer-based approach, but there are differences in how the layers are created and bonded to each other.[24] The most common of the AM method utilized in current commercial 3D printing units sold is material extrusion, which is a process by which the object is built in layers by outputting a semi-liquid material from a computer-controlled nozzle.[25] This process utilizes the extrusion of thermoplastics, in which a spool of filament material get fed into a heated printhead, which extrudes the then molten filament onto a build platform.[26] The thermoplastic material rapidly sets after it exits the printhead. An analogous process is extruding of a cake's icing from an icing nozzle and placing the icing onto the cake.

Another additive manufacturing process is VAT photopolymerization, which uses a light source to solidify successive layers on the surface or base of a liquid photopolymer.[27] The most commonly known method of VAT photopolymerization is a StereoLithography Apparatus ("SLA"), which uses a computer-controlled laser beam to build a 3D object within a tank (or "VAT") of a photopolymer.[28] In a SLA process, a UV laser beam traces out the shape of the first object layer on the surface of the liquid and then builds more layers by lowering the tank.[29] A new method of stereolithography utilizes UV light to solidify the bottom layer of the plastic material to build the eventual 3D object in a precise pattern that is dictated by the object's CAD file. Carbon3D is commercializing this new photopolymerization method,[30] and its patents[31] describe the use of a pool of liquid photopolymer resin, with a bottom that is

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[23] Christopher Barnatt, *Future Technologies: 3D Printing*, EXPLAINING THE FUTURE (July 6, 2016), http://explainingthefuture.com/3dprinting.html.

[24] *Id.*

[25] *Id.*

[26] *Id.*

[27] *Id.*

[28] *Id.*

[29] *Id.*

[30] *See* John R. Tumbleston et al., *Continuous Liquid Interface Production of 3D Objects*, 347 SCIENCE 1349, 1349 (2015) (stating that a continuous liquid interface production (CLIP) method creates an oxygen-containing "dead zone" of an uncured liquid layer, thereby reducing the problem of oxygen inhibition of free radical polymerization of conventional photopolymerizing UV-curing resins and enabling simpler and faster stereolithography).

[31] CARBON, http://carbon3d.com/about/ (last visited Sept. 16, 2016); Aaron Tilley, *How Carbon3D Plans to Transform The Way We Make Stuff*, FORBES (Nov. 4, 2015, 2:30 PM), http://www.forbes.com/sites/aarontilley/2015/11/04/how-carbon3d-plans-to-transform-manufacturing/#1a6e0c0de56c (discussing Carbon3D's ability to 3D print one hundred times faster than SLA and at higher resolutions).

transparent to UV light, so that the UV light shines through and illuminates the cross-section of the printed objects, causing the resin to solidify.[32]

Another printing process is power bed fusion, which uses the selective application of heat to bond adjacent powder granules.[33] The most common way of achieving this process is by laser sintering, in which a layer of powder is swept across a powder bed followed by a laser beam that traces out the cross-section of the first object layer.[34] In the selective laser sintering process, a laser melts particles of powder together.[35] One major advantage of this method is that a variety of powdered materials can be used during this process. Another advantage of selective laser sintering is that it provides high resolution in all three dimensions of the object, so that limited, if any, post-production processes are required.[36]

Yet another printing process is sheet lamination, which sticks together sheets of paper, plastic, or metal foil into object layers by cutting them with a laser or blade.[37] In this process, a sheet of built materials is advanced onto a build platform and an adhesive is applied, after which the laser or blade cuts the outline of the object layer into the sheet, and the process repeats. A major advantage of this process is that since no chemicals are used and no chambers are needed, then larger models can be built. However, a downside to this process is that it is difficult to use for printing complex geometries.[38]

2. *New Business Entities & New Business Models*

The traditional model of producing goods involved entities that conducted R&D, manufacturing, distribution and supply chain operations, and marketing.[39] 3D printing democratizes production and provides the ability to print away from control of a traditional

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[32] Method and Apparatus for Three-Dimensional Fabrication with Feed Through Carrier, WIPO Patent No. WO2014126834 (filed Feb. 10, 2014); Continuous Liquid Interphase Printing, WIPO Patent No. WO2014126837 (filed Feb. 10, 2014).

[33] Barnatt, *supra* note 23.

[34] *Id.* at 71.

[35] *See* Winnan, *infra* note 91, at 200.

[36] *See id.*

[37] *See* Barnatt, *supra* note 23.

[38] GIBSON ET AL., *supra* note 22.

[39] MICHAEL E. PORTER, COMPETITIVE ADVANTAGE: CREATING AND SUSTAINING SUPERIOR PERFORMANCE, 36–48 (1985) (describing the value chain in traditional manufacturing as a framework that follows the company's internal product processes starting with raw materials and ending with customer purchase and service; the steps of traditional manufacturing's product flow is delineated as going from raw materials to operations to delivery to marketing and sales and to service).

manufacturing firm.[40] Since 3D printing can enable a new way to mass customize and replace mass production, then new business entities are arising to capture this new way of creating value. Moreover, since traditional product manufacturing and distribution no longer applies in 3D printing, then new business models will arise to provide new ways of delivering value. Thus, new business entities will arise to take advantage of new business models for creating value, capturing value, and serving consumers. There are five fundamental business entity types, some of which are deploying new business models from traditional manufacturing, that are arising in the 3D printing ecosystem:

1. printer and equipment manufacturing,
2. printing intermediaries,
3. software tools,
4. marketplaces, e-commerce sites, and repositories of 3D printable CAD files, and
5. information technology and service oriented solutions utilizing 3D printing.

First, the 3D printer and equipment manufacturing provides capital equipment to be utilized by other businesses and consumers in the 3D printing ecosystem. Such hardware is being deployed for new applications and new markets,[41] and it is conceivable that 3D printing hardware will someday become as commonplace as mobile phones. 3D printers are developing new hardware improvements that provide benefits in printing speed and throughput, material choice, quality and surface finish, end product strength, and printing resolution, but inevitably such hardware improvements are approaching Moore's Law limitations and costs will decrease. While profit margins in hardware manufacturing are often not appealing to investors, new functionality and new capabilities of printing novel materials are creating new life for the printing manufacturing business. Furthermore, novel technology, such as Continuous Liquid Interface Production

[40] John Hornick, *3D Printing and IP Rights: The Elephant in the Room*, 55 SANTA CLARA L. REV. 801, 803 (2015) (discussing that 3D printing away from control means that an individual can make objects without anyone's knowledge and without any firm being able to control it).

[41] Brian Krassenstein, *Carbon3D Unveils Breakthrough CLIP 3D Printing Technology, 25-100X Faster*, 3DPRINT.COM (Mar. 16, 2015), https://3dprint.com/51566/carbon3d-clip-3d-printing, (introducing Carbon3D's game-changing technology that produces prints with consistent mechanical properties and choice of materials required for commercial quality parts, and demonstrating fidelity at micron (µm) resolution under an electron microscope).

("CLIP"),[42] is being utilized in 3D printer hardware for end-use customers in prototyping and manufacturing.[43] Additionally, new printer manufacturers are attempting to solve the difficult hardware problems with reliability and consistency that has hampered progress in adoption of 3D printers among advanced consumers and 3D printing hubs. R&D advances will enable a more consistent print, smoother surface finishes, greater throughput, and quicker print time; however, inevitably, there are tradeoffs between these parameters and bill of materials ("BOM") costs for printer manufacturers.[44]

Second, printing intermediaries that print on behalf of others are providing printing services to those who do not own a 3D printer or do not want to purchase a 3D printer.[45] These intermediaries are platforms that can be in the form of printing service bureaus, printing hubs, Print as a Service ("PaaS") entities, or print-on-demand services. These entities are either purchasers of 3D printing hardware or are separate production entities that utilize 3D printers. Some offer customizable 3D printed products,[46] and others ship directly to consumers who post-process and sell to their customers. Others enable customers to personalize their 3D printed object, along with serving a printing function. In effect, printing intermediaries capture value by providing either creation or customization or both on their

[42] *Id.*

[43] Brian Krassenstein, *Ford Is Now Using Carbon3D's CLIP 3D Printers With Astonishing Results While Researching New Materials*, 3DPRINT.COM (June 23, 2015), https://3dprint.com/75738/ford-is-now-using-carbon3d-clip-3d-printers-with-astonishing-results-while-researching-new-materials/ (discussing the use of the Carbon3D printer for Ford's fabrication of elastomer grommets development in Focus Electric vehicles).

[44] For example, while greater reliability and consistency can be achieved, the tradeoff will be more components, such as sensors and rigid platforms, thereby increasing BOM cost and shipping cost. However, a more reliable and consistent printer could also reduce maintenance cost and could output better printouts, such that the long run volume cost could be smaller than a cheaper and less consistent printer. 3D printer manufacturers will need to conduct design of experiments studies to optimize performance without running up the BOM cost. Professional-grade and production-specific 3D printers will require more consistent, higher quality, and more reliable prints, thereby necessitating a higher BOM cost, whereas consumer-oriented 3D printers for basic consumer function will continue to be designed with cheaper and cheaper components, so as to decrease BOM cost and increase price-sensitive consumer adoption.

[45] Tabrez Y. Ebrahim, *3D Printing: Digital Infringement & Digital Regulation*, 14 NW. J. TECH. & INTELL. PROP. 37, 51 (2016).

[46] Kraftwürx, http://www.kraftwurx.com/about-our-company (last visited Sept. 16, 2016) (marketing the ability to empower anybody to create, showcase, buy, and sell customized 3D printing products through a network of worldwide production facilities).

platforms and by reducing the complexity and cost of delivery, transportation, logistics, and supply chain of 3D printed goods.

Third, some entities' businesses are focused on developing and selling software tools that make it easier to capture, create, or modify 3D printing content.[47] These entities focus on the R&D of software that creates or modifies the electronic blueprint, or CAD file, of the 3D printer. In essence, these companies are involved with promoting the ease-of-use and ease-of-transfer of 3D CAD files. They provide modelers the ability to design a new object for 3D printing. New innovations are arising in software development, including simpler meshing capabilities for 3D model generation and co-creation development platforms.[48]

Fourth, marketplaces, e-commerce sites, and repositories of 3D printable CAD files are offering ways to store information content in CAD files, modify and share modified CAD files, and transact services associated with CAD files.[49] Some allow designers to monetize their creative works, whereas others are completely free and do not allow designers to monetize their designs.[50] Each of these online platforms is aimed at consumer 3D printing applications, and some offer add on services, such as design services, interactive 3D model visualizations, and manufacturability checks.[51] Others offer e-commerce options, such as selling designs, and yet others offer cloud storage capabilities. Similar to other Internet-based business-to-consumer ("B2C") business models, Internet-based 3D websites allow direct interaction with the consumer.

Fifth, 3D printing is starting to utilize information technology and service-oriented solutions. Some new businesses are utilizing technologies and business models from the information technology industry to develop 3D printing platforms aimed at cost reduction, increased production speeds, and big data analytics to enable customers to cope with dynamic changes in 3D printing

[47] *3D Design Programs: Tools for Your Trade*, KRAFTWÜRX, http://www.kraftwurx.com/3d-design-programs (last visited Sept. 16, 2016).

[48] Ebrahim, *supra* note 45, at 39.

[49] *See id.*; *see also* Tesh W. Dagne, *The Left Shark, Thrones, Sculptures and Unprintable Triangle: 3D Printing and its Intersections with IP*, 25 ALB. L.J. SCI. & TECH. 573, 583 (2015).

[50] *See* Kyle Dolinsky, *CAD's Cradle: Untangling Copyrightability Derivative Works, and Fair Use in 3D Printing*, 71 WASH. & LEE L. REV. 591, 616–17 (2014).

[51] *See, e.g.*, *Digital Factory*, KRAFTWURX, http://www.kraftwurx.com/online-3d-printing-dfretail (last visited Sept. 15, 2016) (describing the many options available, such as an "online customization system [that] offers real-time product visualization for what-you-see-is-what-you-get personalization. Real-time pricing, intuitive controls and an industry-leading selection of more than eighty-five 3D Printing materials and finishes").

environments.[52] Enterprise solutions are enabling e-procurement, supplier tracking, and report generation-functions that information technology companies have serviced. Other service-oriented businesses are utilizing 3D printing through support services within their own business processes and providing repair operations and replacement part services.[53]

B. 3D Printing in the Context of the Technology Adoption Life Cycle

3D printing is generating a tremendous amount of interest. The term "3D printing" has experienced a drastic increase in online searching,[54] in media interest,[55] in patent applications filings,[56] and in legal scholarship.[57] Moreover, 3D printing is arising in litigation[58] and

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[52] *See, e.g.*, *id.* (offering a one-stop-shop where customers can create products, purchase professional consulting, and set up e-commerce websites).

[53] Gail Brooks et al., *3D Printing As a Consumer Technology Business Model*, 18 INT'L J. MGMT & INFO. SYS. 271, 274–75 (2014) (describing the advent of support services within existing business models, so as to provide replacement parts with the same capabilities, enable customers to cut costs by not having to order parts from a third party supplier, repairing parts, and redesigning original parts that are no longer available, each via the use of a 3D printer).

[54] UK INTELLECTUAL PROP. OFFICE PATENT INFORMATICS TEAM, *3D Printing: A Patent Overview* 6, 6 (2013), https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/445232/3D_Printing_Report.pdf (showing at Fig. 1, a plot of the number of times the search term "3D printing" has been inputted into the Google search engine, which shows an exponential rise in 3D printing in search engine usage from the years 2011 to 2013).

[55] *Id.* at 8 (showing in Fig. 2, a plot of the usage of the term "Reprap" in the Google search engine and the co-occurrence of news articles mentioning 3D printing which shows a linear rise in such a trend from the years 2007 to 2013).

[56] Gridlocks Technologies Pvt Ltd, *3D Printing: Technology Insight Report* 1, 29 (2014), http://www.patentinsightpro.com/techreports/0214/Tech%20Insight%20Report%20-%203D%20Printing.pdf (utilizing Patent iNSIGHT Pro and PatSeer research tools to generate a chart of patent publications of 3D printing technologies, in which displayed is a gradual linear rise in patent applications in 3D printing technologies from 1961 to 2008 and an exponential rise in 3D printing technologies in patent applications from 2009 to 2013).

[57] Jasper L. Tran, *The Law and 3D Printing*, 31 J. OF INFO. TECH. AND PRIVACY LAW 505, 505 (2015) (outlining a bibliography of over 100 entries of the emerging field of 3D printing law, the historical growth pattern of law, 3D printing legal scholarship, and the publications and cases related to 3D printing).

[58] Robert E. Yoches & Shaobin Zhu, *IP Strategies for Chinese 3D Printing Companies*, FINNEGAN (Sept. 2014), http://www.finnegan.com/resources/articles/articlesdetail.aspx?news=3d9f9b27-f552-440c-a8b7-82c06c218e4f (discussing recent U.S. IP litigation in 3D printing, and noting that two leaders in 3D-printing in the U.S., Stratasys, Ltd. and 3D

continued . . .

in enforcement orders at the International Trade Commission.[59] 3D printing is among the disruptive technologies that has been included in the latest Hype Cycle for Emerging Technologies' report.[60] The hype cycle[61] perspective of an emerging technology, such as 3D printing, follows a progression of interest that can qualitatively be described as going from a rise, to at a peak, to sliding into a trough, to climbing a slope, and finally to entering a plateau. Since there are different applications and different market segments for 3D printing, then the hype cycle expectations vary with 3D printing applications as a function of time.[62]

Systems, Inc, have sued competitors offering low-cost printers; specifying that 3D Systems has sued Formlabs, a U.S. startup 3D printer manufacturer and Kickstarter, Formlabs' crowdsource funder, for infringing a stereolithography patent; and detailing that Stratasys has sued Afinia for patent infringement of four patents relating to fused deposition modeling).

[59] ClearCorrect Operating, LLC v. Int'l Trade Comm'n,, 810 F.3d 1283, 1290 (Fed. Cir. 2015) (regarding a dispute based on the use of 3D printing technology to produce invisible braces and including infringement of digital files containing digital scans of patients' teeth, the case centers on the importation of patented articles and violation of Section 337 of the Tariff Act).

[60] Betsy Burton & Mike J. Walker, *Hype Cycle for Emerging Technologies, 2015*, GARTNER (July 27, 2015), https://www.gartner.com/doc/3100227/hype-cycle-emerging-technologies- (providing a cross-industry perspective on the technologies and trends that business strategists, chief innovation officers, R&D leaders, entrepreneurs, global market developers, and emerging technology teams utilize and evaluate).

[61] *See Gartner Hype Cycle*, GARTNER, (2016), http://www.gartner.com/technology/research/methodologies/hype-cycle.jsp. The research firm Gartner has long promoted an analytical concept of technology's life cycle called the "hype cycle," which is based on the notion that in the world of technology, people follow-up a process of getting over-excited about emerging technological developments, then disappointed when such developments do not gain traction as expected, and finally a plateauing effect of those developments mature and start to gain adoption and traction. This process has been graphically shown in phases of increasing maturity with time and are titled, "innovation trigger," "peak of inflated expectations," "trough of disillusionment," "scope of enlightenment", and "plateaus of productivity." *See id.*

[62] Michael Molitch-Hou, *Consumer 3D Printing More than 5 Years Away from Mainstream Adoption, Says Gartner*, 3D PRINTING INDUSTRY (Aug. 20, 2014), https://3dprintingindustry.com/news/consumer-3d-printing-5-years-away-mainstream-adoption-says-gartner-31677/ (showing a graphical hype cycle representation of 3D printing in which the following applications are displayed in the respective five hype cycle phases: 1) Technology Trigger phase: IP protection, macro 3D printing, 3D bioprinting systems, classroom 3D printing, 3D printing and supply chain, 3D printing for oil and gas, retail 3D printing, and industrial 3D printing, 2) Peak of Inflated Expectations phase: 3D printing of medical devices, consumer 3D printing, and 3D printing in manufacturing operations, 3) Trough of Disillusionment: n/a, 4) Scope of Enlightenment: 3D print creation software, enterprise 3D printing, 3D printing service bureau, and 3D scanner, and 5) Plateau of

continued . . .

3D printing's hype cycle raises questions of why certain segments are gaining traction while others are not and also what affects the rate of adoption. While there is a growing rise of industrial applications for 3D printing,[63] the hype of 3D printing has barely touched the consumer population. The current largest market segment embracing 3D printing is for industrial applications, such as for rapid prototyping[64] and for molds and other tooling applications, whereas the final consumer products usage is a significantly less mature market segment.[65] There are a number of barriers to entry with 3D printing for the average consumer, such as software for 3D printing being difficult to use and a lack of understanding of the design process associated with 3D printing.[66]

A chasm has developed in the 3D printing consumer space due to varying experiences and knowledge with respect to hardware functionality, software familiarity, cost, and interest in customization. Just as in high technology adoption of new products, there have been early market wins, but there seems to be a need to undertake an immense effort to make a transition into serving the mainstream market.[67] 3D printing adoption mirrors other high technology adoption models where market penetration of any new technology production leads to gaps symbolizing dissociation between groups in accepting a new product or a new technology.[68]

There have been early adopters who have embraced 3D printing for personal fabrication.[69] But there is a mainstream consumer market

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Productivity: 3D printing for prototyping).

[63] *See id.*

[64] ALI K. KAMRANI & EMAD ABOUEL NASR, RAPID PROTOTYPING 295 (2006) (defining rapid prototyping as a process of selectively depositing a gas, liquid, powder, or sheet material in layers, with the purpose of producing solid three-dimensional parts directly from CAD models).

[65] *See* Barnatt, *supra* note 23, at 13 (showing technology S-curves adoption among various market segments by graphing 3D printing adoption percentage versus time and displaying in order of highest adoption per given year the following: rapid prototyping, mold & tooling, digital manufacturing, and personal fabrication).

[66] *See* Matias, *supra* note 16, at 556 (demonstrating, via a research survey, that a knowledge gap exists with 3D printing and that an opportunity exists for software companies to design a user-friendly package to educate consumers, who unlike designers and engineers that have regularly utilized 3D printing technology at work or school, are not educated about the 3D printing process of having an idea, designing a 3D model in CAD, converting the design file to an appropriate file type, and then printing the model).

[67] Regis McKenna, *Foreword* to GEOFFREY A. MOORE, CROSSING THE CHASM X, XI (HarperCollins Publishers rev. ed. 2001).

[68] *See* GEOFFREY A. MOORE, CROSSING THE CHASM 12 (HarperCollins Publishers rev. ed. 2001).

[69] *See* Matias, *supra* note 16, at 554 (remarking on how three consumers have

continued . . .

that has been unaware of or slow to adopt 3D printing.[70] The adoption of 3D printing seems to have developed a chasm between the early adopters and the mainstream market akin to the Technology Adoption Life Cycle model proposed by Geoffrey Moore.[71] A segmentation[72] based on psychographic profiles consists of groups characterized as being innovators,[73] early adopters,[74] early majority[75] (which is followed by a major chasm[76]), late majority,[77] and laggards[78] (wherein

become quite savvy in their overall understanding of 3D printing and one of their uses is for personal manufacturing).

[70] *See id.* (discussing that only a small fraction of roughly 10% of consumers has used a 3D printer).

[71] *See* MOORE, *supra* note 68, at 8–10 (where Moore's model describes a response to a discontinuous innovation based on a new technology, wherein each group represents a unique psychographic profile that is a combination of psychology and demographics that makes its marketing responses different from other groups and where the distribution in the model follows a bell curve shape with divisions in the curve roughly equivalent to standard deviations; further describing that technology is absorbed into any given community in stages corresponding to the psychological and social profiles of various segments in a process that can be thought of as a continuum with definable stages, each that is associated with a group; characterizing success for a company within the context of the High Technology Marketing Model as gaining traction from the left to the right of the curve and capturing each group as a reference base in order to market to the next group).

[72] CLAYTON M. CHRISTENSEN & MICHAEL E. RAYNOR, THE INNOVATOR'S SOLUTION: CREATING AND SUSTAINING SUCCESSFUL GROWTH 75 (2003) (cautioning that delineations based on attributes of products and customers only reveal correlations between attributes and outcomes, and suggesting that only when marketing theory provides causality built on circumstance-based segmentation schemes that assert what causes customers to buy a product results in predictable marketing; in other words, critical segmentation analysis is based on the circumstance, and not the actual customer, and requires observation of the circumstances of certain circumstances).

[73] *See* MOORE, *supra* note 68, at 9 (where innovators are defined as ones pursuing new technology products aggressively even before a formal marketing program has been launched since the technology is a central interest in their life and since they often make a technology purchase simply for the pleasure of exploring the new device's properties).

[74] *Id.* (where early adopters are defined as not being technologists, but rather people who find it easy to imagine, understand, and appreciate the benefits of a new technology, can relate potential benefits of the new technology to their concerns, and rely on their own intuition regarding the new technology in making purchasing decisions for particular reasons).

[75] *Id.* (where early majority is defined as a group driven by a strong sense of practicality and wanting to see how other people are making out before they buy in themselves and wanting to see well-established references before investing substantially; further describing that roughly one-third of the whole technology adoption life cycle is comprised of this group, and therefore, winning their business is key to any substantial growth).

[76] *See* CHRISTENSEN, *supra* note 72, at 83 (emphasizing that one's view of a

continued . . .

each is characterized by the degree of adoption of 3D printing).

One challenge for 3D printing to attain a greater adoption and develop a greater market penetration is the need for endorsement of a particular earlier responsive group before developing credibility with a subsequent adoption group.[79] Thus, for example, the support of innovators is needed before reaching early adopters. Another challenge for 3D printing is the difficulty with neatly defining the psychographic profiles associated with 3D printing users and would-be users. An initial characterization utilizing the Technology Adoption Life Cycle model based on observations of 3D printing uses can be: Do-It-Yourselfers ("DIY") as Innovators, Tinkerers as early adopters, "Prosumers" as the early majority, consumers as the late majority, and Skeptics at laggards.

The DIY community has been defined by creating, modifying, or repairing objects without the aid of a paid professional and without being motivated by commercial gain.[80] DIYers are driven by the intrinsic enjoyment of creating and customizing objects, and 3D printing has served as a tool to enable them to pursue making objects. The DYI community fits the psychographic profile of innovators since creative desires are already a central interest in their lives and they find 3D printing an enjoyable outlet for their already existing creative visions. Marketers do not need a formal marketing program to attract DIYs to 3D printing, since DIYers would utilize 3D printing simply to explore 3D printing's properties for creation.

The Tinkerer community is comprised of those who specifically seek out 3D printing technology to make their own products, but unlike DIYers, have particular problems they are solving in the absence of marketplace choices.[81] Tinkerers have been referred to as

market for a certain technology determines what product features are relevant) (therefore, characterizing the 3D printing ecosystem as having segments comprising a chasm in adoption also presupposes that certain 3D printing features are relevant to certain segments).

[77] *See* MOORE, *supra* note 68, at 10 (where late majority is defined as sharing the same characteristics as the early majority plus also requiring that an established standard from large well-established companies; further describing that also roughly one-third of the whole technology adoption life cycle is comprised of this group, and also that gaining traction with this group is especially profitable because all R&D costs have been amortized).

[78] *Id.* (where laggards is defined as a group that simply does not want anything to do with new technology for any reason where it be personal or economic).

[79] *Id.*

[80] Stacey Kuznetsov & Eric Paulos, *Rise of the Expert Amateur: DIY Projects, Communities, and Cultures*, 6TH NORDIC CONF. ON HUMAN-COMPUTER INTERACTION, 1 (2010).

[81] Matias, *supra* note 16, at 552.

Lead Users, who develop and modify products for their own use and anticipate relatively high benefits from obtaining a solution to their needs.[82] The Tinkerer community fits the psychographic profile of early adopters since they can readily imagine, understand, and appreciate the benefits of 3D printing technology and can relate the potential benefits of 3D printing technology to their concerns and needs. In many cases, tinkerers are sophisticated consumers who are trying to fashion solutions to their own particular problems, in the absence of marketplace choices.[83] In essence, tinkerers specifically seek out 3D printers as substitute tools or mechanisms for making their own products, designs, and outputs at home.

While DIYers are utilizing 3D printing for their existing creative desires and Tinkerers find 3D printing as useful solutions for their particular needs, others have even greater sophistication and expectations of 3D printing and fit the psychographic profile for the Early Majority. The label "Prosumer" in the context of 3D printing refers to either: 1) consumers who need higher-grade printing than a hobbyist,[84] or alternatively, 2) a 3D printing populace that is a strong voice or influencer in 3D printing.[85] Both of these characterizations of "Prosumer" are applicable to the Early Majority, since each would need to witness others' usage before investing in 3D printing for themselves.[86] In the first case, a 3D printing user for a high-grade application will need to see 3D printing demonstrated to their satisfaction before putting at risk their high cost or high value project; this is unlike, for example, a DIYer, whose project cost is minimal or can be easily replaced. In the second case, an individual who becomes a strong voice or influencer by blogging, social networking, or spreading messages would first need a point of comparison to provide support or critique for a 3D printing tool or service. However, in either case, each requires a reference point before investing in the emerging technology, and winning over this Early Majority would

[82] ERIC VON HIPPEL, DEMOCRATIZING INNOVATION 19, 22 (The MIT Press 2005).

[83] *See* Matias, *supra* note 16, at 552.

[84] CHARLES BELL, MAINTAINING AND TROUBLESHOOTING YOUR 3D PRINTER 54 (2014).

[85] Susan Gunelius, *The Shift from CONsumers to PROsumers*, FORBES.COM (July 3, 2010, 11:34 AM), http://www.forbes.com/sites/work-in-progress/2010/07/03/the-shift-from-consumers-to-prosumers/#3161e490543f (describing that the term "prosumer" no longer means a "professional consumer" who simply "consumes" products, but instead refers to consumers who are the voices and influencers of products via the social web, such as by blogging, microblogging, social networking, and spreading messages in general about the product).

[86] EVERETT M. ROGERS, DIFFUSION OF INNOVATIONS 249 (3d ed. 1962).

reap substantial growth due to it being a large market segment.

A large chasm separates the early majority from the late majority in the High Technology Marketing Model. Unlike the early majority of "Prosumers," which only requires practicality and some established references of 3D printing technology for engagement, the late majority of Non-Tech Savvy Consumers desires the adoption from well-established companies for engagement of this group. This Non-Tech Savvy Consumer segment refers to the common populace that only begins to use a new technology after seeing a large number of reference points of usage. Finally, the category of laggards will be comprised of Skeptics, which simply will not want anything to do with 3D printing technology.

C. IP Scarcity Narrows Adoption Chasms

3D printing is changing the paradigm of producing goods in traditional manufacturing by enabling consumers to become producers. Each of the aforementioned segments—DIYers, Tinkerers, Prosumers, and Non-Tech Savvy Consumers (the exception being Skeptics)—can utilize 3D printing. Unlike traditional manufacturing, where investments in equipment and facilities, personnel, sales and distribution, and IP were needed to develop, organize, deliver, and protect the value created from producing goods, 3D printing democratizes creation and production.

Traditional manufacturing factors into IP as a cost in the development and distribution process. Proactive IP strategy calls for seeking patent, trademark, and copyright protection in conjunction with the product development process. Even those who ignore IP in traditional manufacturing, potentially end up paying costs later on through litigation expenses stemming from IP infringement or from loss of value from not being able to prevent competitors' market entry or scale due to the limited monopoly rights afforded by patents and trademarks.

However, 3D printing is different from traditional manufacturing since 3D printing separates creation from distribution. 3D printing consumers can produce goods themselves and distribute content with a 3D print for a very low cost, if not for nearly free. Since 3D printing has democratized creation, the development of low cost 3D printing has weakened the need for IP.[87] Unlike traditional manufacturers,

[87] *See* Lemley, *supra* note 10, at 3–5 (discussing that the disaggregation of creation, production, and distribution for the Internet and for 3D printing democratizes access to content, and therefore, there is a less need for IP with growing adoption of cost-reducing technologies).

which have some IP motives and incentives, 3D printing creators[88] are driven by the ability to produce goods cheaply and in a decentralized manner.[89] Such creators are not interested in utilizing 3D printing with IP-based motives.[90] Rather, 3D printing creators are motivated by 3D printing's technological opportunities over traditional manufacturing, such as: reduced costs, customization, creativity, time to market, and component complexity.[91]

However, even with reduced IP motivations, some consumer markets segments have not yet embraced 3D printing or are slow to adopt it. Similar to other high tech adoption cycles, different market segments have different adoption rates, and a major challenge for a business is to gain traction among later adopters of the technology. The High Technology Marketing Model suggests that there is a gap in adoption between the innovators and the early adopters, another gap in adoption between the early majority and the late majority, and a major chasm of adoption between the early majority and late majority.[92]

The chasm between the various market segments in traditional manufacturing was harder to cross when IP was a barrier.[93] In

[88] *Id.* at 26 (Creators who are using 3D printing are paying less attention to IP and are not motivated by incentives that IP may provide. Despite the initial limitations with a nascent 3D printing technology, such as difficulties in user friendliness, strength, surface finish, speed, and failure rates, the advantages have caught on with innovator and with early adopter creators).

[89] *Id.* at 49.

[90] Such 3D printing consumers do not need to factor in a cost of IP in their creation budget because they do not either proactively seeking IP protection nor lose future value from their 3D printed goods by ignoring IP (since such consumers are keeping the 3D printed goods for themselves).

[91] CHRISTOPHER D. WINNAN, ADVENTURES IN 3D PRINTING: LIMITLESS POSSIBILITIES AND PROFIT 25–30 (2013).

[92] *See* Moore, *supra* note 68, at 18.

[93] For example, the IP regime has benefited large manufacturers, whose use of patents ultimately prevented smaller, innovative, startups to commercialize their technologies. In such cases, the large manufacturers developed products, protected by patents, that served lucrative, high margin market segments, but avoided lower margin and higher population market segments. In such scenarios, the large manufacturers develop patent thickets or patent clusters, which have been known to impede innovation. The effect has been the smaller companies were prevented from developing their technologies in some industries, partly due to concern about what the larger manufacturers' patents covered, partly from the great cost to commercialize technology, and partly from the lack of benefit from capturing value from low margin segments. As an example, the chip industry show this effect for gaming applications. Large chip manufacturers, such as Intel, AMD, and NVIDIA, have developed graphics cards to serve high margin gaming enthusiasts, and in doing so, have secured patents to protect chip hardware for specific applications geared for this market segment. However, smaller companies are restricted from entering due to the cost of developing manufacturing facilities to develop chips in

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contrast, democratization of production reduces IP's barrier of entry and reduces the adoption chasms between various market segments in 3D printing, as opposed to other technologies. 3D printing adoption entails IP as being less of a factor than the chasm in traditional manufacturing of high technology production. Thus, the defensive limited monopoly rights afforded by IP and the large development costs associated with traditionally manufactured products does not hinder adoption between adoption segments in 3D printing as much as in traditional manufacturing. In essence, the blurred line between manufacturer and customer in 3D printing makes it easier for later-to-adopt consumers to cross adoption chasms.

III. TRADEMARKS ENFORCEMENT STRATEGIES IN 3D PRINTING

The previous section has shown that 3D printing technologies are proliferating. New 3D printing business are developing innovative business models, 3D printing utilization is crossing adoption segments and multiplying, and the IP regime is less of an issue in a 3D printing world than it was in a traditional manufacturing world. Each of these rapidly developing trends with 3D printing is also rapidly raising new challenges and uncertainties regarding IP.

Manufacturers had traditionally produced goods on their own, filed trademarks to indicate the source of origin of those goods, filed patents to protect novel technologies associated with those goods,[94] and built globally linked supply chains to deliver goods to retail channels and end use customers. However, since 3D printing changes and redefines this traditional model, democratizes manufacturing, and enables personalized and localized production, a question arises as to what role IP plays in a new 3D printing world.

This section advances Professor Mark Lemley's thesis that IP artificially imposes scarcity when mass creation and mass distribution through digitization technologies (such as 3D printing, which digitizes physical goods into digital design files) enable zero marginal cost production.[95] Thus, one take on Professor Lemley's viewpoint is that disaggregation of digital content indirectly lessens the value of IP,

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graphics cards for the lower margin, larger general population. Thus, the effect was an adoption chasm was created, in which later-to-adopt segments were not served, partly due to IP barriers and developmental costs.

[94] This paper focuses on trademarks and brands, and does not delve into other aspects of IP law such as patent law (a more in-depth discussion of patent law and 3D printing is covered in Tabrez Y. Ebrahim, *3D Printing: Digital Infringement & Digital* Regulation, 14 NW. J. TECH. & INTELL. PROP. 37 (2016).

[95] Mark A. Lemley, *IP in a World Without Scarcity*, 90 N.Y.U. L. Rev. 460, 467–68 (2014).

since IP would need to artificially impose scarcity to be relevant with the mass adoption of digitization technologies (such as 3D printing, which digitizes physical goods into digital design files) in a post-scarcity world.[96] Therefore, the ability of 3D printing to enable mass creation and distribution of digital content in the form of CAD files lessens the need for trademark law, which is one form of IP.

Even with the lessened importance of trademark law in 3D printing, traditional manufacturers could attempt to enforce their trademarks through infringement, post-sale confusion, dilution, and counterfeiting actions. However, this paper argues that manufacturers would be better suited to deemphasize their focus on trademark litigation and instead develop a brand engagement strategy for 3D printing. The continued discussion in this paper proposes that trademarks are valued by consumers for information about the identity of products and as source identifiers, whereas brands are valued by consumers for having emotional and symbolic appeal.

A. Democratizing Creation Reduces Trademarks' Traditional Functions

The democratization of creation provided by 3D printing is enabling anybody to make almost anything.[97] 3D printing enables unauthorized copies of a traditional manufacturer's products to be printed on 3D printers with a company's trademark, logo, or specialized design. Traditional manufacturers are concerned with 3D printing's impact on their business for a number of reasons including:

1. **Search difficulties**: consumers will find it more difficult to find traditional manufacturers' authentic goods when other consumers are increasingly sharing CAD files with information content bearing resemblance to traditional manufacturers' goods;
2. **Deception**: consumers will more easily be deceived by what is authentic and what is not, thereby causing consumers to make purchasing mistakes;
3. **Weakened communication**: consumers will find it more difficult to interpret and internalize communication messages sent by traditional manufacturers to them when others are printing good bearing similar resemblances but

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[96] *Id.*

[97] John F. Hornick, *IP Licensing in a 3D Printed World*, LES NOUVELLES, June 2015, at 95.

contrary to the communication message inherent in the traditionally manufactured good;

4. **Erosion of assets**: consumers will be destroying the value of traditional manufacturers' trademark assets simply by 3D printing goods resembling authentic goods even when not done knowingly; and
5. **Devaluing Internet-based business models**: consumers will make it especially harder for traditional manufacturers to conduct business on the Internet, and eroding certain benefits of traditional manufacturers' business conducted on the Internet, since consumers will have quicker, easier, or more prevalent access to CAD files than the manufacturers' business-to-consumer website functions.[98]

Traditional manufacturers will feel less confident that consumers will recognize their trademarked product was actually made by that traditional manufacturer as 3D printing adoption rises. Moreover, traditional manufacturers are becoming concerned about the loss of revenues from the increasing likelihood of counterfeiting and trademark infringement brought on by 3D printing. Some estimates predict an expected loss of $100 billion per year in IP globally due to counterfeited goods produced by 3D printing.[99]

With 3D printing technology becoming widely accessible, so too are the means to produce counterfeit goods and to infringe on registered trademarks.[100] The ease of transferring CAD files that contain the blueprint instructions to download and create identical copies of goods enables mass-production of counterfeit goods and mass-production of goods that will infringe on registered trademarks. Another way to produce a counterfeit mark is to 3D print it onto a product, and a counterfeiter then obtains the product with the

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[98] *Id.*

[99] Press Release, Gartner, Gartner Says Uses of 3D Printing Will Ignite Major Debate on Ethics and Regulation (Jan. 29, 2014) (on file with author).

[100] Counterfeiting and infringement are related, but distinct. Counterfeiting is the making of fraudulent copies of something valuable whereas trademarks are infringed by likely to confuse. Counterfeiting is narrower in scope than trademark infringement, such that counterfeiting is a subset of trademark infringement. Counterfeiting applies only to trademarks in way made to look identical to the actual registered mark. In short, all counterfeit marks are infringing, whereas all infringements are not counterfeits; infringement trademarks can include a broader class of trademarks that are confusingly similar to genuine trademarks. On the other hand, counterfeit trademarks include trademarks that are substantially indistinguishable from a genuine mark, such that there are only minor or trivial differences from the genuine trademark.

counterfeited mark, scans it with a 3D scanner, and makes copies.[101] Traditional manufacturers of goods could employ a number of response strategies, including writing cease and desist letters, filing trademark infringement lawsuits, and demanding that internet service providers block websites that host potentially infringing material.[102] These actions parallel the well-documented history of such responsive actions from the Recording Industry Association of America ("RIAA") following the advent of peer-to-peer music file sharing.[103] Given the similarities between music files and CAD files in ease of sharing and transmitting electronically[104] content employing IP, there is a strong possibility that a similarly responsive litigation strategy will be employed by traditional manufacturers as was employed by the music industry to protect IP assets. As traditional manufacturers see consumers utilizing 3D printers to print goods bearing a resemblance to their own, they will utilize trademark law as a control mechanism to prevent 3D printing users from destroying their markets and businesses.[105]

1. Infringement Actions

Trademark law, unlike patent and copyright law, is not mentioned in the U.S. Constitution.[106] Trademark law has been designed to

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[101] Dan Cohn, *3D Printing & Trademark Counterfeiting Part 3: Break the Mold or Erase the Ink?* TECH., MANUFACTURING & TRANSP. INDUSTRY INSIDER (Apr. 8, 2015), http://www.tmtindustryinsider.com/2015/04/3d-printing-trademark-counterfeiting-part-3-break-the-mold-or-erase-the-ink.

[102] Amanda Scardamaglia, *Flashpoints in 3D Printing and Trademark Law*, 23 J. L. INFO. & SCI. 30 (2015) (comparing the response of the copyright content industries, which responded heavily with litigation when faced with similar challenges of piracy on the Internet).

[103] Electr. Frontier Found., *RIAA v. The People: Five Years Later*, (Sept. 30, 2008), https://www.eff.org/wp/riaa-v-people-five-years-later (describing that the RIAA had filed, settled, or threatened legal actions against over 30,000 music fans for sharing songs on peer-to-peer file sharing network, and such a litigation campaign proved to be ineffective and tens of millions of music fans continued to use peer-to-peer file sharing systems).

[104] While each of MP3 files and CAD files can be easily shared via peer-to-peer networks, CAD files themselves can be modified by users whereas MP3 files are typically not modified, but instead are only shared. *See* Lucas S. Osborn, *Regulating Three-Dimensional Printing: The Converging Worlds of Bits and Atoms*, 51 SAN DIEGO L. REV. 553, 559 (2014). Nonetheless, the ease of sharing, copying, and exchanging is similar to both file types. *See id.* However, there are parallels and lessons that can be learned from the peer-to-peer music file sharing world where it was expensive and time consuming for the Recording Industry Association of America to file suits of digital copyright infringement. *See* ELECTR. FRONTIER FOUND., https://www.eff.org/wp/riaa-v-people-five-years-later (Sept. 30, 2008).

[105] *See* Scardamaglia, *supra* note 102, at 3.

[106] *See* U.S. CONST. art. 1, § 8, cl. 8.

protect consumers, so they are confident products marked with a traditional manufacturer's symbol were actually made by that traditional manufacturer.[107] Thus, trademark law serves both as a way to protect identification of the traditional manufacturer's good and as a way to protect the trademark's integrity.[108]

Trademark law becomes implicated when others make an exact copy of an object. A party that owns the rights to a particular trademark can sue subsequent parties for trademark infringement.[109] Thus, for example, if another party made an exact copy of an object with a 3D printer and that copy included a trademark, that copy would infringe on the trademark if used in commerce. This means that 3D printing objects would only be considered trademark infringement when there is commercial use of a copied three-dimensional object, but not for purely personal use.[110] This is because trademarks do not prevent unauthorized production of a product for private non-commercial purposes, such as in one's own home.[111] But once an attempt has been made to try to sell an unauthorized 3D printed object bearing a trademark, then trademark infringement arises.[112] But a party would be able to successfully defend against a trademark infringement action against it when it replicates the object without replicating the trademark (such as without the logo).[113]

However, if these infringement exceptions of personal use or without the trademark do not apply, then there can be a trademark infringement claim against another if the "likelihood of confusion"[114] test based on a list of factors[115] is met.[116] The relevant confusion can

[107] *See* J. THOMAS MCCARTHY, TRADEMARK AND UNFAIR COMPETITION §§ 24:1–7 (4th ed. 2004).

[108] *See id.* §§ 24:5–6.

[109] 15 U.S.C. §§ 1114, 1125 (2012).

[110] *See generally* Scardamaglia, *supra* note 102, at 12 (stating "[c]onsequently, personal, descriptive or aesthetic use of a shape or the use of a shape for its functional capacity will not ordinarily constitute infringement nor will the purely descriptive use of a registered word mark").

[111] *See id* at 48, 51.

[112] *See id.* at 49.

[113] MICHAEL WEINBERG, WHEN 3D PRINTING AND THE LAW GET TOGETHER, WILL CRAZY THINGS HAPPEN? Information Technology and Law Series 11, 22 (Bibi van den Berg et al. eds., 2006).

[114] The "likelihood of confusion" is a multifactor test and can be applied in a federal claim for infringement of a federally registered mark or a federal claim of infringement of an unregistered mark under the Lanham Act's § 43(a) or alternatively under a state common law action.

[115] *See* RESTATEMENT (THIRD) OF UNFAIR COMPETITION § 20 (AM. LAW INST. 1995); *see* J. THOMAS MCCARTHY, MCCARTHY ON TRADEMARK AND UNFAIR COMPETITION §§ 24:30–43 (4th ed. 2016); *see generally* RICHARD L. KIRKPATRICK, LIKELIHOOD OF CONFUSION IN TRADEMARK LAW 2-1 to -79 (2d ed. 2016).

be attributed to any number of areas—to source, sponsorship, affiliation, or connection. Each federal circuit has developed its own list of factors, and the Restatement of Unfair Competition has identified eight relevant factors, with six described as market factors and two based on intent and evidence of actual confusion.[117] Many of the circuits' lists of factors consider the defendant's intent, such that a defendant knowingly uses the plaintiff's trademark to identify similar goods may strongly show an intent to derive benefit from the reputation of the plaintiff's marks.[118]

If a traditional manufacturer decides to pursue a trademark infringement suit against a 3D printing user, then it can pursue under the theories of direct liability or secondary liability, which is an indirect infringement theory that be either contributory or vicarious liability. One option would be to sue the direct infringer who uses a 3D printer to make unauthorized copies. The challenge with direct infringement theory with trademarks happens when the object at issue is not the physical good, but the digital CAD file. The digital instructions for 3D printing the trademarked good would probably not be considered direct infringement. For example, in the litigation by BMW Group against Turbosquid for selling unauthorized virtual 3D models of vehicle designs for eventual 3D printing, the issue at hand was whether a CAD file of a BMW car was considered an object or instruction to print the object.[119]

Additionally, traditional manufacturers would have difficulty with direct infringement actions since it would take considerable time and effort to identify and locate such a direct infringer entity. Moreover, since such a direct infringer would be an individual with significantly less financial resources than a corporation, then the cost would outweigh any substantial benefit in monetary damages.

Another alternative is to pursue indirect infringers, such as the

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[116] Nearly all of the "likelihood of confusion" factor tests consider the similarity of the marks. However, when there are non-competing goods, then an assessment is made as to whether the goods are related. In some cases, if the goods are unrelated, but are identical marks, then the use can be non-infringing and permissible.

[117] *See* RESTATEMENT (THIRD) OF UNFAIR COMPETITION, *supra* note 115, at §§ 21-22.

[118] Often times, trademark infringement suits involve results of a consumer survey run by an expert who attempts to show existence or absence of a basis of intent. While it is very expensive to conduct a survey, such surveys can serve as a means to provide some sort of evidence demonstrating intent.

[119] Complaint at 1, BMW Group v. Turbosquid, Inc., No. 2:16-cv-02500-SDW-LDW (D.N.J. May 3, 2016) (wherein the plaintiff BMG Group alleged infringement of trademarks, trade dress, and design patents in a complaint against Turbosquid, which contended that the 3D models were for visualization only and not for eventual 3D printing uses).

aforementioned intermediaries of printing service bureaus, printing hubs, PaaS entities, and print-on-demand services companies. Contributory infringement can apply when a third party, which is not the traditional manufacturer, aids or engages another to engage in the trademark infringing conduct.[120] Essentially contributory infringement is a judicially created doctrine and it typically applies to manufacturers and distributors of goods. In the world of 3D printing, the distributors are the ones that enable transmission and sharing of CAD files, which can be printing intermediaries that effectively distribute goods in the form of the digital blueprint CAD files. The Restatement of Unfair Competition specifies that:

> One who markets goods or services to a third person who further markets the goods or services in a manner that subjects the third person to liability to another for infringement…is subject to liability to that other for contributory infringement if:
>
> a) the actor intentionally induces the third person to engage in the infringing conduct; or
>
> b) the actor fails to take reasonable precautions against the occurrence of the third person's infringing conduct in circumstances in which the infringing conduct can be reasonably anticipated.[121]

These indirect infringers are liable for infringement in the U.S. when they have knowledge that printing the 3D object violated the trademarks rights of the traditional manufacturer.[122] There are other indirect infringement standards in other counties; for example, the U.K. considers indirect infringement in the course of trade,[123] such that the potentially infringing entity is not required to have intention or knowledge that their actions amount to infringement.

However, traditional manufacturers will want to have a business relationship with printing intermediaries, and therefore would not want to pursue trademark infringement suits against them. Instead, the traditional manufacturers would be advised against considering

[120] Mark A. Lemley, *Inducing Patent Infringement*, 39 U.C. DAVIS L. REV. 225, 229 (2005).

[121] *See* RESTATEMENT (THIRD) OF UNFAIR COMPETITION, *supra* note 115.

[122] *See, e.g., Glob.-Tech Appliances, Inc. v. SEB S.A.,* 563 U.S. 754, 131 S. Ct. 2060, 2068 (2011).

[123] Trade Marks Act of 1994, §10(2) (Eng.); Community Trade Mark Regulation 2004, 9(1) (Eng).

infringement suits, but instead licensing options. For example, the printing intermediaries can serve as a mechanism for providing authorized CAD files that are authentic representations of the traditional manufacturers' goods. These licensing agreements in between traditional manufacturers and printing intermediaries should involve terms that cover the traditional manufacturer's trademark and look and feel of the good. Moreover, traditional manufacturers that avoid their initial reaction towards suing printing intermediaries for indirect infringement could also benefit from cross-license agreements in which the end user customer modifies a CAD file and provides that modified CAD file back to the traditional manufacturer.

2. Dilution

Dilution[124] and infringement are sometimes conflated concepts, but they are distinct. Dilution of a famous trademark is an alternative way of protecting a trademark owner's interest even if the use was not in commerce, did not confuse consumers, or did not cause direct economic harm to the trademark owner.[125] The protection for dilution[126] for a traditional manufacturer will only apply when the trademark is famous and widely recognized.[127] A reason for making a trademark dilution claim is that another party's actions no longer exclusively designate the source of those goods.[128]

This can be particularly relevant to 3D printing, since a 3D printer can easily print logos for different uses compared to a traditional manufacturer and can create unique ways of associating a trademark for a different purpose. By doing so, such 3D printing uses can lessen

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[124] John Shaeffer, *Trademark Infringement and Dilution are Different—It's Simple*, 100 THE TRADEMARK REPORTER 808–09 (2010) (asserting that dilution is different from infringement, since in infringement the consumer is confused by believing that there is only a single source for the goods (but in reality there are two unrelated sources), whereas in dilution, the consumer correctly believes that there are two sources selling goods (when there used to be only one source selling goods)).

[125] Trademark Dilution Revision Act of 2006 (H.R. 683) (TDRA).

[126] *See generally* Trademark Dilution Revision Act of 2006, 15 U.S.C. § 1125(c) (2012) (entitling the owner of a famous mark to an injunction against another person whose action is likely to cause dilution by blurring or dilution by tarnishment of the famous mark).

[127] 15 U.S.C. § 1125(c)(2) (2012) (noting that for purpose of a claim for dilution, "a mark is famous if it is widely recognized by the general consuming public of the United States as a designation of source of the goods or services of the mark's owner").

[128] 15 U.S.C. § 1125(c)(3)(A) (2012) (stating that "[a]ny fair use . . . of a famous mark by another person other than as a designation of source for the person's own goods or services" is not actionable as dilution by blurring or dilution by tarnishment).

the association of source of origin of a traditional manufacturer's goods. For example, a 3D printer can be utilized to more easily print 3D logos for different uses than intended by the traditional manufacturer. In such a case, confusion is not likely because consumers would find it implausible that such a different and unrelated use would exist, but there would be dilution due to weakening the source of origin.

A traditional manufacturer can make a claim for dilution by blurring or dilution by tarnishment against a consumer who 3D prints and sells an object bearing a trademark.[129] In either case, the federal statute requires that a trademark is only eligible for protection against dilution if it is famous, which requires wide recognition by the general consuming public based on duration, extent, and geographic reach of advertising and publicity of the trademark.[130]

Moreover, traditional manufacturers can also bring a claim against 3D printing users for dilution of trade dress. Since 3D printing can easily create 3D objects, then traditional manufacturers can seek dilution by trade dress claims against those who sell objects identical to famous objects bearing distinctive shapes, textures, product configurations, and packaging.[131] However, this will be a difficult and rare claim, since the Supreme Court has held that there is not inherently distinctive product configuration.[132]

3. *Post-Sale Confusion*

Post-sale confusion gives a trademark holder a remedy, since an inferior product bears a trademark that is identical to or confusingly similar to the trademark holder's trademark, thereby diminishing the reputation by potentially confusing a non-purchaser that the inferior product belongs to the trademark holder.[133] Also, a post-sale confusion claim can be made when a potential purchaser of the traditional manufacturer's trademark products is confused in encountering a post-sale context, such as in a direct purchaser's possession.[134] In such a case, the consumer is not deceived about a product's origin at the time of purchase, but other members of the

[129] *See* 15 U.S.C. § 1125(c)(1).

[130] 15 U.S.C. § 1125(c)(2)(A) (2012).

[131] 15 U.S.C. § 1125(c)(2)(B) (2012).

[132] Wal-Mart Stores, Inc. v. Samara Bros., Inc., 29 U.S. 205 (2000) (holding that product configuration can only be protected as trade dress after proof of secondary meaning, and further discussing challenges with showing product configuration as being famous).

[133] Gibson Guitar Corp. v. Paul Reed Smith Guitars, LP, 423 F.3d 539, 552 (6th Cir. 2005).

[134] *See* 15 U.S.C. § 1114(1) (2012).

public might be misled when they subsequently encounter the consumer in possession of the product.[135]

In essence, post-sale confusion[136] holds that infringement can injure a trademark owner even if purchasers of the infringing product are not confused.[137] Post-sale confusion is similar in some ways to a trademark infringement action, but instead of having to prove "likelihood of confusion," the burden of proof is reduced to a possibility of confusion.[138]

The case law has shown two types of post-sale confusion: bystander confusion or status confusion.[139] Bystander confusion occurs when a potential purchaser of the trademark holder's product observes the product outside of the retail context and wrongly believes that the product comes from the trademark holder.[140] If the quality of the product is negative, then that potential purchaser will stop purchasing the trademark holder's product in the future. This is relevant to 3D printing, since objects can be printed with inferior quality with a 3D printer. The negative association caused by the 3D printing output, whether by the choice of a 3D printer user or by substandard quality produced by the particular type of printer, lessens the value of a trademark as an indicator of quality. Due to increasing hardware costs, many consumer-grade 3D printers are built from low-cost components, which results in low quality prints. Thus, even a 3D printing user who wants to produce a high quality 3D print might end up producing a low quality print by virtue of the 3D printer, and in doing so could create bystander confusion for a potential purchaser who wrongly believe the good came from the trademark holder.

On the other hand, status confusion arises when consumers are purchasing a product for its social status, but not for its high quality. Typically, these products command higher prices because they are scarcely offered for sale, thereby making them more luxurious to consumers.[141] Since 3D printing enables more ease of production of

[135] James Grace, *The End of Post-Sale Confusion: How Consumer 3D Printing Will Diminish the Function of Trademarks*, 28 HARV. J.L. & TECH. 263, 270 (2014).

[136] As an example, a counterfeit watch of a well-known brand could be purchased by a consumer who knows it is not genuine, but the public would erroneously consider it to be genuine when that watch is seen on the purchasing consumer's wrist. Under the post-sale confusion theory, the traditional manufacturer could bring claims against both the counterfeiter who sold the counterfeit product and a competitor who developed and was selling a confusingly similar product.

[137] Deven R. Desai & Gerard N. Magliocca, *Patents, Meet Napster: 3D Printing and the Digitization of Things*, 102 GEO. L.J. 1691, 1710 (2014).

[138] Jeremy N. Sheff, *Veblen Brands*, 96 MINN. L. REV. 769, 774 (2012).

[139] *Id.* at 778.

[140] *Id.* at 778–79.

[141] *Id.* at 791–92.

goods, then even scarce goods will be more easily produced, and therefore, status confusion will increase. As 3D printing increases and people are more easily deceived into falsely attributing social status with those who possess what were once scarce goods, there will be lost sales for the trademark owner who had relied on the scarcity of goods to demand price premiums. As unauthorized 3D printed replicas of trademarked products increase, the public perception of scarcity of that product decreases.

Given that consumer products can be easily produced by a 3D printer, then consumer expectations for trademarks will be diminished. Consumers may no longer rely on trademarks as indicating a source of origin. In response, a traditional manufacturer could also bring a claim of post-sale confusion against those who utilize a 3D printer to print goods that cause potential purchasers or non-purchaser confusion, whether it is bystander confusion or status confusion. However, in order to do so, the universe of potential consumers must be identified.[142] This could be a challenge, since the universe of potential consumers of 3D prints is vast and difficult to track down. Thus, post-sale confusion, while a viable claim, is difficult to pursue. The theory inherent in post-sale confusion, of protecting the traditional manufacturer's artificial scarcity of the good and its status symbol, is wrinkled because consumers will have less of a reason to think that whatever trade dress is observed outside of a traditional manufacturer's control or store was made by the traditional manufacturer. Therefore, while traditional manufacturers may attempt to pursue such claims, they will be limited in value.

4. *Increased Counterfeiting*

In addition to a decrease in the importance and strength of trademarks, 3D printing will also increase the ability to produce counterfeited goods. As 3D printing scanning capabilities,[143] applications, and adoption each increase, so will the use of 3D printing technology for the counterfeiting of goods. Manufacturers of goods will become concerned about counterfeiting since the counterfeit is substantially indistinguishable from their registered mark, thereby decreasing sales of their goods.[144] Traditional manufacturers will

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[142] Connie Davis Powell, *We All Know It's a Knock-Off! Re-Evaluating the Need for the Post-Sale Confusion Doctrine in Trademark Law*, 14 N.C.J.L. & TECH,1, 25 (2012).

[143] Dan Cohn, *3D Printing & Trademark Counterfeiting Part 2: Break the Mold or Erase the Ink?* (Apr. 6, 2015), http://www.tmtindustryinsider.com/2015/04/3d-printing-trademark-counterfeiting-part-2-break-the-mold-or-erase-the-ink/.

[144] Lisa Pearson, Georges Nahitchevansky, Christopher P. Bussert, and James H. Sullivan, Jr., *An Overview of Legal Remedies Against the Trafficking in Goods*

continued . . .

become concerned because, over time, the growth of imitators will confuse consumers, destroy trust and communication properties of brands, and no longer identify the source of the good.[145]

Moreover, since 3D printing enables printing of goods with different materials while still retaining the other product characteristics such as shape and texture, then counterfeiting via 3D printing can destroy brand value due to use of different materials that may be of a lower quality than the original material associated with that particular object. Furthermore, online trademark infringement is more likely with 3D printing, since CAD files can be utilized to sell "replica" branded goods and imitators that infringe on the trademark of a well-known brand name.

Counterfeited goods, which are often referred to as "fake goods" or "knock-off" goods, will be much easier to produce with 3D printers. Counterfeiting is defined as the practice of manufacturing, distributing, or selling goods under a trademark identical to a registered trademark.[146] 3D printing technology makes it easier and quicker to produce counterfeited goods or counterfeited marks. There are multiple ways that a 3D printer can be utilized for the purpose of counterfeiting. First, CAD files can serve as blueprints for counterfeiting, and CAD files could get into the hand of an IP infringer, who could mass-produce identical-looking counterfeit products with ease.[147] Second, individuals can create and share CAD files containing the blueprint of a good bearing resemblance to a registered trademark and many goods can be printed from that CAD file.[148] Third, 3D printers can be utilized to print 2D trademarks onto 3D printed objects, in an effort to produce a knock-off good that would be a fake yet identical to a good with a registered trademark.[149]

Moreover, counterfeiting goods by the use of a 3D printer could also raise product liability issues. A user who utilizes a 3D printer to

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Bearing Counterfeit Trademarks and Gray Market Goods Under United States Law, http://www.kilpatricktownsend.com/~/media/Files/articles/LPearsonOverviewofLegalRemedies.ashx (last visited Sept. 16, 2016).

[145] J.L. ZAICHKOWSKY, THE PSYCHOLOGY BEHIND TRADEMARK INFRINGEMENT AND COUNTERFEITING 11 (Lawrence Erlbaum Associates, 2006).

[146] *Protecting a Trademark: Counterfeiting (Fact Sheets)*, INT'L TRADEMARK ASS'N, http://www.inta.org/TrademarkBasics/FactSheets/Pages/CounterfeitingNL.aspx (last updated July 2016) (discussing that counterfeiting is different from trademark infringement, in which selling products under confusingly similar trademarks).

[147] *See* Scardamaglia, *supra* note 102, at 33.

[148] *See id.* at 50 (providing examples of how knock-off designer sunglasses, handbags, jewelry, and furniture could undermine businesses selling goods in those industries).

[149] *See id.*

print counterfeit components for use in systems, either new or as a replacement, jeopardizes the safety of the public since the system could be unstable or unsafe. Thus, since a traditional manufacturer does not have control of how components may be introduced or replaced in a system due to the advent of 3D printing, then there is greater risk for liability due to system failure causing damage, injury, or pain. Additionally, the advent of 3D printed drugs customized to individuals[150] has raised the possibility of counterfeit drugs, which can lead to pain and injury. If 3D printing becomes prevalent, then traditional manufacturers of cars, consumer goods, or drugs, might have to purchase some sort of insurance to protect against the risk of 3D printed replacement parts.

There can be multiple avenues for traditional manufacturers to seek remedies against defendants for counterfeiting. The Trademark Counterfeiting Act of 1984 makes it a federal offense to violate the Lanham Act with an intentional use or an unauthorized use of a counterfeit trademark.[151] Also, liability under the Lanham Act for a counterfeit mark imposes liability for placing a non-genuine article in a genuine container, such a non-genuine fluid into a genuine soda container.[152] A traditional manufacturer can attain criminal penalties against a 3D printing counterfeiter or can also pursue Racketeer Influenced and Corrupt Organizations Act ("RICO") claims against those who participate in trafficking counterfeit goods.

B. Security, Marking, & Detection Technologies as Countermeasures

As 3D printing proliferates, a key question for traditional manufacturers to ask themselves will be: What will the response be to trademark infringement, dilution, and counterfeiting? One financial consultant has suggested that traditional manufacturers should not ask themselves simply, "What is my 3D printing strategy?" but instead ask, "What is my business strategy in a world becoming more and

[150] Ann Robinson, *Welcome to the Complex World of 3D-printed drugs*, THE GUARDIAN (Aug. 21, 2015), http://www.theguardian.com/sustainable-business/2015/aug/21/welcome-to-complex-world-of-3d-printed-drugs-spritam-fda (discussing, for example, that a 3D printed drug can act as a proxy robot that can mix individual constituents akin to an automated cocktail maker, such that one can create one's own drug using a 3D printer or such that drug blueprints can be 3D printed at a local pharmacy).

[151] Trademark Counterfeiting Act of 1984, Pub. L. No. 98-473, § 1502(a), 98 Stat. 2178 (1984).

[152] 15 U.S.C. § 1116(d)(1)(B) (2012).

more dominated by 3D printing?"[153] This perspective suggests that manufacturers do not necessarily need to be in the business of stopping 3D printing, but need to react and consider approaches in a world where others in their value chain will be utilizing 3D printing. One particular reaction will the use of security, marking, or detection technologies as countermeasures.

Besides the retaliatory legal action or threat thereof, technology advances can also thwart counterfeiting.[154] The use of quantum dots,[155] anti-erasing ink,[156] shape memory polymers[157] and DNA

[153] Ernst & Young, LLP, *3D Printing Taxation Issues & Impacts: Technology is Turning the World Upside Down for Manufacturing and Distribution*, 22 (2015), http://www.ey.com/Publication/vwLUAssets/ey-3d-printing-taxation-issues-and-impacts/$FILE/ey-3d-printing-issues-impacts.pdf.

[154] *See generally* Symposium, *3D Printing and Beyond: Emerging Intellectual Property Issues with 3D Printing and Additive Manufacturing: Panel 2: Liability Issues and 3D Printing*, 34 CARDOZO ARTS & ENT. L.J. 32 (2016) (generally explaining that even though potential counterfeiters and infringers can utilize 3D printing technology, so too can traditional manufacturers. For example, traditional manufacturers' marketing personnel and trademark attorneys can develop unique marks that can be ingrained into the traditional manufacturer's product using 3D printing technology. 3D printers will make it easier to 3D print complex, intricate, and colorful designs into the manufactured product, thereby displaying a very distinctive mark with the product. Moreover, 3D printers can make it easier for traditional manufacturers to change the design of a mark electronically, and implement that changed design into the printed product. That is, 3D printing can also simplify the production of the printed mark onto an object, just as it can simplify the production process of a making the 3D object itself. However, despite traditional manufacturers' ability to utilize 3D printers to their benefit in designing and integrating a mark onto a product, individuals will be equally likely as well as quicker to utilize 3D printers to produce counterfeit and infringing goods. Given the waste potential user base of 3D printing, counterfeiting in particular will be harder to detect by traditional manufacturers, and therefore, the use of 3D printers by potential counterfeiters will have more of an impact in counterfeiting than will the use of 3D printers by traditional manufacturers in protecting counterfeiting).

[155] Stephen Ward, *3D Printing and Counterfeit Goods*, http://www.pinkerton.com/blog/3d-printing-counterfeit-products (discussing that quantum dots are tiny nanocrystals made from semiconductor materials and can be embedded into an authentic item, such that their quantum mechanical properties could not be replicated by a counterfeiting process, thereby providing an identification means for authenticity); Quantum Materials Corporation http://www.qmcdots.com/products/products-3dprinting.php (explaining that quantum dot ink can be used for anti-counterfeiting by creating a unique un-clonable "fingerprint" for every package using existing printing technology).

[156] Bruce Craig, *New Ink to Combat Counterfeiters*, ASIA PRINTER ONLINE, (Sept. 23, 2013) (discussing the use of anti-erasing ink for preventing counterfeiting by employing fast-drying formulations that are compatible with printers and leving irremovable trace marks).

[157] Kai Yu, Alexander Ritchie, Yiqi Mao, Martin L. Dunn, H. Jerry Qi, *Controlled Sequential Shape Changing Components by 3D Printing of Shape*

continued . . .

marking[158] are being considered as technology measures to prevent counterfeiting.[159] Additionally, digital rights management ("DRM") technologies can transform 3D printers from a general-purpose printer capable of printing anything to having limited printing capabilities based on digital restrictions.[160]

The issuance of a broad DRM patent[161] to Intellectual Ventures is an example of a way to control printing of objects. Such a system, as described in Intellectual Ventures' patent, would ensure that nobody could print an unauthorized copy.[162] Manufacturers of goods can utilize such technological advances to serve as countermeasures to counterfeiting and trademark infringement, but would-be

Memory Polymer Multimaterials, IUTAM Symposium of Soft Active Materials Vol. 12 (2015) at 193 (discussing that 3D printing can create functional shape memory polymers with both spontaneous and sequential shape recovery abilities in response to an applied stimulus, such as temperature, magnetic fields, light, or moisture); Tim Lince, *Innovations Emerge to Pre-Empt the Counterfeit Threat of 3D Printing*, WORLD TRADEMARK REVIEW, 2 (discussing that shape memory polymer allows hidden shapes, such as letters or numbers, to be revealed on the material of the product when heated).

158 John Hornick, *How to Tell What's Real and What's Fake in a 3D Printed World*, 3D PRINTING INDUS. (Feb. 5, 2014), http://3dprintingindustry.com/news/tell-whats-real-whats-fake-3d-printed-world-23219/ (discussing a precision-engineered technology developed by Applied DNA Sciences in which plant DNA is utilized to mark genuine products with signatures). *See generally* Monica Rozenfeld, *3-D Printing Opens Products to Counterfeiting*, THE INST. (Nov. 7, 2014), http://theinstitute.ieee.org/technology-focus/technology-topic/3d-printing-opens-products-to-counterfeiting [http://web.archive.org/web/20150810173154/http://theinstitute.ieee.org/technology-focus/technology-topic/3d-printing-opens-products-to-counterfeiting] (discussing that DNA marking attaches a signature to a product which provides whether a product is genuine, by encoding information into inks, dyes, and resins).

159 Tim Lince, *Innovations Emerge to Pre-Empt the Counterfeit Threat of 3D Printing*, WORLD TRADEMARK REV. (Jul. 4, 2014), http://www.worldtrademarkreview.com/Blog/detail.aspx?g=3d5fdade-8639-49d4-984e-e85eb037a827.

160 Antonio Regalado, *Nathan Myhrvold's Cunning Plan to Prevent 3-D Printer Piracy*, MIT TECHNOLOGY REV. (Oct. 11, 2012) https://www.technologyreview.com/s/429566/nathan-myhrvolds-cunning-plan-to-prevent-3-d-printer-piracy/ (noting that with DRM technology, a 3D printer will not print object designs until they have been paid for, since the 3D printer will first check whether it has the rights to make the object).

161 *See generally* Mfg. Control Sys., U.S. Patent No. 8,286,236 (filed Jan. 31, 2008) (covering the use of a digital file that can only produce an object from a manufacturing machine is an authorization code is received for a host of processes, such as extrusion, ejection, stamping, die casting, and 3D printing).

162 Ryan Whitwam, *How DRM Will Infest the 3D Printing Revolution*, EXTREMETECH, (Oct. 16, 2012, 7:42 AM), http://www.extremetech.com/extreme/137955-how-drm-will-infest-the-3d-printing-revolution.

counterfeiters and infringers can also utilize their own technological advances to thwart traditional manufacturers' advances.

Moreover, acoustic technology is also being utilized as a detection mechanism. Since every 3D printer makes a set of sounds as it 3D prints an object, those sounds can be converted into electronic signals representative of the shapes being printed.[163] This in turn enables learning certain algorithms to determine which designs were 3D printed, thus making it more difficult to steal designs by 3D printing.

However, other manufacturers will recognize that finding individuals who utilize 3D printers to produce counterfeit goods or infringe registered trademarks will be difficult or a time consuming process. Instead of employing novel detection and security technologies to protect their assets, traditional manufacturers should consider brand building strategies.

IV. BRAND BUILDING STRATEGIES IN 3D PRINTING

Much of the initial 3D printing legal scholarship, law firm alerts, and articles in the press related to IP has centered upon uncertainties of infringement. There is legal uncertainty about the developments in 3D printing, since it revolutionizes the means of production away from the traditional manufacturer. This uncertainty necessitates that traditional manufacturer develop strategies to prevent lessening of their IP asset value. However, such a perspective focuses on legal risk prevention and ignores businesses building with 3D printing for traditional manufacturers.

Traditional manufacturers have employed and engaged marketers to develop and implement branding strategies to aid in outreach to consumers, create identities of the manufacturers' products or services, and promote return purchases or new purchases.[164] Just as 3D printing is changing the traditional means of manufacturing, it is also changing the fundamental branding strategies. Trademarks and brands have been implemented by traditional manufacturers in commerce after traditional manufacturers produced the good and in the process of the good being distributed to the consumer.[165] However, since 3D printing permits production away from control, it also enables new

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[163] Mike Murphy, *Scientists Figured Out How to Steal Any 3-D-Printed Product Just From the Sounds the Printer Makes*, NEXTGOV (Apr. 1, 2016), http://www.nextgov.com/emerging-tech/2016/04/scientists-figured-out-how-steal-any-3d-printed-product-just-sounds-printer-makes/127176/ (discussing that recording the whirrs of a 3-D printer can enable reverse-engineering of the 3D printing design being created).

[164] *See* Katya Assaf, *Brand Fetishism*, 43 CONN. L. REV. 83, 93 (2010).

[165] *See id.* at 90.

ways of branding by taking into account the change of control of manufacturing.

Just as traditional manufacturers are losing control of manufacturing to others, they should also proactively transition away from traditional branding functions. This might seem counterintuitive at first, but a deeper analysis shows the benefits of employing new marketing strategies in a world where manufacturing has moved away from traditional control. This does not mean traditional manufacturers should ignore conducting brand engagement with 3D printing users. Instead, they should develop proactive marketing strategies that enable 3D printing users to become engaged with the traditional manufacturer by virtue of utilizing 3D printing technology. That is, traditional manufacturers should utilize branding strategies that are in sync with this loss of control, so that brand engagement success will occur when a 3D printing user seeks to utilize 3D printing technology.

This discussion proposes that brands, and not trademarks, will be the means to enable such marketing success by engaging 3D printing users who are seeking to or are utilizing 3D printing technology. The reason that trademarks' benefits are limited in the 3D printing ecosystem are that their value resides only in information about the identity of products and as source identifiers, whereas brands are valued by consumers for having emotional and symbolic appeal. Given that 3D printing technology lessens the need for consumers to identify and associate products of traditional manufacturers,[166] the identification function of trademarks is also lessened. Instead, traditional manufacturers should consider brand-building strategies, since brands utilize emotions, identity, and self-image, and enable reoccurring customers.

As Professors Deven Desai and Gerard Magliocca have pointed out, it is ironic that, as 3D printing enables more options for manufacturing goods, consumers are also demanding greater assurances about the goods, while at the same time, assumptions underlying trademark law are becoming more untenable in the 3D printing marketplace.[167] Thus, as 3D printing grows, then consumers will be less inclined to believe that a trademark represents the source of origin. With copying becoming easier with 3D printing, branding becomes a critical differentiator for traditional manufacturers, which

[166] *See generally* Lemley, *supra* note 95; Joann Michalik, *et al.*, *3D Opportunity for Product Design: Additive Manufacturing and the Early Stage*, DELOITTE U. PRESS (Jul. 17, 2015), http://dupress.deloitte.com/dup-us-en/focus/3d-opportunity/3d-printing-product-design-and-development.html.

[167] Deven Desai & Gerard N. Magliocca, *Patents, Meet Napster: 3D Printing and the Digitization of Things*, 102 GEO. L.J. 1691, 1712 (2014).

will need to consider the different ways that they can build brand equity with their consumer base.

The process of seeking or utilizing 3D printing can encourage emotion, identity, and self-image associated with a traditional manufacturer. This is a brand building process that traditional manufacturers should establish, encourage, and extol, so as to create new ways of 3D printing users associating with traditional manufacturers and to promote return 3D printing uses. Such a focus on emotion appeal should utilize the lessons learned from past new technological revolutions that enabled new ways to engage consumers, such as the Internet and with mobile phones. Moreover, given that users of 3D printers are inherently enthusiastic about utilizing a new means to produce goods, a brand engagement approach that focuses on emotional appeal with 3D printing will generate a greater effect than a traditional marketing approach.

Such a brand engagement and brand-building process in 3D printing requires that traditional manufacturers carefully distinguish between trademarks and brands. The terms "trademark" and "brand" are often muddled and utilized interchangeably. This analysis distinguishes between these terms from a legal standpoint and applies the analysis to 3D printing. A discussion of the de-emphasis of trademarks and the need for a re-emphasis of brands in the context of 3D printing is provided.

A. Consideration of the Differences in Trademarks & Brands

As Professor Deven Desai has suggested, there is a lack of a common understanding of these terms, and differences in definition between lawyers, marketers, and economists.[168] One of the challenges of discussing trademarks and brands in the context of 3D printing, which has a number of new business entities, is the varied definitions of each term.[169] Even the oft-cited leading paper by William Landes and Richard Posner conflates the two terms when describing the economizing function of a trademark or brand name being rough synonyms.[170] While trademarks and brands can function as complementary assets and while U.S. courts have assumed the terms have the same meanings, they do have differences.

The terms "trademarks" and "brands" have been used

[168] DEVEN DESAI, IOANNIS LIANOS, & SPENCER WEBER WALLER, BRANDS, COMPETITION AND IP 7 (2015).

[169] *Id.* at 7–8, 217–37.

[170] William M. Landes and Richard Posner, *Trademark Law: An Economics Perspective*, 30 J.L. & ECON. 265, 269 (1987).

interchangeably in scholarship and in commerce. However, there is a legal difference between the terms. The two concepts have differences in purpose and in meaning.[171] A trademark is mark that legally[172] represents some entity, such as a business, by their goods or services, and in effect, is a seal of authenticity.[173] A trademark can also indicate the source of product origin.[174] In effect, trademarks have become seen as devices to reduce consumer search costs, ensuring that a manufacturer supports investment in producing a consistent product quality over time.[175]

This economics view of information provided by trademarks is also similarly tied to the legal benefit of trademarks or protecting the source of origin. A trademark possesses the attributes of property, and therefore, its protection is attained by registration. The legal protection of trademarks is limited to unauthorized "use in commerce" [176] in connection with the sale, offering for sale, distribution, or advertising of any good; however, courts have interpreted this requirement of the meaning of "use in commerce" broadly.[177] Thus, the use of another's trademark makes the good unauthentic and implies unfair competition caused by a theft of the competitor's name and public deception.

By contrast, a brand name is the name that a business chooses for

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[171] *The Role of Trademarks in Marketing*, WIPO MAG. (Feb. 2002) (explaining that while popular marketing terms use "brand" as being interchangeable with "trademark," a product's brand is much larger concept than a trademark, since building brand equity is a bigger challenge than choosing, registering, or maintaining trademarks; also discussing that effective marketing practice requires both knowledge of trademarks and understanding of brand image).

[172] In order to become a trademark, a process for registration must be followed with the United States Patent & Trademark Office. A trademark could be a device, make, label, name, signature, word, letter, shape of goods, packaging, color or combination of colors, smell, a sound—or alternatively, a brand. A trademark can serve as a legal foundation of a brand, and a brand and become a trademark.

[173] Yale Elec. Corp. v. Robertson, 26 F.2d 972, 974 (2d Cir. 1928) (stating that "[A merchant's] mark is his authentic seal; by it he vouches for the goods which bear it; it carries his name for good or ill. If another uses it, he borrows the owner's reputation, whose quality no longer lies within his own control").

[174] Barton Beebe, *The Semiotic Analysis of Trademark Law*, 51 UCLA L. REV. 621, 623 (2004).

[175] Mario Biagioli, Anupam Chander & Madhavi Sunder, *Brand New World: Distinguishing Oneself in the Global Flow*, 47 U.C. DAVIS L. REV., 455, 457 (2013).

[176] 15 U.S.C. § 1127 (2012) (defining "commerce" to mean all commerce which may lawfully be regulated by Congress).

[177] *See, e.g.*, Harmon Pictures Corp. v. Williams Rest. Corp., 929 F.2d 662, 666 (Fed. Cir. 1991) (finding that a small single location of a restaurant in small Tennessee town utilized its trademark in commerce even with only fifteen percent of its customers being from out of state, thereby further showing the ease to meet requirement of "use in commerce" in the Lanham Act).

one of their products or their business, such that it identifies a specific product or the name of the company.[178] The internationally agreed legal definition of a brand is a sign that certifies the origin or a product or service and differentiating it from the competition.[179] However, in addition to this legal definition, a brand is also a name with a power to influence and ability to command a level of trust, respect, emotion, and passion between the consumer and the manufacturer.[180] Moreover, brands also have a financial connotation, in that they are intangible assets which can be posted on a balance sheet; the development of brands can facilitate "brand equity," which is commonly referred to as the strength of a brand.[181] Businesses should be interested in building brand equity, since it can serve as a revenue enhancer and expense reducer in many ways.[182]

Despite such broad ranging characteristics of brands, the legal scholarship community has largely avoided analysis of brands, and has instead focused on trademark law. Professor Deven Desai has provided an analysis of how legal scholarship has viewed brands and trademarks. His perspective is that trademark law scholarship has under-theorized brands and more attention should be paid to brand scholarship.[183] He points out that trademark law is narrowly focused on obstructing information flow, and instead should refocus on information exchange.

Other scholars have suggested that trademark scholarship has focused too heavily on the role of trademarks in commerce and the

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[178] In essence, a brand is a set of promises that a business makes to its target customers, such that the business makes it easy for the consumers to identify the product with consistency and quality. A brand can consist of a brand identity, brand image, brand personality, brand character, and brand essence.

[179] JEAN-NÖEL KAPFERER, THE NEW STRATEGIC BRAND MANAGEMENT: ADVANCED INSIGHTS AND STRATEGIC THINKING, 8 (Kogan Page Ltd. 5th ed. 2012) (1992) (ebook).

[180] *Id.* at 12.

[181] GORDON V. SMITH & SUSAN M. RICHEY, TRADEMARK VALUATION: A TOOL FOR BRAND MANAGEMENT 37–38 (2d ed. 2013) (ebook) (referring to brand equity as a monetary term, rather than a subjective term, and associated with enduring customer loyalty).

[182] *Id.* at 231–32 (outlining that successful brand building can increase revenues by permitting premium pricing, increasing market share, enabling the introduction of new products or services, extending the product life in the marketplace, accelerating the time-to-market, easing market penetration, increasing growth rate, and providing versatility for product extensions and/or licensing; additionally, discussing that brand building can reduce expenses by relieving the owner of the cost to create, providing purchasing power, providing economies of scale, and reducing advertising and promotion costs).

[183] Deven R. Desai, *From Trademarks to Brands*, 64 FLA. L. REV. 981, 985 (2012).

economics of information.[184] These perspectives suggest that trademarks have historically signaled to the consumer a particular kind of information—that of the source of manufacturing and its associated qualities.[185] These traditional views, which are based on law and economics approaches, have come to see that consumers are rational gatherers and processor of information when making purchasing decisions, and trademarks are devices to reduce consumer search costs by a producer over time and space.[186]

Professor Desai points out that a new theory of trademarks should focus on brands and their functions and suggests that trademarks are a subset of brands.[187] He calls for trademark law to recognize that consumer preferences change with time and that a consumer's information about a good is part of a large network.[188] He discusses that even when search information costs are lessened, such as with the advent of the Internet, that the focus should not be on limiting trademark confusion with shopping, but instead, should be to enable a searcher to find a brand.[189]

Another reason for trademark law to be deemphasized in the 3D printing era is that 3D printing technology itself further reduces the value of trademarks. Professor Lucas Osborn has pointed out that the ability to use 3D printing to print a range of fake trademarked goods will lessen the line between trademark protection and incentives for producers.[190] Thus, traditional manufacturers will be less inclined to invest in trademark protection, especially in industries where 3D printing adoption will increase, knowing that 3D printing technology will be utilized to ultimately lessen the value of trademarks even further. Since manufacturers will have a lesser desire to invest into pursuing trademarks, they should instead consider brands as an alternative strategy.

B. Brands Building with Information Content and Exchange

The virtual nature of creating and sharing CAD files makes enforcement of counterfeiting and infringement through litigation

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[184] Biagioli, *supra* note 175 at 456–57.

[185] Margaret Chon, *Slow Logo: Brand Citizenship in Global Value Networks*, 47 U.C. DAVIS L. REV. 935, 945–46 (2014).

[186] Deven R. Desai, *Bounded by Brands: An Information Network Approach to Trademarks*, 47 U.C. DAVIS L. REV. 821, 823 (2014).

[187] *See* Desai, *supra* note 12, at 1043.

[188] *See* Desai, *supra* note 186, at 824.

[189] *See* Desai, *supra* note 12, at 840.

[190] Lucas S. Osborn, *Regulating Three-Dimensional Printing: The Converging World of Bits and Atoms*, 51 SAN DIEGO L. REV. 553, 583 (2014).

challenging. There are ways that a manufacturer can stop would be counterfeiters and would be infringers. But alienating a consumer fan base engaged in trademark infringement or in unauthorized brand use would not be good business practice and likely would not serve as a deterrent.[191] Moreover, the ease of information exchange prevalent in 3D printing via CAD files can make tracking of the goods to be printed from CAD files a challenge. Manufacturers can also play a cat and mouse game of advancing technology to detect IP infringement by 3D printing users.

However, a better strategy would be for traditional manufacturers to consider other customer engagement and branding strategies. Rather than fight 3D printing, traditional manufacturers should embrace 3D printing information exchange. Traditional manufacturers should implement the lessons learned from Web 2.0, where the emphasis shifted to user-generation, sharing, collaboration, and dynamic content. The same lessons and strategies utilized in Internet-based Web 2.0 businesses of authenticating, personalizing, and building immersive, community, and end-to-end solutions can be utilized towards building brands in a 3D printing world.

Brands can serve as an alternate means of enabling a new type of reliability. Traditionally, trademarks served as the way to indicate source or origin and to educate consumers about the goods they purchased.[192] Thus, the trademark served as a sense of reassurance and of reliability. However, since 3D printing enables production away from control, the trademark is no longer a way for traditional manufacturers to promote reliability.

Moreover, brands provide a means to utilize the expressive social phenomena inherent with 3D printing. Brands are essentially about culture and reflect the technologies and the people of a time and place.[193] Given that brands convey meaning and can embody a distinctive persona, then they are better suited for the emphasis provided with creativity inherent with 3D printing. Unlike trademarks, which essentially provide a one-way information function, brands can promote a communicative process between the buyer and the manufacturer, particularly with 3D printing.

The dynamic information exchange brought by creating and

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[191] Marc Trachtenberg, *The Impact of 3D Printing on Brands: The Shape of Things to Come?*, THOMSON REUTERS (2015), http://trademarks.thomsonreuters.com/sites/default/files/rsrc_assets/docs/tr-3dprinting-wp-single-reuters%20(3_new).pdf (last visited Sept. 16, 2016).

[192] Trademark Basics: A Guide for Business, INT'L TRADEMARK ASS'N, http://www.inta.org/Media/Documents/2012_TMBasicsBusiness.pdf (last visited Sept. 16, 2016).

[193] Biagioli, *supra* note 175, at 459.

exchanging CAD files with 3D printing promotes an ease of sharing identity and emotion conveyed by brands. Moreover, the ease of information exchange associated with electronic transmission and exchange of CAD files enables brands to be utilized to similarly convey information about the goods. Thus, brands can serve to promote awareness and identity about the traditional manufacturer. Brands are effective because they can circumvent middlemen that are needed in traditional manufacturing and distribution. Since 3D printing eliminates the traditional distribution middleman, then brands can be the means to reach consumers directly by satisfying the emotional appeal desired by consumers in purchasing goods.

A brand in 3D printing can serve as a promise and as a mechanism to fulfill that promise. Traditional manufacturers can utilize branding strategies to provide a greater reassurance to their customers and also to differentiate themselves among other producers.[194] However, unlike in traditional manufacturing which has a distribution and supply chain with many parties where branding is experienced by the end user at the purchase decision stage or purchasing stage, traditional manufacturers in 3D printing can engage in branding at information exchange stages. Traditional manufacturers can take advantage of the flow of information and the quality of information within the 3D printing ecosystem to engage consumers.

In contrast with traditional manufacturing where customers can become mechanically brand loyal,[195] 3D printing offers new options and new perspectives in reaching a consumer. Moreover, in the traditional manufacturing world, launching a brand was a high cost and required added costs throughout the distribution chain; whereas, the 3D printing ecosystem enables branding strategies through low-cost information exchange mechanisms. Moreover, traditional manufacturers can also take the brand out of the store and place it in the control of consumers.[196]

In implementing new branding strategies, traditional manufacturers will need to develop new innovative branding and marketing campaigns. This papers suggests and further describes these four specific ways to develop brand engagement with consumers:

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[194] *Id.* at 476–78.

[195] Deven R. Desai, *Response: An Information Approach to Trademarks*, 100 GEO. L.J. 2119, 2124 (2012).

[196] Michael Stone, *A 3D Design for Licensing Disruption*, FORBES (June 9, 2014), http://www.forbes.com/sites/michaelstone/2014/06/09/a-3d-design-for-licensing-disruption/#1a0bfd6338a3.

1. **Authentication**: Traditional manufacturers can build greater brand value by selling authentic and authorized CAD files to consumers who would print them with their own 3D printers;
2. **Personalization**: Traditional manufacturers can enable 3D printer users to personalize the manufacturers' products merchandise;
3. **Creative**: Traditional manufacturers should develop creative and co-creation play experiences and brand engagement practices with 3D printers; and
4. **Communities**: Traditional manufacturers should build online 3D printing communities as medium for brand engagement.[197]

Some companies are already offering these solutions, and in doing so, are garnering branding strategy to engage customers.

1. Authentic & Authorized CAD Files

3D printing CAD files are a way of conducting information and commercial exchange of goods in the 3D printing ecosystem. Many traditional manufacturers will be in the business of selling or transmitting CAD files in some form—either directly, through hubs, or through intermediaries. Such manufacturers will attempt to build brand loyalty with their end consumers through CAD file sales.

However, since CAD files enable transfer of physical objects as digital files, which can then be printed by anybody, then this mechanism can serve to promote counterfeiting.[198] Therefore, many consumers, especially those for which traditional manufacturers have built strong brand relationships, will want reassurances that the CAD file is from that particular manufacturer. Besides the desire to have an authentic product in the form of a CAD file, consumers will also want to be assured that they will not be making printing mistakes or printing out low quality 3D objects that may the result of unauthentic CAD files.

Brand protection companies can now embark on a new business of authenticating CAD files. These companies historically protected

[197] *See infra* Parts III(B)(1), III(B)(2), III(B)(3), & III(B)(4) and accompanying text.

[198] Maya M. Eckstein, *Let's Look Closer at 3D Printing and IP Issues,* INSIDE COUNSEL (Feb. 9, 2016), http://www.insidecounsel.com/2016/02/09/lets-look-closer-at-3d-printing-and-ip-issues.

brands from online counterfeiting, fraud, piracy, cybersquatting, and other digital threats. Companies, such as NetNames, have provided end-to-end online brand protection solutions to protect digital assets and brands online.[199] NetNames has been in the business of utilizing proprietary technologies and human analysis in the digital world, to protect against forces that erode online brands.[200] Many other similar companies will arise to provide authentication services for 3D printing CAD files. Such companies can be the source of digital reassurance of CAD files.

Counterfeiting prevention companies can embark on leveraging their technologies that are being utilized for other digital application business towards authentication of 3D printing digital CAD files. Companies that are successful with this service will become trusted CAD authentication providers and will end up making traditional manufacturers leaders of quality CAD files for eventual printing.

2. *Tools for Personalization*

3D printing technology allows consumers to become producers of their goods. Given the creative outlets provided by 3D printing, enthusiasts are also personalizing goods by the use of a 3D printer. Companies that give users the ability to use 3D printers to personalize goods are creating new businesses. 3D printing will serve as another way for consumers to take control of the ways they shop. Just as technological development with the Internet and with mobile phones enabled new ways for consumers to shop for goods, 3D printing also allows consumers to take advantage of their shopping experiences by giving consumers the ability to personalize. With this added control, brands (rather than trademarks) can serve as the mechanism to provide reliability, safety, and quality of what is produced.

For example, WhiteClouds is 3DaaS ("3D-as-a-Service") platform that enables brands and channels to create 3D experiences and turn them into full-color 3D printed products.[201] After WhiteClouds purchased 3DplusMe, the company has begun to offer 3D capture-to-print branded experiences, such as kiosks in retail stores.[202] This

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[199] *About NetNames*, NETNAMES, http://www.netnames.com/company (last visited Sep. 16, 2016).

[200] Jen King, *Online Anti-Counterfeiting Strategies Preserve Brand Equity: Net Names*, LUXURY DAILY (Aug. 24, 2015, 3:45 PM), https://www.luxurydaily.com/online-anti-counterfeiting-strategies-preserve-brand-equity-netnames/.

[201] *About Us,* WHITECLOUDS, https://www.whiteclouds.com/about-us (last visited Sept. 16, 2016).

[202] *Powerhouses in 3D-Printing Merge, WhiteClouds Acquires 3DplusMe*, MARKET WIRED (Jan. 6, 2016, 3:09 PM), http://www.marketwired.com/press-

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capture-to-print technology enables personalized experiences for toys, action figures, sports heroes, video games, and movie characters, through collaboration with leading brands such as Marvel, Hasbro, Major League Baseball, Major League Soccer, and DreamWorks.[203] This software platform includes a 3D scanner to capture a 3D geometry of a consumer and 3D print the high-resolution capture of the face onto an action figure. This use of 3D printers to make a consumer into a 3D printed superhero empowers brands to use 3D printing to engage consumers.

As another example, Marvel has partnered with novelty company Firebox to allow a replica of anybody's face to be 3D printed onto an action figure.[204] Firebox allows users to take and upload profile head shots onto Firebox's website, which 3D prints a 3D-printed model of the head onto a supplied superhero action figure.[205] Firebox also can 3D print a figurine of one's face onto a different person's semi-nude body, which could be a range of slim to curvy and range of skin tones. This serves as another example of where personalization enables engagement with a consumer. By enabling personalization through 3D printing capabilities, traditional manufacturers are developing psychological associations between themselves and with consumers. In doing so, 3D printing users are becoming more and more aware of the traditional manufacturer's product offerings in a certain market, and thereby, the consumer ends up gaining a greater sense of expectation with the traditional manufacturer.

3. *Creative Experiences*

3D printing technology can also enable creative and co-creation play experiences. The 3D printer allows users to make creative modifications to existing brands into objects for printing. These creative experiences essentially enable brand licensing revenue for major brand companies that embrace 3D printing.

As an example, 3D Systems and Hasbro have agreed to co-develop and commercialize innovative play printers and platforms for children,

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release/powerhouses-in-3d-printing-merge-whiteclouds-acquires-3dplusme-2086116.htm.

[203] Scott J. Grunewald, *Full-Color 3D Printing Service Provider WhiteClouds Announces 3DplusMe Acquisition at CES 2016*, 3DPRINT.COM (Jan. 6, 2016), https://3dprint.com/114069/whiteclouds-3dplusme/.

[204] *Become a Superhero…In Action Figure Form*, DISCOVERY COMM. LLC (Apr. 6, 2012 1:35 PM), http://news.discovery.com/tech/become-superhero-action-figure-120406.htm.

[205] Ben Coxworth, *Firebox Will Put Your Head on a Superhero Action Figure,* NEW ATLAS (Apr. 5, 2012), http://www.gizmag.com/personalised-superhero-action-figure/22084/.

including the use of their Transformer and My Little Pony brands.[206] These play printers create a new market where consumers will partake in a co-development process with the brand, and in turn, create further awareness of the brand. Additionally, consumers in the toy and home 3D printing market can now also print parts for toys that need repair using this new play printer and platform.

Another example that implements creative 3D printing features is the website SuperFanArt, a website that enables fans inspired by Hasbro brands to showcase their artwork and sell their 3D printed designs on the website Shapeways.[207] This website grants fans of their brands a license to create new artistic expressions based on the Hasbro brands. Consumers can visit the SuperFanArt website to browse for and order 3D printed products that have been designed by artists who have licensed the brands to make changes for their own creative purposes. Hasbro has essentially opened up their brands to their fans to enable them to co-create products.

In doing so, such traditional manufacturers are promoting consumer engagement through psychological dimensions of branding. By requiring consumers to be involved with the creative process, the traditional manufacturers consumers' psychological connotations with the traditional manufacturers.

4. *Online 3D Printing Communities*

Brands can also be promoted through online communities that associate together people with common interests or having a common identity. Social identity theory has shown that identification with a social group occurs when the group incorporates aspects of the group into their personal sense of identity, resulting in a stable commitment to the group.[208]

Traditional manufacturers building online communities enable 3D printing of their goods by translating a community member's general commitment to 3D printing into the business of the traditional manufacturer.

There are a number of ways that an online community can be

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[206] *3D Systems and Hasbro Agree to Co-Venture and Mainstream 3D Printing Play Experiences for Children*, HASBRO (Feb. 14, 2014), http://investor.hasbro.com/releasedetail.cfm?releaseid=825857.

[207] *Introducing SuperFanArt*, SHAPEWAYS, http://www.shapeways.com/discover/superfanart (last visited Oct. 1, 2016).

[208] ROBERT E. KRAUT & PAUL RESNICK, BUILDING SUCCESSFUL ONLINE COMMUNITIES: EVIDENCE-BASED SOCIAL DESIGN 80–81 (2011) (explaining that identity-based attachment leads people to continue their participation in the group despite turnover, makes people more compliant than bonds-based commitment, and fosters identity-based commitment to a community).

designed to facilitate the commitment of users towards the underlying 3D printing value proposition that is being promoted by the traditional manufacturer. A community structure can be designed to recruit participants with existing social ties.[209] Additionally, the online community's purpose and success with achieving such purpose can also garner generating additional 3D printing users.[210] Moreover, a traditional manufacturer can create an online community that would show information about other communities in the same ecosystem.

The niche of 3D printing can be utilized to create a 3D printing online community that will further generate new members. That is, the online community can "leverage [] early participants to attract later [participants]."[211] The end result will be an online community that will coalesce around a topic that leverages 3D printing for that traditional manufacturer's business.

C. The 4 New Ps of Marketing in 3D Printing

Brands can provide information about the user. Marketing can serve as way to reach out to and appeal to users. Thus, traditional manufacturers can change their marketing approach to coincide with changes in branding strategy as a consequence of 3D printing's change in the way production is done. A new marketing mix framework specific to 3D printing can better guide traditional manufacturers in engaging consumers. Such a new marketing mix can give traditional manufacturers a new way to engage with consumers and react to the ramifications of growing 3D printing adoption.

The traditional marketing framework, which consists of "Product, Price, Place, and Promotion"[212] was first introduced by Neil Borden

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209 *Id.* at 112.

210 *Id.* at 113.

211 *Id.* at 231.

212 MARC P. COSENTINO, CASE IN POINT 50 (Burgee Press 2013) (defining the traditional four P's analysis as encompassing the following inquiries: 1) Product: What are the products and services?, or What is the company's niche?; 2) Price: How does the company's price compare to the competition's?, How was the price determined?, Is the company priced correctly?, If the company's changes the price what will be the resulting sales volume?; 3) Place: How does a company get its products to the end user?, How can a company increase its distribution channels?, Does a company's competitors have products in places that the company does not?, Does a company's competitors service markets that the company cannot reach, if so, why, and how can the company reach them?; 4) Promotions: How can a company best market its product?, Is the company reaching the right market?, What kind of marketing campaigns has the company produced in the past?, Were such marketing campaigns effective?, Can the company afford to increase its marketing campaign, and if so, how and how would it be structured?).

and Jerome McCarthy.[213] This framework has been utilized for over 50 years, and it has generally been accepted as an apt framework for a marketing manager. However, many marketing scholars have criticized the 4Ps as not being applicable in many contexts and have proposed modifications. Many have suggested improved frameworks, addressed deficiencies of the 4Ps, and proposed new acronyms, but most new proposals have not been met with much success or gained mass adoption by scholars or practitioners.[214]

Nonetheless, an industry specific marketing framework for the nascent yet rapidly growing 3D printing industry could provide guidance to advertising and marketing professionals, trademark lawyers, managers, and scholars who are seeking input on to offer solutions to 3D printing consumers in a world where the traditional manufacturer is no longer the producer. A new framework that takes a customer-centric perspective instead would provide fine-tune refinement to the traditional marketing mix.[215] This section proposes a new 4Ps framework specific to 3D printing, and serves to assist new entities to build brand relationships with customers.

A new 4Ps framework for 3D printing would be centered on principles that encompass brand engagement with 3D printing. This new 4Ps marketing mix promotes use of increasing information about the consumer in the 3D printing marketplace. And this increased amount of information will also enable consumers to better and more frequently experience brands, and in doing so, provide traditional manufacturers more information about the user.[216] In doing so, the new framework provides benefits to traditional manufacturers who partake in information content created by and shared among 3D printing consumers. The new 4Ps of 3D printing is comprised of Peer-production, Personalization, Physibles, and Prosumers, each of which are described herein. The underlying principles in each of these new 4Ps are considerations that traditional manufacturers should utilize in developing and implementing brand engagement with consumers who are increasingly utilizing 3D printing.

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[213] John A. Quelch & Katherine E. Jocz, *Milestones in Marketing*, 82 BUS. HIST. REV. 4, 831 (SPECIAL ISSUE) (2008).

[214] John Fitzgerald, Neal Cavanaugh, & Rebecca Bhiro, *CPR for the 4Ps: Breathing New Life into the Marketing Mix* (2014) (published thesis, Keiser University) (on file with the Free Electronic Library) (providing an exhaustive compilation of the multiple recommendations for altering the 4Ps and a method of identifying similarities, differences, and patterns among the various proposals).

[215] Richard Ettenson, Eduardo Cornado, & Jonathan Knowles, *Rethinking the 4P's*, HARV. BUS. REV., Jan.-Feb. 2013.

[216] Desai, *supra* note 186, at 847.

1. *Peer-production*

Peer production has been defined as a model of social-production characterized by decentralization, coordination of large numbers, and the use of social cues and motivations rather than authority within individual agents.[217] Peer production has been considered an effective organizational model separated from property and contract and has been deemed to be particular effective in software development.[218] Peer production has been utilized among the largest and most important collaborative Internet community, and many large, global technology companies have implemented peer production as a business strategy.[219]

Several aspects of 3D printing fit under this description, primarily since an open development model can be effectively utilized in distributing the 3D printing function.[220] 3D printing online communities can enable peer-production, since 3D printing enthusiasts will have a preexisting commitment to the purpose that an online 3D printing community promotes.[221]

2. *Personalization*

3D printing represents a technology that creates an affordable and on-demand product that, unlike traditional manufacturing, can be personalized by a consumer. The advent of online 3D printing platforms—covering design supply, design hosting, design customization, design co-creation, design crowdfunding, printing, printing sales, and printing crowdfunding—has enabled customers to participate in creation of goods.[222]

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[217] Yochai Benkler & Helen Nissenbaum, *Commons-Based Peer Production and Virtue*, 14 J. POL. PHIL. 394, 400 (2006).

[218] Yochai Benkler, *Peer Production and Cooperation* in HANDBOOK ON ECONOMICS OF THE INTERNET (Johannes M. Bauer & Michael Latzer eds., forthcoming 2016).

[219] Yochai Benkler, Aaron Shaw, & Benjamin Mako Hill, *Peer Production: A Form of Collective Intelligence* in HANDBOOK OF COLLECTIVE INTELLIGENCE, (Thomas W. Malone & Michael S. Bernstein eds., 2015).

[220] Jarkko Moilanen & Tere Vaden, *3D Printing Community and Emerging Practices of Peer Production*, 18 FIRST MONDAY J. 1 (2013).

[221] ROBERT E. KRAUT & PAUL RESNICK, BUILDING SUCCESSFUL ONLINE COMMUNITIES: EVIDENCE-BASED SOCIAL DESIGN, 102 (2011) (discussing that one reason people feel a commitment to an online community is because there is a preexisting commitment to the purpose the community serves).

[222] Thierry Rayna, Ludmila Striukova, & John Darlington, *Open Innovation, Co-creation and Mass Customization: What Role for 3D Printing Platforms?*, *in* PROCEEDINGS ON THE 7TH WORLD CONFERENCE ON MASS CUSTOMIZATION, PERSONALIZATION, AND CO-CREATION (MCPC 2014) AALBORG, DENMARK, FEBRUARY 4TH–7TH, 2014: TWENTY YEARS OF MASS CUSTOMIZATION–TOWARDS NEW FRONTIERS 425 (Thomas Brunoe, Kjeld Nielsen, Kaj Joergensen, & Stig Taps

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One additional way to enable consumers to personalize their goods has been by bringing together multiple technologies under a house brand, which provides an end-to-end solution for consumers.[223] Such a technique can provide a greater sense of promise between the traditional manufacturer and the consumer. As an example, Stratasys has begun to market itself as such a one-stop shop for 3D printing by calling itself "The 3D Printing Solutions Company," and providing products and services for each of a customer's design, part functionality, supply chain, life cycle, product personalization, and low volume production.[224]

Another example that promotes personalization includes the iMakr store, which is a large store only for 3D printing related shopping. These stores can promote brand building and reliability with consumers since they provide an ease of enabling customers to enter stores to personalize goods. Moreover, such iMakrs stores can serve as a means of promising reliability and promise associated with the iMakr brand.

3. *Physibles*

A physible has been defined as a digital printable item.[225] Specifically, a physible has been defined as a data object that is capable for being manufactured as a physical object using an additive manufacturing process such as with a 3D printer.[226] The Pirate Bay website, a website that facilitates peer-to-peer file sharing and which has been found guilty of copyright infringement, has created a new category of physibles, along with existing categories of audio, video, games, audio-books, high-res movies, and comics.[227] This website considers 3D printers and scanners to be the first step in the defining and developing physibles, and suggests that the future will be about sharing more physible data. Traditional manufacturers need to

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eds. 2014).

[223] Neil Wilkof, *Commentary: Trademarks and Brands in the Competitive Landscape of the 3D Printing Ecosystem*, 104 THE TRADEMARK REP. 817, 818 (Int'l Trademark Assoc. ed., May–June 2014).

[224] Dr. Phil Reeves, *Incorporating 3D Printing Into Your Business Model*, STRATASYS STRATEGIC CONSULTING, http://consulting.stratasys.com/wp-content/uploads/PIMS-Berlin.pdf (last visited Sept. 16, 2016).

[225] Daniel Harris Brean, *Patenting Physibles: A Fresh Perspective For Claiming 3D-Printable Products*, 55 SANTA CLARA L. REV. 837, 838 (2015).

[226] Duann, *The Pirate Bay Get Physibles: A New Category for 'Sharing' Physical Product Files*, THE SHAPEWAYS BLOG (Jan. 23, 2012), https://www.shapeways.com/blog/archives/1177-the-pirate-bay-get-physibles-a-new-category-for-sharing-physical-product-files.html.

[227] WinstonQ2038, *Evolution: New Category*, THE PIRATE BAY (Jan. 23, 2012), http://thepiratebay.org/blog/203.

consider the term physible in their marketing strategy as 3D printing adoption rises.

4. *Prosumers*

The term "prosumer" was introduced in 1980, and it involves both production and consumption, rather than focusing on only production or consumption. [228] The term "prosumer" is a combination of professional and consumer. By uniting the production and consumption practices, a prosumer, is able to take possession of the meaning of the content in creation.[229]

In other words, prosumers refers to proactive consumers which can be perceived as a kind of dedicated loyalist. Such prosumers are willing to promote and further develop a brand. One such example of presumption is found in consumers who utilize 3D printing to enable identity for use in performances or decoration. While traditional manufacturing has been utilized to make branded goods for use in art performances, home decoration, and clothing accessories, its abilities are limited. Traditional manufacturing usage is limited due to its time limitations and presence of distribution middlemen. In contrast, 3D printing can provide direct, quick, and relatively easy printing of props, embellishments, and accessories—each of which are way for traditional manufacturers to engage the prosumer community.

Thus, the traditional 4Ps marketing mix of "Product, Price, Promotion, and Place" to make choices in bringing a product to market aids in brand value development. The new 4Ps model in 3D printing of "Peer-Production, Personalization, Physibles, and Prosumers" can enable manufacturers to build brand value with consumers as producers in the process of digitizing, modifying, and sharing 3D printing CAD files. Traditional manufacturers should engage consumers in their 3D printing production process, utilizing the lessons from software development, open-source, and e-commerce communities. These lessons should be applied to the new marketing framework for growing brand value in the context of a 3D printing online communities to encourage online creation, modification, and sharing of CAD files for eventual printing of tangible objects.

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[228] George Ritzer & Nathan Jurgenson, *Production, Consumption, Prosumption: The Nature of Capitalism in the Age of the Digital 'Prosumer,'* 10 JOURNAL OF CONSUMER CULTURE, 13, 14 (2010), *available at* http://joc.sagepub.com/content/10/1/13.

[229] Roberta Paltrinieri & Piergiorgio Degli Esposti, *Process of Inclusion and Exclusion in the Sphere of Prosumerism*, MDPI OPEN ACCESS PUBLISHING, 5 FUTURE INTERNET, 22 (2013), https://pdfs.semanticscholar.org/9c7e/4dbb5936ecd0b59c04cb0eeaf7bfe0170549.pdf
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V. CONCLUSION

3D printing enables users to turn a digital blueprint into a physical object. There has been an increasing shift to digital formats, digital platforms, and digital services that makes printing 3D objects more accessible. As 3D printing has allowed consumers to customize, modify, and share goods in digital form, then traditional manufacturers have had to revise their trademark enforcement and brand engagement strategies to serve consumers in a new localized production model. As consumers have become both the producer and the end use customer in a 3D printing world, some traditional manufacturers have become concerned about loss of sales due to counterfeit products produced from 3D printing. Their initial reactions have been to pursue legal claims against consumers for infringement, dilution, post-sale confusion, and counterfeiting.

This paper has discussed the presence of decreased trademark value and increased importance in brand value in 3D printing and recommends that manufacturers develop brand engagement strategies, rather than resorting to litigation and solely relying on advancements in unauthorized use detection technologies. In light of this context and due to the very nature of personalized manufacturing being a radical change from the traditional manufacturing economy, a new 4Ps framework has been introduced to market to 3D printing users, and in doing so, further advance branding engagement strategies.