
International Legal and Ethical Challenges Related to the Use and Development of 3D Technology in the U.S. And China

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Ethical and legal uses of technology should be addressed when a new technology gains popularity. The main focus of this research is to provide a detailed discussion of the legal and ethical issues pertaining to the use of 3D technology. Recent court cases provide examples of current and potential concerns associated with this technology from a consumer and business perspective. With the growing interest in 3D technology worldwide, especially in China, a discussion of similar laws in China related to 3D technology provides an international outlook of some of the trials ahead as business and consumer interest in 3D technology continues to escalate.

Keywords: *ethical, legal, 3D printing, 3D technology, intellectual property, patent law, product liability, trademark, repair and reconstruction.*

Introduction

Hod Lipson, a professor at Cornell University and co-author of the book, *“Fabricated: The new World of 3D Printing”* [1] mused about 3D printing possibilities in a quote from a New York Times article that stated, “A milestone for us would be to print a robot that would get up and walk out of the printer, Batteries included.” [2, p. 1]. Indeed, 3D printing

technology is in its infancy in terms of possibilities, yet the spectrum of legal issues raised by 3D printing have been around for over 100 years. Arguably, laws have always impeded or facilitated innovation depending on whose perspective is considered.

Laws concerning intellectual property, product liability and contract are relevant in the use of 3D printing technology. Conceivably, since 3D printers are touted as having the ability to print just about anything, this means that 3D printing could raise legal issues involving gun control, national security, trade secrets, drug and food legislation, health regulations, environmental regulations, Federal Reserve and banking issues, treaties and international agreements and the list goes on.

What distinguishes 3D printers from other innovations is that a 3D printer opens the door for consumers to replicate items that are patented in the blink of an eye. The ability to print objects from a 3D file that can be accessed online may provide the consumer with the capability of producing a replica of a patented object, whereas without the 3D printer this task would be difficult to perform. Currently, no specific law in the U.S. addresses intellectual property infringement based solely on the fact that the tool used to “infringe” is a 3D printer. However, there are several laws and court cases that specifically address issues that are associated with the use of 3D technology. The following discussion of the laws and court cases provide a detailed foundation for businesses and consumers to begin to understand the legal and ethical issues that are associated with the many different uses of 3D technology.

Patent Law

Existing Patent laws are arguably equipped to cover infringement of a patent involving a 3D printer. There are three types of patents in the United States: utility, design and plant, *Infringement of Patent*, 2006 [3]. Essentially, a patent is a limited monopoly. It gives the patent holder significant economic control over the use of the patented article. It is a reward for the inventor’s time and investment in creating the article. The U.S. Constitution authorizes Congress with the power “. . . to promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries” U.S. Const. art. I, § 8 [4]. Additionally, “. . . such grant shall be for a term beginning on the date on

which the patent issues and ending 20 years from the date on which the application for the patent was filed in the United States ,” Contents and Term of Patent; Provisional Rights, 2006 [5]. Infringement occurs when the patented invention is made, used, sold, or offered for sale within the United States or imported into the United States a patented invention without authorization [3]. Ignorance of the patent is not a defense to infringement, Presumption of Validity, 2006 [6]. The non-patent holder may defend against the lawsuit by asserting that the patent is invalid, or that the defendant’s article did not infringe on the patent held by the patentee, Presumption of Validity, 2006 [6].

3D Printer Manufacturers

How might patent laws impact 3D printer manufacturers? One major manufacturer of 3D printers, Stratasys, recently filed a 20 page patent infringement complaint against 3D desktop manufacturer, Afinia alleging that Afinia is directly infringing the following patents owned by Stratasys: ‘925 Patent, ‘058 Patent, ‘124 Patent and the ‘239 Patent, *Stratasys Inc. v. Microboards Technology, LLC d/b/a/Afinia*. [7, 8]. Afinia filed a response that denies the allegations of infringement. Patents lawsuits are expensive, so a royalty agreement would be a reasonable result to the dispute. Stratasys, however, may prefer to proceed to trial and stop distribution of the printers [9].

Stratasys said it invested 9.3 percent of its revenues in R&D in 2012. “We intend to protect that investment,” [10, p. 1] said David Reis, Stratasys Ltd. CEO in a press release on November 25, 2013; “Stratasys Acts to Protect Its Intellectual Property: 3D printer maker names Afinia as defendant in patent infringement lawsuit.” Is Stratasys simply protecting its investment in intellectual property? Or, this “litigation could be part of a strategy to combat the threat Stratasys faces from low-cost 3D printers manufactured in China and marketed through U.S. licensing agreements.” [11, p. 1].

In 2012, another established 3D printer manufacturer sued a newer 3D printing manufacturer. That complaint was filed in United States District Court District of South Carolina Rock Hill Division, by Plaintiff 3D Systems, Inc., against defendants Formlabs, Inc. and Kickstarter, Inc., alleging patent infringement, *3D Systems, Inc. v. Formlabs, Inc., and Kickstarter, Inc.* [12]. Formlabs, Inc. manufactured 3D printers, but Kickstarter, Inc., hosted a

website which sold items offered by Formlabs. 3D Systems, Inc. alleged that “Kickstarter is actively encouraging ‘hacker and maker’ companies to make 3D printers for Kickstarter to sell...” [12, p. 10]. In its Prayer for Relief, 3D Systems, Inc. alleged that one or more of the claims of the '520 Patent was willfully infringed, directly infringed, contributorily infringed, and/or induced infringement by the defendants [12]. Regarding this lawsuit, Michael Weinberg [13] wrote,

This may be one of the first patent lawsuits to affect the home 3D printing market, but probably for reasons beyond Formlabs’ survival. It could effectively shut Kickstarter’s door to hardware startups. It could also signal that traditional 3D printing companies are more interested in suing the consumer market out of existence than cultivating it (p. 1).

The 3D Systems, Inc. lawsuit was later reported to be in a settlement stage [14] On November 8, 2013, 3D Systems, Inc. filed a motion to voluntarily dismiss the case against the defendants [15].

Copyright Law

The Copyright Act, like Patent law, stems from the Constitution, U.S. Const. art. I, § 8 and U.S. Copyright Act, 2009 [4, 16]. The Copyright Act is Federal legislation enacted by Congress under its Constitutional grant of authority to protect the writings of authors granting an exclusive right of reproduction to the copyright holder [4, 16]. Copyright in a work created on or after January 1, 1978 generally endures for a term consisting of the life of the author and 70 years after the author's death [16].

Copyright actions may also be seen in 3D printer legal issues. The courts have not addressed 3D printing and copyright infringement, but there have been a few situations that stopped short of litigation. In early 2011, the first takedown request under the Digital Millennium Copyright Act (DMCA) [16] was asserted regarding 3-D printing. In that case, Ulrich Schwanitz discovered how to print the "impossible" Penrose Triangle, a popular optical illusion. Schwanitz released a video of it and challenged others to figure it out. 3D modeler Artur Tchoukanov rose to the challenge by designing a 3D shape. Tchoukanov uploaded his shape's specifications to Thingiverse [17]. Despite the take down request promptly filed by Schwanitz for alleged copyright infringement, the issue was settled and no litigation ensued.

Another situation, also in 2011, occurred when Baltimore engineer, Todd Blatt recreated a cube in a 3D CAD program that apparently resembled the alien cube depicted in the Paramount movie, “Super 8.” Blatt uploaded it to Shapeways, and within 24 hours lawyers for Paramount Pictures dispatched a cease-and-desist letter. Blatt complied. Paramount may have been motivated to move quickly as it had licensed the object to another manufacturer, Quantum Mechanics [18, 19] Again, no litigation occurred from the incident.

Some scholars have tried to speculate what a federal court might do if a 3D printing case is filed alleging copyright infringement issues against the manufacturer, consumer, software distributors or internet sites. There are a few obvious cases which may shed light on potential legal issues and outcomes, namely: *Sony* and *Grokster*.

The Sony Court reviewed the legality of using video tape recorders to copy content using Betamax tapes, *Sony Corporation of America Et Al. v. Universal City Studios, Inc., Et Al.* Essentially, “The question presented is whether the sale of petitioners’ copying equipment to the general public violates any of the rights conferred upon respondents by the Copyright Act” [20, p. 419]. Universal City Studios, Inc. did not seek relief against the VTR consumer, but opted to seek, “...money damages and an equitable accounting of profits from petitioners, as well as an injunction against the manufacture and marketing of Betamax VTR’s” [20, p. 420].

We can use the “VTR” as an analogy for a 3D Printer. Would a copyright holder attack the producer of the 3D printer and not the consumer who hypothetically actually committed the infringement? The holding in *Sony* stated that, “...the sale of copying equipment, like the sale of other articles of commerce, does not constitute contributory infringement if the product is widely used for legitimate, unobjectionable purposes. Indeed, it need merely be capable of substantial non-infringing uses.” [20, p. 442]. The Court wrote,

...It seems extraordinary to suggest that the Copyright Act confers upon all copyright owners collectively, much less the two respondents in this case, the exclusive right to distribute VTR's simply because they may be used to infringe copyrights. That, however, is the logical implication of their claim. The request for an injunction below indicates that respondents seek, in effect, to declare VTR's contraband.

Their suggestion in this Court that a continuing royalty pursuant to a judicially created compulsory license would be an acceptable remedy merely indicates that respondents, for their part, would be willing to license their claimed monopoly interest in VTR's to Sony in return for a royalty [20, p. 441 n.21].

Hypothetically, we can substitute our present day 3D printer for the Sony's Betamax video tape recorders. Given that the Sony Court deemed that a VTR had a substantial non-infringing uses, we might also categorize the 3D printer as having substantial non-infringing uses – at least as much as the VTR. Hence, producers of 3D printers will probably not be found liable for contributory infringement if a consumer secretly prints an object that is copyrighted – such as an alien cube from Paramount's Super 8. Of course, the copyright holder might successfully litigate for direct infringement against someone who brazenly prints copyrighted objects from his desktop 3D printer and tries to sell the item on eBay.

Switching gears, in *Metro-Goldwyn-Mayer Studios, Inc., et al, v. Grokster, Ltd., et. al.* [21], the Court reviewed *Grokster's* involvement in sharing “billions of files” across peer-to-peer networks. The Court identified evidence that distributors were cognizant that their software was being used to download copyrighted files, and there was evidence that the distributors encouraged the infringement by the end-users. The Court noted that: “After the notorious file-sharing service, Napster, was sued by copyright holders for facilitating copyright infringement, both respondents promoted and marketed themselves as Napster alternatives” [21, p. syllabus]. The Court astutely acknowledged, “The tension between the competing values of supporting creativity through copyright protection and promoting technological innovation by limiting infringement liability is the subject of this case” [21, p. syllabus]. The Court drew the line in *Grokster* by not entertaining Sony's “staple article of commerce” analysis as a defense where inducement was indicated [21, pp. 934-935, 20, pp. 440-442].

Consumers

Repair and Reconstruction

With 3D printers a consumer will have access to print replacement parts for appliances, sunglasses, automobiles, bicycles, computers, or other patented products. Under the doctrine of repair and reconstruction the consumer may lawfully repair her own property to some extent. The U.S. Supreme Court raised the repair and reconstruction patent issue in *Wilson v. Simpson*, 50 U.S. 109 [22], and further discussed the doctrine in *Aro Manufacturing Co. v. Convertible Top Replacement Co.*, 365 U.S. 336 [23]. Permissible repair may include “rebuilding” a worn truck clutch, even if “done on a commercial scale” [24, p. 1104], referencing *Dana Corp. v. American Precision Co.*, 827 F.2d 755, 1987 [25]. The Jazz Photo Corp. court noted that the defendants in *Dana Corp. v. American Precision Co.*, “...acquired worn clutches that had been discarded by their original owners, disassembled them, cleaned and sorted the individual parts, replaced worn or defective parts with new or salvaged parts, and reassembled the clutches” [24, p. 1104], referencing *Dana Corp. v. American Precision Co.*, 827 F.2d 755, 1987 [25, p. 759]. The Dana court relied on the Aro Manufacturing Co. case, where the Supreme Court shed light on what constituted unlawful reconstruction: “... that reconstruction of a patented entity, comprised of unpatented elements, is limited to such a true reconstruction of the entity as to ‘in fact make a new article,’ . . . after the entity, viewed as a whole, has become spent,” [25, p. 758] that there must be a “second creation” of the patented invention, and that “mere replacement of individual unpatented parts, one at a time, whether of the same part repeatedly or different parts successively, is no more than the lawful right of the owner to repair his property” [25, p. 758], citing *Aro Mfg Co.*, 365 U.S. at 346 [23]; and *Wilbur-Ellis Co. v. Kuther*, 377 U.S. 422 [26].

Does this legal precedent mean that a consumer can replace parts on his cell phone with his desktop 3D printer without infringing on the underlying patent for the cell phone? There is no bright line rule, and each case will likely have to be determined on its own set of facts. Additionally, many of these cases include issues of contributory and direct infringement. To find contributory infringement, however, the courts require that direct infringement is established (see *Aro Manufacturing Co. v. Convertible Top*

Replacement Co.) [23]. Examples of similar issues that have arisen in the lower courts since *Aro Manufacturing Co.* include *Husky Injection Molding Sys. Ltd. v. R & D Tool & Engineering Co.*, 291 F.3d 780 (Fed. Cir. 2002) and *Jazz Photo Corp. v. International Trade Commission*, 264 F.3d 1094, 1105 (Fed. Cir. 2001) as discussed by Wilbanks [27].

The lower courts have often held that a particular defendant's use was lawful "repair" and not reconstruction, but the courts are not uniform in how they have applied the U.S. Supreme Court's ruling in *Aro Manufacturing Co.* Some scholars have suggested reform, or that that Court should clarify the repair-reconstruction standard, particularly with the advent of 3D printing capability. Wilbanks states,

The Supreme Court should therefore redefine the repair-reconstruction standard to reduce litigation, allow consistent application of the law, and provide consumers with certainty. The following recommendations may better define the difference between permissible repair and infringing reconstruction, or at least provide consumers who are accused of infringement with a more predictable litigation process [27, p. 1174].

The problem might arise where many consumers can potentially download software and print exact parts for most products without obtaining the part from the patent holder. Will the cumulative volume of this practice encourage patentees to begin suing consumers on the basis that the consumer has encroached into impermissible reconstruction of patented items? The consumer may find it difficult to establish the line between lawful repair and unlawful reconstruction. Should the consumer cross that line, she may risk having a lawsuit filed against her for patent infringement. The opportunities for this to occur will increase when the 3D printer is affordable for many consumers and becomes a common household device.

Technology can provide opportunity for tempted consumers to circumvent the patent or copyright holder's control over a product. For example, the VCR in Sony [20] and the internet and MP3 players in Napster [28] were innovations which gave the consumer the ability to infringe a copyright that wasn't available prior to the inventions of the VCR and the MP3 player and the Internet. If anything, the Napster case provided a signal to the market that there was a demand for online digital music.

The market capitalized on the problem and resolved it by creating new business models. iTunes created a business model whereby consumers

can pay a relatively small price to download a song. iTunes is the gatekeeper as it ensures that the music that it offers in its service is legally available. The success of the iTunes model demonstrates that the consumer is satisfied with paying a small price to download one song. The legal issue has been resolved by creating business models that facilitate the needs and wants of the consumer with the economic interests of the copyright holders. Similarly, the market encouraged firms such as Netflix and Cable companies to provide digital movies for a reasonable fee to consumers. The IP rights involved in these cases are the same as the rights involved in a copyright or a patent that pertains to a 3D printer. Similarly, the 3D printer market should pay attention to related IP issues, and respond with a market solution to thwart infringement and make money at the same time.

Trademark (The Lanham Act)

Unlike Copyright and Patent protection, Trademark law does not flow from the U.S. Constitution. The Lanham Act, 15 U.S.C.S. § 1051 et seq. [29] is the primary federal trademark statute in the United States. Trademark law issues may include disputes over Trademarks, trade dress, dilution, and service marks. The U.S Patent and Trademark Office identify a trademark as “a word, name, symbol or device that is used in trade with goods to indicate the source of the goods and to distinguish them from the goods of others” [30]. Trademarks generally protect words, names, symbols, or devices and, three- dimensional shapes and colors may be protected under trade dress claims [31].

Legal issues that potentially arise under trade dress law in the 3D printer realm may include a hobbyist who thinks that it would be fun to print a plastic water bottle that has a similar design and shape as a FIJI artesian water bottle. She may be able to use the bottle at home for her personal use. But, if she were to print these bottles with her 3D printer and then offer to sell them on eBay, she may face trade dress claim by FIJI Water Company, LLC. In the FIJI case, *Fiji Water Co., LLC v. Fiji Mineral Water USA, LLC*, the court found that FIJI had a viable trade dress claim against a competitor based on the competitor’s use of a similar bottle shape, among other design features, as used by FIJI [29, 32]. Hence, our 3D hobbyist must be careful not to encroach on a product’s trade dress.

Product Liability

Product liability law allows consumers, or users of a product, compensation for injuries resulting from defective products that are placed in the stream of commerce by manufacturers or sellers, and often extends to retailers, wholesalers, assemblers, endorsers, and licensors of intellectual property rights. Products can be defective for a number of reasons including inadequate instructions and warnings, as well as design and manufacturing defects. Product liability theories for recovery include warranty, negligence and strict liability. The warranty theory of liability arises out of a contract concerning an express or implied promise about the product [33]. For example, the seller of the 3D printed object may promise the buyer that the product will have certain dimensions, weight or material content. If the 3D printed object fails to deliver the product as promised, the plaintiff may argue a breach of warranty. There are several types of warranties; express; implied warranty of merchantability and implied warranty of fitness as specified in the Uniform Commercial Code § 2-313(1); § 2-314(1); and § 2-315, respectively [34]. Generally, a breach of warranty issue is for property loss. Of course, the parties may also resort to the language in their contract for remedies.

The law of tort, however, involves plaintiff's assertion that the seller, distributor or manufacturer of the 3D printed item (product) or the 3D printer itself, is either negligent or strictly liable. Every state controls its own product liability law unless federal regulations preempt a category of products or activity. For example, the Biomaterials Access Assurance Act of 1998 [35] protects some biomaterial suppliers of implanted medical devices from product liability in civil suits. Or, the federal regulation may limit the application of state tort law where a conflict between the federal statute and the state statute exists (See *Lofton v. McNeil Consumer & Specialty Pharms.*, No. 10-10956, 2012 WL 579772, 5th Cir. Feb. 22, 2012). In this 2012 court case, the manufacturer was insulated by FDA regulations from including a warning on Motrin concerning severe autoimmune allergic reactions [36]. Unless the 3D material or printed object falls within the jurisdiction of a federal statute, the laws of the state having jurisdiction over the case will be applied.

To prevail against the defendant in a negligence claim in most states, the plaintiff must show that the defendant owed her a duty of care

regarding the product, the duty must have been breached and the breach caused an injury. The plaintiff must demonstrate that she actually suffered a loss, or damages. In negligent product liability cases, the claims may be for negligent manufacturer, negligent inspection and negligent failure to warn. Should the plaintiff proceed under a theory of strict liability for his injuries, he is relieved of proving “duty” but he must show that the defendant is “engaged in the business of selling or otherwise distributing products”, Restatement (THIRD) of Torts: Prods. Liab. § 1 (1998) [37]. This requirement may arguably relieve the mere hobbyist from strict liability of injuries resulting from his defective 3D printed object. Of course, if the hobbyist is printing many of the 3D printed objects for sale, then he may be escalated into the category of “seller” for purposes of strict liability. The small business that prints 3D products for customers may escape strict liability if the business can argue that it prints only unique items ordered by individual customers and is not a commercial seller of the defective product. For example, a 3D printing business may only print one key ring. Hence, it would not be considered a commercial seller of key rings. A 3D product design agency that creates a 3D file which allegedly prints a defective product may be liable for resulting injuries if the court agrees that the software or code is a tangible product and the agency is “engaged” in the business of selling designs, Restatement of Torts, Third, Products Liability § 19 [38, 39]. Products may be defective for numerous reasons including manufacturing defects, inadequate warnings and design defects, Restatement of Torts, Third, Products Liability § 2 [40].

State laws may vary concerning requirements necessary for a plaintiff to prevail under any of the above theories of product liability. Federal restrictions on consumer products are mandated by the Consumer Product Safety Act, 15 U.S.C. §§ 2051-2089, 1998 [41]. For example, certain small parts, or small toys, intended to be used by children must be accompanied by a warning or warning label as specified by the United States Consumer Product Safety Commission [42].

If the manufacturer of a 3D printed item intends the items to be sold as a children’s toy, and it fails to include the warning either on the product itself, or in the detailed instructions or packaging, then arguably, the producer of the product could be in violation of the Child Safety Protection Act. Some warnings must be visible on the product itself to be resold, such as the warning that is on a baby bath seat. If the warning is

removed from the baby bath seat, even a reseller is not permitted to sell the item [43].

According to the U.S. federal Consumer Protection Safety Commission, “CPSC’s laws and regulations apply to anyone who sells or distributes consumer products. This includes thrift stores, consignment stores, charities, and individuals holding yard sales and flea markets. Used products have caused injuries and deaths and have been the subject of numerous recalls” [44, p. 1]. What does this mean for 3D printing companies that print a toy that is regulated by the Child Safety Consumer Protection Act? Arguably, at the very least, the 3D printed item intended for use by a child should be created in compliance with the CPSA, including necessary warnings that may be required to accompany the product. Additionally, manufacturers of children’s items must provide for permanent tracking information that is either printed on the product or the packaging. Simply because a hand-crafter or even a 3D hobbyist created the item to sell, does not exclude the product from the law, Section 14(a)(5) of the Consumer Product Safety Act, 15 U.S.C. §2063(a)(5) (CPSA). The requirement was originally part of section 103 of the Consumer Product Safety Improvement Act of 2008 (CPSIA) (Public Law 110-314) [45].

3d Open Source Software

Open source software is not a new concept, but open source hardware as it relates to 3D printing is in the early stages of development. If a component is offered as open source hardware then it is licensed to anyone to modify and duplicate. The open source hardware license characterizes the intellectual property of the item. Open source hardware means that hobbyists, or anyone, can download the specifications, build, or direct someone else to assemble the item without fear of infringing another’s intellectual property [46] . The concept encourages more innovation without the tension of trespassing on a producer or manufacturer’s intellectual property.

Copyright law provides the legal basis for open source software. The General Public License (GPL) is a prominent open source software license which grants the licenses and provides "copyleft" conditions such as the authority to modify and distribute licensed works, and broad rights to improvements of the licensed code [47]. Conversely, “useful physical objects are generally not protected by copyright” [48, p. 261].

Open source hardware is nevertheless developing in the market. Some examples include the TAPR license (Tucson Amateur Packet Radio) and the CERN license (created by the European Organization for Nuclear Research). These licenses are intended to emulate the "copyleft" provisions of the GPL in the arena of open hardware, and CERN allows collaboration on hardware projects [48]. Not only is a 3D printer available as open source hardware item, but so are many common household items that can be printed. Open source 3D printing has made its way to consumers via providers such as the RepRap project, and Thingiverse. It will become increasingly more economic for a family to print domestic products at home, rather than purchase the product in a retail outlet. Presently there are at least 100,000 open source designs available for 3D printing [49]. Examples of open source household items available on the Thingiverse website include, customized paintbrush holder [50], multiple necklace hanger [51], and iPhone 4 dock [52]. Certainly the potential for a patent holder to protest the legal validity of an open source item exists. At least one major firm, Google, has pledged not to proceed against open source developers for patent infringement [53].

Legislation

Some scholars have written about a push for reform in the area of 3D printers and their capability. Of course, each scholar brings a different perspective to the table; some support the hobbyist, the consumer who owns a 3D desktop printer and the innovators who utilize the existing technology to make it bigger, better and faster. Others stand steady in the IP holder's camp – they seek to support the manufacturer or the producer who has invested heavily in the technology and wants to maintain its limited monopoly. Other perspectives involve social policy – such as the welfare of the public.

This later view has especially been seen in the call for gun control and the use of 3D printers in manufacturing guns. Hence, the "gun" issue is specifically targeted at a specified object – guns. The issue is distinct from whatever IP issues that a gun manufacturer or designer may hold. The issue in this situation is law enforcement and the tension that it creates with the 2nd Amendment. Of course, we can speculate whether an established patent holder of a gun (or, gun part) will side with the law makers trying to regulate

the use of 3D printed guns, or with the enthusiastic hobbyist seeking to enforce her 2nd Amendment right to print off a gun for personal use. It would be interesting if we see patent holders guns (or, gun parts) –who might normally speak out for the protection, if not the expansion of 2nd Amendment rights – switch sides in this argument and come out swinging against the proliferation of 3D printed guns. The NRA reportedly “remained silent” regarding the recent vote before the Senate to reauthorize the ban on plastic guns [54]. The ban is directed at guns that x-ray machines and metal detectors cannot detect [54]. President Obama signed the bill which formalized a 10-year extension of the Undetectable Firearms Act [55].

Other scholars couch their writings in terms of educating or alerting 3D printer enthusiasts about the need to craft, or to heed legislation that may impact the 3D printer hobbyist, consumer, or the innovators of the technology. For example, the repair and replacement doctrine, discussed above, may be ripe for manufactures to sound the alarm when a plethora of consumers sitting at home with their 3D desktop printers begin a mass printing off of replacement parts for appliances, cell phones, computers, etc. Could the manufacturers become concerned enough to push back with aggressive lawsuits against consumers for crossing the line? One whitepaper written by Michael Weinberg [56], indicates that this possibility merits consideration by stakeholders before we get to the inevitable legal tension between the 3D printer owner and IP holder. Weinberg also suggests that a DMCA take down notice for patents could be seen in the future.

Another position is that we should not prematurely enact 3D printer legislation. According to Finocchiaro, “Ultimately, both 3-D printing technology's presently limited potential to cause economic damage to rights-holders and the fact that neither policymakers nor judges can reasonably foresee its potential, suggest that it would be prudent to limit regulatory intrusions into the sector” [57, p. 508].

3d Technology Interest In China

China has gained a foothold in various manufacturing markets that compete with U.S. products. The Chinese are as fascinated with the prospects of 3D printers, as anyone else. China's Ministry of Industry and Information Technology formed the “China 3D Printing Technology Industry Alliance” in 2012 to finance 10 research centers. The first, in Nanjing, was approved in

March, 2013, and dozens of companies have joined the group. Luo Jun, the head of the Asian Manufacturing Association, who attended a 3D printing conference in Beijing in 2013, anticipates revenues from products and industry in China to increase to about \$1.6 billion within three years. His confidence reportedly stems from China's research in 3D printing technology [58].

While China's motivation and interest in 3D printing is growing, there are challenges ahead. China has established itself in manufacturing and exporting products, but this effort has been driven by large scale "monolithic" production strategies that are not suited for the smaller, highly specialized jobs associated with 3D printers. Additionally, intellectual property laws may not be as conducive to the development of futuristic technology in China as they are in other countries. But, this is changing. McKinsey & Co., a global management consulting firm, reported in 2012 that the Chinese government ministry handled 40% more intellectual property violations in 2012 than it did in 2011 [59].

Laws Related to 3D Development

China has the necessary intellectual property laws in place to manage potential IP issues that will challenge the growth of 3D printer use and manufacturing. Many of the PRC provisions, while not identical, share similarities to provisions in the U.S. For example, under Chapter V, article 45 of the PRC Patent Law code provides that the duration of a patent for "...inventions shall be twenty years, and the duration of a patent right for utility models and a patent right for designs shall be ten years, counted from the date of filing" [60]. Similarly, the Copyright Law in the PRC contains some basic similarities as U.S. Copyright law. Duration is established, although it is different than that the length of time in the U.S. Section 3, Article 21 of the PRC Copyright code establishes fifty years from the death of the author as the duration for the copyright [61].

China's first trademark law was enacted in 1982, and in 2001 it amended Article 8 of the Trademark Law of the People's Republic of China to include three-dimensional objects. In 2007, the Supreme People's Court of China and the Supreme People's Procuratorate issued sections on statutory criminal issues concerning intellectual property rights [62].

The Patent law in the PRC presently contains provisions which will protect 3D designs. In Article 2 of the PRC Patent code, designs may include a shape, as well as color, pattern or combination of same. Therefore, it is protected against infringement whether it is manufactured via a 3D printer, or by a traditional manufacturing method, so long as the item is registered as a design with the Chinese Patent Office. Of course, the defendant can attack an allegation against patent infringement on the basis that the underlying patent is defected. For example, if the patent was not properly registered, or if it was not novel and therefore should not have been registered. In China, another defense against patent infringement is if the “printing was not done for commercial use, but only for personal/domestic use (this is potentially an enormous problem for IP owners, as 3D printers become more affordable, and thus, it is likely that this defense could be limited by legislation or the Supreme Court in its interpretations); or experimental use defenses (which arguably can be applied to design patents)” [63, p. 1].

PRC Copyright law protects artistic works and arguably 3D representations of same. Article 22 of the PRC Copyright code includes many defenses that would most likely be applicable to a consumer using a 3D printer to replicate artistic work [61]. Such defenses include private research and study [63]. Copyright infringement will be addressed by Chinese courts. In early 2003, The Beijing High People's Court ruled against Chinese toymaker, Coko Toy Company, based in the northern Chinese city of Tianjin, and in favor of Lego, a Danish toy company, in a copyright infringement lawsuit that was based on “made-in-China” copies of Lego's castles and pirate ship designs. Lego claimed that it was “the first time that the Chinese legal system has delivered a judgment that confirms copyright protection of industrial design/applied art” [64].

China is no stranger to organizations and treaties involving IP issues. World Intellectual Property Organization (WIPO) reports that China has been a member of WIPO since 1980, and that China is a party to many International treaties and agreements regarding intellectual property [65]. WIPO is a well-recognized international organization that provides conflict resolution, education, assistance with court issues and many other international IP services [66].

Conclusions

Even though 3D printing technologies have been in existence since the 1980s, companies are now beginning to realize the possibilities of using this technology in many different ways. However, these capabilities and opportunities must be approached with caution. Descriptions, definitions and examples of laws throughout this paper demonstrate the applicability of different categories of laws to the emerging uses of 3D technology. Examples of these issues as they relate to patent, trademark, copyright, product liability and other areas of law have been provided throughout this research paper to illustrate current and potential risks of using 3D printing technology for business and personal purposes. Because the uses of 3D technology is expanding internationally, legal and ethical issues may differ from one country to another, but many will be similar as shown in the discussion of legal and ethical issues in China and the United States.

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