5-21-2014

3D Printers

James Barker

Nicholas Pleasants

Peter Montine

Shudan Zhu

3D Printers

University of Washington, Technology Law and Public Policy Clinic

A preliminary report, addressing potential market disruption, the state of the law, and recommendations on future legislative action regarding consumer-grade 3D printing.

Supervising Faculty: William Covington

Authors:
James Barker
Nicholas Pleasants
Peter Montine
Shudan Zhu

5/21/2014

Table of Contents

Section 1: Market Disruption

Disruptive Elements of 3D Printing Technology

Although 3D printing by no means should be regarded as a newly developed technology, its impacts on major markets are still limited. As the development of this promising piece of technology accelerates, the tipping point might be reached sooner than most people would have expected. Among all those fancy technologies brought to life by the modern society, what characteristics really set the 3D printing technology apart and set the course for a new industrial revolution? According to Harvard Business School professor Clayton Christensen, 3D printing is a classic disruptive technology because it is simpler, cheaper, smaller and more convenient to use than traditional manufacturing technology.[1] Professor Christensen's observation certainly provides us with a good summary of this "new" and potentially highly disruptive technology, and for this reason, it might be smart to put in place new regulations on 3D printing technology before harms to existing industries and markets are done. Besides, 3D printing also presents an opportunity for countries across the world to take advantage of this emerging technology and reposition themselves in the network of the global market.

Because of the huge impacts 3D printing technology might impose, a little more elaboration on major disruptive elements of 3D printing might be warranted. First, in contrast to traditional manufacturing technologies, 3D adopts an additive instead of a subtractive method, as various materials are deposited layer after layer to create the end products. This unique feature makes it possible for 3D printers to build structures that cannot be created using conventional methods, which is especially true for objects with complex geometries and internal structures. Second, a single 3D printer can produce vastly different products, which means an unprecedented level of customization and flexibility at much lower cost. Besides, batches of one will become more and more common and complexity is virtually free. Third, a 3D printer can cost much less than a machine employed in a traditional factory, and as the prices of 3D printers keep going down, it is foreseeable that someday in the near future, average consumers will be able to have one 3D printer at home for relatively simple tasks, and certain kind of future 3D printing centers will carry more sophisticated models of printers for more demanding tasks. Fourth, the economics of manufacturing will be changed as the economies of scale will be rendered inapplicable and one machine, unlimited product lines will become the norm. However, this does not necessarily mean higher per unit cost because the manufacturing process is less labor intensive and more efficient in terms of material use.[2]

Impacts of 3D Printing Technology on Traditional Business Models

The inherent disruptive characteristics of 3D printing can lead to another industrial revolution in the foreseeable future, and by 2025, it could have an impact of up to $550 billion a year in the global market.[3] The impacts of 3D printing can fundamentally change how products are designed, developed, manufactured and distributed, and in turn revolutionize traditional business models the industries have been relying on over the decades.

McKinsey & Company has identified five possible disruptions that 3D printing technology might bring to various industries: [4]

---

[1] Clayton M. Christensen, The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail (Boston: Harvard Business School Press, 1997)
[2] "3D Printing and the Future of Manufacturing", CSC Leading Edge Forum, Fall 2012, p. 3
http://www.csc.com/innovation/insights/92142-the_future_of_3d_printing_services_and_manufacturing
[3] "3-D printing takes shape", McKinsey Quarterly, January 2014
http://www.mckinsey.com/insights/manufacturing/3-d_printing_takes_shape
[4] *Id.*

1. 3D printing can accelerate product-development cycles. Companies have long been using 3D printing for prototype creation as part of their product development cycles to accelerate the process and lower the costs, but now as manufacturing of final products through 3D printing becomes feasible, the whole tooling process can be eliminated, or equally likely, companies will start selling their final products manufactured by 3D printing while at the same time waiting for the production tools for mass production to be finished.

2. 3D printing technology can bring in new manufacturing strategies. 3D printers feature a high level of versatility, of which some end products are especially suited to take advantage. Among those products are ones involving high labor costs, requiring complex tooling, or those having high scrap rates. Further, the much smaller footprint of 3D printers can also mean localization of manufacturing and for some developed countries this might mean the return of the manufacturing industry, which they have been losing to developing countries over the past several decades.

3. 3D printing technology can shift sources of profit as the economies of scale would be largely irrelevant and the distribution costs significantly reduced. Profit in manufacturing will rely more on design and customization rather than on minimizing the unit cost of a particular product.

4. 3D printing technology will stimulate the development of new manufacturing capabilities. As 3D printing becomes ubiquitous, features of 3D printing equipment will be improved, such as: speed, the use of printing materials with improved characteristics, and greater complexity of printable objects in terms of geometry and mixed material (such as integrated computing). As a greater proportion of consumer goods become available through home 3D printing, we may expect to see a shift in the focus of traditional manufacturing so as to avoid competition.

5. 3D printing technology will lower the barriers of entry for new players in a particular market, and companies will find it easier to engage in vertical or horizontal expansions into new lines of business.

Industries 3D Printing Might Disrupt

Because of 3D printing technology's unique disruptive characteristics and potential impacts on existing business models, many industries are facing great likelihood of disruption. However, if 3D printing technology is subject to timely and proper regulation, certain industries can also benefit tremendously from the increasingly widespread and cost-efficient use of this technology.

3D printing technology will have a huge impact on traditional large-scale commercial manufacturing. Shortened time-to-market, superior capabilities for products, open design, high level of customization and localization of production would together disrupt traditional business processes and traditional manufacturers would have to react quickly to adapt to the coming changes or would risk being excluded from taking the full advantage of this revolution.[5] With the introduction into the market of increasingly sophisticated 3D printers with ever dropping prices, the traditional line separating manufacturers and customers is becoming blurred.[6] For many products, especially those less complex and cheaper for daily use, average consumers will be gradually facing a choice between buying the products premade or to simply build them at home using their 3D printers. This does not mean big manufacturers like Foxconn would disappear overnight or even in the next ten years, but the landscape of traditional large-scale commercial manufacturing would be vastly different in the foreseeable future.

[5] CSC Leading Edge Forum, *supra* note 2, at p. 21
[6] *Id.*

Challenges also mean opportunities, and for certain industries, 3D printing technology can lead the way to a bright future. For the defense industry, it is hugely beneficial if replacement parts can be 3D printed on the battlefield instead of relying exclusively on the supply chain, and for some crucial components of military equipment, 3D printing can also mean similar or even better quality components with much lower costs of manufacturing.[7] For instance, a company called EOIR Technology has used 3D printing to manufacture mounts for use on the surface of tanks,[8] and Trainer Development Flight Facility has been producing unmanned aerial vehicles (UAVs) by combining 3D printing and traditional manufacturing methods to reduce the costs significantly.[9] For the aerospace industry, 3D printing technology means reduced maintenance requirements, consolidated components and fuel saving with lighter but stronger parts of aircrafts.[10] For the space exploration industry, 3D printing can also mean direct manufacturing in space, which in turn can largely if not completely eliminate costly transportation of spare parts and tools needed for daily operation. For the healthcare industry, 3D printing can be used to print artificial organs, bones and prosthetic devices. For those artificial body parts to function optimally on a specific patient, high level of customization plays the predominant role in providing better fixation, reducing surgery time and minimizing the likelihood of infection.[11] The whole organs can also be 3D printed using live cells or tissues, which might in future help solve the problem of organ shortages.

Naturally, disruptions caused by 3D printing are likely to differ from one industry to another. For lower value manufacturing sectors, 3D printing might be able to bring a real change in a few years while for more complex manufacturing sectors, because of the complexity involved in the manufacturing process and the economies of scale, they are likely to be the last to be seriously affected by 3D printing. For other industries, such as food and drink industry, no major change might come any time soon unless consumers can manage to adapt their appetite to the new 3D printed synthetic food or drink. A report from Big Innovation Center provides speculation on the potential disruption for the manufacturing subsectors tracked in the UK: [12]

Table 1: *Big Innovation Center* Report on Disruption of Manufacturing Industries from 3D Printing

Industry Sector	Total GVA in UK (In £ Billions, 2010)	Potential for Disruption by 3D Printing
Food, Drink and Tobacco	25	Unlikely to move wholly to 3D printing, although some components (including packaging) may be 3D printed within supply chains.
Textiles, Clothing and Leather	4.5	Likely to be heavily disrupted by 3D printing, with design, logistics and retail processes potentially transformed.
Wood and Paper	4.8	3D printing penetration will depend on ability to process different materials.
Printing and Recording	7.1	Printing and recording have already been hugely disrupted by shift to digital content; this is likely to be far more significant than 3D printing, as digital media dominate physical media.
Refined Fuels	2.2	Unlikely to be significantly affected by 3D printing.
Chemicals	11.7	Some parts of the industry may be affected by shift to 3D printing, but complexity of chemical technologies likely to make 3D printing

[7] *Id.* at p. 9
[8] *Id.*
[9] *Id.* at p. 10
[10] *Id*.
[11] *Id.* at p.13
[12] "Three Dimensional Policy: Why Britain needs a policy framework for 3D printing", Big Innovation Center, October 2012
http://www.biginnovationcentre.com/Assets/Docs/Reports/3D%20printing%20paper_FINAL_15%20Oct.pdf

		slow to disrupt.
Pharmaceuticals	11.9	Significant potential for on-demand manufacture of drugs in hospitals, although much will depend on technology.
Rubber and plastics	5	High likelihood of disruption, especially for bespoke shaped plastics. Plastics are also likely to be the key material for 3D printing, which may prompt innovation in development of plastics.
Metals and building materials	22.9	Potential for significant disruption from 3D printing. However, 3D printing may not provide the scale of production required for some industrial and construction processes.
Computers, electronics and electrical equipment	13.8	Some potential for disruption from 3D printing, although issues of assembly and precision may limit uptake.
Machinery 28 10.4	10.4	3D printing is likely to play a major role in providing bespoke and on-demand machinery.
Cars and other vehicles	5.6	3D printing is unlikely to remove assembly lines or end mass production, but may play a role in manufacture of components.
Ships and aerospace	5.6	Large scale building projects make 3D printing unlikely, although may be involved in the supply chain.
Furniture	3.5	3D printing should play a major role in re-shaping furniture markets, with designs and logistics heavily disrupted.
Other manufacturing	4.2	Other manufacturing includes a range of low-tech, bespoke manufactures such as toys; these are likely to be one of the earliest markets for 3D printing.

Section 2: The State of the Law

Subsection 2A: Guns and Inherently Dangerous Goods

History of 3D-printed weapons

Just as 3D printing is not new, making dangerous objects out of plastic to avoid detection is not new. As far back as the Vietnam War, military-grade grenades could be made without using metal to avoid detection. Sharp knives can be made out of plastic. Weapons can be made out of wood, bone, etc.

This section will identify and address some of the issues that arise with the increasing availability of 3D printers and gun designs, but to a sophisticated criminal, this is nothing new. Lawmakers may wish to address some of the dangers that are posed by 3D-printed weapons, but it is important that this issue is not allowed to swallow the many positive commercial advances offered by 3D printing.

Manufacturing Methods

3D-printed weapons can be manufactured either as an entirely new weapon created from plastic, or as an attachment to an existing weapon such as a high capacity magazine for a rifle. The parts for each are designed and saved as CAD (computer aided design) files, which can easily be distributed over the internet and made usable by anyone with a 3D printer. 3D design site Thingiverse previously offered gun designs for download even though it violated their terms of service. They have since removed the designs, which led to the development of an independent community of 3D gun supporters sharing designs.

Issues

a. Uncontrolled access by restricted persons

The widespread distribution of the gun design files would make it easy for anyone with a 3D printer to create a gun at home. In the near future, this could mean easy access for a variety of groups that are currently barred from owning weapons, such as children, convicted felons, and the mentally retarded.

b. Uncontrolled access to restricted parts (e.g. high-capacity magazines)

In various jurisdictions around the country, certain types of firearms and magazines have been banned. Most prominently, the Federal Assault Weapons Ban prohibited the manufacture and sale of newly manufactured semi-automatic weapons and high-capacity magazines in the United States from 1994 to 2004. Title XI, 108 Stat. 1796. Manufacturing bans assume the government has the ability to control the manufacture of guns. Although a skilled machinist could still manufacture their own gun parts at home, the availability of 3D printing makes this much more likely to occur. While Second Amendment proponents questioned the legality and necessity of such a ban, Congress saw a need to curb the violence caused by the proliferation of such weapons. The proliferation of 3D printing jeopardizes the government's ability to enforce such bans.

c. Uncontrolled access in restricted places (e.g. airports, courthouses, etc.)

There is concern that 3D printed weapons would be taken into places that are designated weapons-free zones, such as airport terminals, courthouses, schools, etc. Because plastic-based weapons could likely avoid detection by metal detectors, there is some credibility to this threat. But as 3D printing advocates point out, there is nothing new about this threat. Nothing is preventing airline passengers from bringing plastic knives or a wooden spear on the plane. While 3D printing may make it slightly easier to bring guns past metal detectors, this should be looked at in the context of all non-metal weapons that could escape detection.

Jurisdiction and Response

a. Federal

Undetectable Firearms Modernization Act:

Sponsored by Steve Israel, D-New York as H.R. 1474, and also in the Senate as S. 1474 by Bill Nelson, D-Florida. This bill would reauthorize a ban on undetectable firearms as well as extend a ban to undetectable firearm receivers and undetectable magazines. The original legislation was the Undetectable Firearms Act of 1988, which sunset after 25 years in 2013. It is proposed to add receivers to the ban because receivers contain the serial number that make these weapons traceable. Although these bills have stalled in committee, the technology has made the manufacture of these undetectable weapons increasingly easy and Congress may wish to take action soon.

b. State Department Actions:

Cease & Desist letter sent to Defense Distributed; International Traffic in Arms Regulation (ITAR)

c. Alternatives to restricted access

For the time being, advanced materials can only be accessed via high-end printing machines, which are available to non-commercial customers generally through transitional printing services, such as Shapeways.org. Commercial 3D printing services may be regulated in a similar manner to conventional manufacturing, but policymakers should endeavor to build positive relationships with this industry. Conventional wisdom in the 3D printing space indicates that what is currently possible only on high-end equipment will surely come to the consumer-grade market in

time. With that in mind, transitional printing services may be a good predictor of the uses to which 3D Printers will be put in the private context.[13]

Subsection 2B: Intellectual Property

The proliferation of 3-D printing will have an impact the intellectual property system. However, it is hard to predict the magnitude of this impact, the scale of the resulting conflict, or the proper response (or preventative measures) to this impact. Widespread 3-D printing has the potential to challenge many, if not all, aspects of the current IP system. 3-D printers can print materials that infringe on copyright and patent protections. The computer files used to print the objects can also be subject to copyrights. 3-D printers are able to print objects that violate protected trademarks or trade dress. Thinking about how 3-D printers might affect intellectual property rights is critical to anticipating the impact this technology will have on this legal system.

a. Copyright

3-D printers will affect copyrights by making it easier for someone to copy and reproduce an original work without the creator's consent. A copyright gives the creator of an original literary or artistic work exclusive control over the reproduction and distribution of the work for a limited time. 3-D printers make it easier for an unauthorized person to reproduce a copyrighted work. Without 3-D printing, in order to make a copy of a three-dimensional work, you need to somehow replicate the creation process. With 3-D printers, all you need is a digital version of the work and your printer will do the rest. Such blueprints may be obtained by illicit downloading of the original source, if the object was originally printed; may be obtained by means of a 3D scanner; or may be created from scratch by means of a CAD program. However, most of the objects you can print with a 3-D printer are non-copyrightable, so the threat in this area is mostly constrained to toys, memorabilia, and small items of sculpture; for example, role-playing game figurines.[14] [15]

Figure 1: 3D Printed "Warhammer ™" Figurine

Copyright is also implicated by the CAD files (also referred to as Blueprints, Schematics, or Object Files) used by 3-D printers to print objects. But the copyright issues surrounding these files will not change substantially in nature from what they are now – they will only grow in size as these printers become more common. Protection of these files is likely to fall within the purview of the Digital Millennium Copyright Act (DMCA), which protects against circumvention of copyrighted files' digital rights management (DRM) technologies. However, DRM cannot protect against people who scan copyrighted works and then print them directly from their 3-D printers; and does not

[13] *See* Charles W. Finocchiaro, Personal Factory or Catalyst for Piracy? The Hype, Hysteria, and Hard Realities of Consumer 3D Printing, 31 Cardozo Arts & Ent. L. J. 473 at 474 (2013) citing The Printed World, Economist, http://www.economist.com/node/18114221/print/ (2011)

[14] *See* Jon Ippolito, Print your own Legos, game figures--if the lawyers don't stop you first, NMDnet.org, http://www.nmdnet.org/2012/06/04/print-your-own-legos-game-figures-if-the-lawyers-dont-stop-you-first/ (2012)

[15] Image credits: Jon Ippolito, Print your own Legos, game figures--if the lawyers don't stop you first, NMDnet.org, http://www.nmdnet.org/2012/06/04/print-your-own-legos-game-figures-if-the-lawyers-dont-stop-you-first/ (2012) Photo by Andrew B. Myers

offer a complete solution to piracy, just as the DMCA does not eliminate piracy in movies and music. While traditional copyright law can theoretically prevent this kind of reproduction, 3-D printers can potentially provide scale and accessibility that would make enforcement impracticable.

b. Patent

Patents will also be affected by the widespread use of 3-D printers. A patent gives an inventor a collection of exclusive rights on their invention for a set period of time. Any person with a 3-D file of the invention could manufacture it without the patent holder's permission. Patents allow inventors to control the market for their invention and make sure that, if anyone buys their invention, they get paid for it. 3-D printers could get around this process by allowing someone to print off the invention without having to buy it from anyone, including the original inventor.

Previously the impracticality of manufacturing a single item prevented people from getting around patent protection, but 3-D printers allow them to conceivably do just that. However, large-scale manufacturing is still a more cost-efficient process than large-scale 3-D printing, so the threat of a single person with their 3-D printer challenging a large manufacturer is basically nonexistent. The areas most at risk of being impacted by this new type of manufacturing are the health care and automotive industries, where single items are expensive and complicated. Medical device patents are particularly vulnerable because the research and development costs for medical devices may be relatively high compared to the material and manufacturing costs of printing them; furthermore, the end-users of pirated medical device "prints" constitute a sympathetic class that the medical establishment would rather avoid taking to court.[16]

One term that has caught on in the press and industry, coined by commentator David Rejeski, is the "Thingiverse World", a post-3D Printing manufacturing paradigm in which the manufacture of small durable goods is decentralized and inexpensive. [17] Already, a great variety of household goods and toys, including drone kits[18], is available for download and print via www.thingiverse.com, www.shapeways.com , and others.

c. Trademark and Trade Dress

3-D printers could greatly affect trademark and trade dress protection. A trademark is a sign that signifies products or services which come from a particular source. 3-D printers could allow users to print objects with trademarks on them without the trademark holder's consent, thereby trading on that brand or diluting the trademark. Similarly, a user could print a trademarked object without the trademark, removing its association with its owner. Trade dress is an object's visual appearance that informs the consumer of its source. Trade dress could be affected by 3-D printers in similar ways to trademarks, either by adding trade dress where it doesn't belong, or taking it away from where it does belong.

In the landscape of small goods that are no longer patented, traditionally Trademark and Trade Dress have afforded businesses great leverage to control their product. However, inventive designers such as Golan Levins and Shawn Sims have found ways to create a product using 3D printing to create a product that trades on the goodwill

[16] *See* Kyle J. Trout, Esq. and Justing N. Mullen, Kramer Amado, Preserving the Value of Medical Device Patents during the Rise of Three-Dimensional Printing, 20 No. 14 Westlaw Journal Intellectual Property 1 (2013)
[17] *See* David Rejeski, The Next Industrial Revolution: How We Will Make Things in the 21st Century and Why it Matters, 43 Envtl. L. Rep. News & Analysis 10232 (2013), referring to http://www.thingiverse.com
[18] Shapeways.com features a page devoted to 3D printed unmanned aerial vehicles (Drones) at http://www.shapeways.com/gadgets/drones?li=Gadget

of a variety of well-established children's building toys, in the Free Universal Connector Kit (acronym intentional), which provides interconnection parts for such toys as Lego™, K'Nex™, and others.[19]

Summary of the Law

There is still much uncertainty as to how the spread of 3-D printers will actually affect the field of intellectual property. So far the issues that have arisen have been dealt with using traditional intellectual property enforcement – cease-and-desist letters, infringement lawsuits, and takedown notices. Because the application of these old principles to this new technology is still taking shape, the legal actions have been somewhat unpredictable and uneven. However, the question remains whether these measures will be enough to protect existing intellectual property rights as 3-D printers become more and more common.

Subsection 2C: Consumer Protection

Trademark: More consumer risks in 3D printer world than in conventional gray-market.

By potentially circumventing trademark law's brand-based protection of consumer welfare, for instance with kits and products designed to mimic or replace branded products, (such as the Levins / Sims "Free Universal Connector Kit",) as discussed above, 3D printing has the potential to encourage the adoption and use of copycat products. Because the source of 3D printable schematics is not necessarily easy to discern or to hold liable, and because the overhead for producing schematics is substantially lower than that of producing counterfeit goods; such trademark violations may impose greater risks on customers than would conventional mass-produced grey-market goods.

In the context of products that bear low risks to customers, such as toys and entertainment like the Levins kit, the potential that such products may be inferior in quality to branded or licensed products does not implicate safety concerns. (Also, replacement products may in fact be superior.) However, consumer confusion is of greater concern with replacements for load-bearing or useful products and devices. For example, replacement vehicular parts or accessories like load-bearing components of after-market roof-racks may appear to adequately match or replace brand-name products; however, material properties such as strength and lack of structural defects are of serious concern.

Product Liability Law: Distribution of production to the consumer upends traditional product liability.

The norm for product liability in commerce is strict liability for anyone who sells a defective product, as noted in the Restatement:

"A manufacturer is strictly liable in tort when placing a product on the market, knowing that it is to be used without inspection for defects, and it proves to have a defect that causes injury to a human being. … The purpose of imposing strict liability is to insure that the costs of injuries resulting from defective products are borne by those who market such products, rather than by the injured persons who are powerless to protect themselves."[20]

In the context of 3D printing, each element of the Restatement view on product liability may be called into question for practical reasons:

1. What constitutes the Product? Is it the 3D schematic? Is it the schematic in combination with instructions on operating the 3D printer to produce said schematic, for instance, what type of printer can produce the design and

[19] *See* Andy Greenberg, How a Geek Dad and His 3D Printer Aim to Liberate Legos, Forbes Magazine, http://www.forbes.com/sites/andygreenberg/2012/04/05/how-a-geek-dad-and-his-3d-printer-aim-to-liberate-legos/ (2012)
[20] Am. L. Prod. Liab. 3d § 1:13

with which thermoplastic? Is it the final product itself, provided that instructions were followed correctly? Or is it any final product which may be produced from the schematic by a 3D printer, regardless of whether the correct plastic ink was used, or the correct machine settings?

2. Who is the manufacturer, and particularly, does the allocation of responsibility shift with the proximate cause of the existence of the defect? For instance, if a part is defective because the schematic is defective, is it the author or distributor of a schematic that is responsible? If the defect is caused by a malfunction in the printer, is the printer manufacturer responsible in part, or has the owner of the machine assumed liability for defects in parts that he prints with it? If the defect is caused by user error, does full liability rest on the owner of the printer?

3. Can the user of a 3D printer who sells a product, if found strictly liable for harm to an end user, recover in part or in whole for negligence from any of the: schematic designer, 3D printer manufacturer, material supplier, etc.; where he can find flaws in the schematic, operating instructions, random variation due to machine malfunction, or other errors outside of his immediate control?

The precise impact of 3D printing on the landscape of consumer protection is unknown due to the complete absence of case law; however, commentators speculate that the distribution of manufacturing to the end user will result in a "commercial-occasional divide"; noting that historically, commercial vendors are subject to the Restatement's strict liability regime, whereas hobbyist, casual, or "occasional" makers of products (for instance, street-fair vendors), tend to fall under a negligence regime.[21] It is unclear whether the producer of the end product will be the sole liable party, or whether liability may be shared in some circumstances by either or both of the 3D printer manufacturer or the designer of the 3D schematic; however it is *likely* to fall on only the vendor.[22]

Section 3: Recommendations

Intellectual Property Recommendations

On an abstract level, there seem to be three main options for the intellectual property response to 3-D printers. They are:

- Using the existing system: apply the underlying rationales of intellectual property rights to this new technology. This response would be most appropriate if the effects of 3-D printers were expected to be minimal and insignificant.

- Changing the current system: mold the existing intellectual property regime to be better suited to dealing with 3-D printers. One example would be creating a system similar to the DMCA for patents and trademarks/trade dress. This response would be reasonable if the effects of 3-D printers were expected to be legitimate but not different from other IP problems.

- Creating a new system: create new intellectual property rights that specifically protect against 3-D printers. This protection could incorporate elements from other types of IP but would focus exclusively on infringement by 3-D printers. This response would only be advisable if the effects of 3-D printers were expected to be far-reaching and debilitating.

[21] *See* Nora Freeman Engstrom, 3D Printing and Product Liability: Identifying the Obstacles, 162 U. PA. L. Rev. Online 35 (2013)
[22] *See* Id. at 38

Consumer Protection Recommendations

Historically, product liability law has adapted well by operation of the courts to serve the public interest even when confronted with new technology. Although it is simple to construct hypothetical instances in which consumer protections may be inadequate in the face of distributed manufacturing; however, intervening too early may cause one or both of two adverse consequences:[23]

- Fail to address serious problems as they actually manifest and
- Inadvertently prevent or stall the optimal development of the technology.

Concluding remarks

The motivations for regulation in the 3D printing space may be fairly characterized as coming under four categories:

- Beneficial public safety policy with respect to dangerous goods;
- Sufficient consumer protections;
- Robust business environment;
- Protection of intellectual property.

With respect to public policy, we see on the one hand that technological advancement brings with it new opportunities for danger. [24] On the other hand, whether 3D printed weapons are any more dangerous than conventional, DIY weapons remains an open question. Regardless of the actual dangers, legislation has already been proposed to stave off a flood of plastic guns.

Conversely, useful devices such as tools and accessory parts of vehicles or appliances may require some form of additional regulation to meet consumer protection / product liability standards. Historically, product liability has evolved through judicial action. In the absence of case law relating 3D printing to product liability at this time, the extent of the need is unknown. Current law suggests that a more relaxed form of liability (meaning negligence rather than strict product liability) may attach to persons selling 3D printed items at a small scale; but if the practice of producing goods in this manner greatly increases, a more structured legal regime may be needed.

With respect to business, there is no evidence currently from which to conclude that 3D printing will catastrophically impact the business environment. More likely, 3D printing will open for content producers new channels of distribution and provide greater opportunity for exposure for new and innovative market entrants. Market impact will vary depending on whether the product at issue can be cheaply printed, and will therefore follow advancements in 3D printing technology as more types of products can be printed. Thus, business impact is somewhat speculative at this time.

With respect to intellectual property, there is significant opportunity for disruption of the protection of small goods subject to trademark and copyright (such as toys, figurines) and patent (medical devices and tools). A comprehensive solution may require explicit extension of DMCA-like protections for 3D schematics or scans, for instance; or may require an enforcement regime that takes into account more numerous, smaller infringers than anticipated by the current law.

---

[23] *See* Michael Weinberg, Public Knowledge, What's the Deal with Copyright and 3D Printing?, http://www.publicknowledge.org/news-blog/blogs/whats-the-deal-with-copyright-and-3d-printing (2013)
[24] *See* Julian J. Johnson, Print, Lock, and Load: 3-D Printers, Creation of Guns, and the Potential Threat to Fourth Amendment Rights, U. Ill. J.L. Tech. & Pol'y 337 (2013)

On balance, opening the door for rapid and relatively free development of this new technology may usher in significant improvements in distribution of products, including medical devices; and to generally promote the advancement of technology with its myriad unknown potential benefits. Many potential pitfalls have been identified and discussed, but most appear speculative at this time. Therefore, in the absence of clear and present detrimental impacts arising from early consumer adoption in the 3D printing space, it seems that a wait-and-see approach is warranted to promote the advancement of this technology at its current pace.

Background References and Further Reading

Books

- Hod Lipson and Melba Kurman, Fabricated: The New World of 3D Printing, John Wiley & Sons (2013)

Cases

- Sony Corp. v. Universal City Studios, Inc., 464 U.S. 417 (1984) held that companies which manufacture home recording machines are not liable for contributory infringement because the machines have significant noninfringing uses and are sold for legitimate purposes.
- Metro-Goldwyn-Meyer Studios Inc. v. Grokster, Ltd., 545 U.S. 913 (2005) held that producing a technology that aids infringement, and promoting that use for infringement, can be grounds for suit for inducing copyright infringement.
- Burrow-Giles Lithographic Co. v. Sarony, 111 U.S. 53 (1884)
- Kieselstein-Cord v. Accessories by Pearl, Inc., 632 F.2d 989 (2nd Cir. 1980)
- Carol Burnhart Inc. v. Econ. Cover Corp., 773 F.2d 411 (2nd Cir. 1985)
- Brandir Int'l, Inc. v. Cascade Pac. Lumber Co., 834 F.2d 1142 (2nd Cir. 1987)
- Pivot Point Int'l v. Charlene Prods., 372 F.3d 913 (7th Cir. 2004)

Law Review Articles

- Haritha Dasari, Assessing Copyright Protection and Infringement Issues Involved with 3D Printing and Scanning, 41 AIPLA Q.J. 279 (2013) at 288-289
- David Doherty, Downloading Infringement: Patent Law as a Roadblock to the 3D Printing Revolution, 26 Harv. J.L. & Tech. 353 (2012)
- Nora Freeman Engstrom, 3D Printing and Product Liability: Identifying the Obstacles, 162 U. PA. L. Rev. Online 35 (2013)
- Charles W. Finocchiaro, Personal Factory or Catalyst for Piracy? The Hype, Hysteria, and Hard Realities of Consumer 3D Printing, 31 Cardozo Arts & Ent. L. J. 473 at 474 (2013) citing The Printed World, Economist, http://www.economist.com/node/18114221/print/ (2011)
- Julian J. Johnson, Print, Lock, and Load: 3-D Printers, Creation of Guns, and the Potential Threat to Fourth Amendment Rights, U. Ill. J.L. Tech. & Pol'y 337 (2013)
- John M. Newman, Copyright Freeconomics, 66 Vand. L. Rev. 1409
- Stephanie Noble, Researching Emerging Technology, 42-AUG Colo. Law. 103 (2013)
- David Rejeski, The Next Industrial Revolution: How We Will Make Things in the 21st Century and Why it Matters, 43 Envtl. L. Rep. News & Analysis 10232 (2013)
- Brian Rideout, Printing the Impossible Triangle: The Copyright Implications of Three-Dimensional Printing, 5 J. Bus. Entrepreneurship & L. 161 (2011)

Periodicals

- Richard Acello, Call it the Apple Effect | Firm Puts its Mark on Design Patents, 99-AUG A.B.A. J. 32 (2013)
- Andy Greenberg, How a Geek Dad and His 3D Printer Aim to Liberate Legos, Forbes Magazine, http://www.forbes.com/sites/andygreenberg/2012/04/05/how-a-geek-dad-and-his-3d-printer-aim-to-liberate-legos/ (2012)
- Jon Ippolito, Print your own Legos, game figures--if the lawyers don't stop you first, NMDnet.org, http://www.nmdnet.org/2012/06/04/print-your-own-legos-game-figures-if-the-lawyers-dont-stop-you-first/ (2012)
- R.B. Ruhl, Preparing Students for the Big Reinvention in Law, 60-AUG Fed. Law. 36 (2013)
- Clive Thomson, 3D Printing's Legal Morass, Wired, http://www.wired.com/design/2012/05/3-d-printing-patent-law/ (2012)
- Kyle J. Trout, Esq. and Justin N. Mullen, Kramer Amado, Preserving the Value of Medical Device Patents during the Rise of Three-Dimensional Printing, 20 No. 14 Westlaw Journal Intellectual Property 1 (2013)
- Vogel, B. J., Bloomberg Law, Casting 3D Printing's Coming IP Litigation: Usual Suspects and Dark Horses. http://about.bloomberglaw.com/practitioner-contributions/casting-3d-printings-coming-ip-litigation-usual-suspects-and-dark-horses/ (2014)
- Michael Weinberg, Public Knowledge, 3D Printing, Matisse, and the Arbitrariness of Copyright Terms, http://www.publicknowledge.org/news-blog/blogs/3d-printing-matisse-and-arbitrariness-copyrig (2013)
- Michael Weinberg, Public Knowledge, Thanks to 3D Printing and Open Source Hardware, Patent May be on the Cusp of a Copyright Moment http://www.publicknowledge.org/news-blog/blogs/thanks-to-3d-printing-and-open-source-hardware-patent-may-be-on-the-cusp-of-1 (2013)
- Michael Weinberg, Public Knowledge, What's the Deal with Copyright and 3D Printing?, http://www.publicknowledge.org/news-blog/blogs/whats-the-deal-with-copyright-and-3d-printing (2013)