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Progress in the Making

3D Printing Policy Considerations through the Library Lens

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ABSTRACT

Libraries nationwide are expanding access to 3D printing. Library makerspaces that offer 3D printing services provide people with the ability to create essentially any object they can imagine. These libraries serve as labs of innovation and experimentation for aspiring entrepreneurs looking to bring new products to market—and for everyone to advance learning and creativity.

As 3D printing becomes more common inside and outside of libraries, it has the potential to transform our society in a number of ways and, in the process, raises numerous new issues for policymakers to consider.

This paper provides a history and overview of 3D printing technology; discusses the potential economic impacts of the growth of the 3D printing industry; outlines the role 3D printing now plays in formal education and libraries; provides an analysis of the policy implications of 3D printing; and offers insight into the role the library community should play as lawmakers, government agencies, companies and the courts craft frameworks for 3D printing activities. The paper's public policy discussion cuts across a number of issues, including intellectual property, intellectual freedom and individual liberty and product liability.

Why is 3D Printing Important for Librarians?

The library community stands on the front lines of the digital revolution. Libraries connect entire communities with the digital technologies that are fundamentally changing the way we process and utilize information. 3D printing is among the most recent transformative digital services to be offered in libraries. A small, but rapidly growing number of public libraries—currently about 250 locations¹—in every part of our country are adopting 3D printers and making them available for patron use.

Using a 3D printer in the Maker Lab at the Allen County Public Library in Ft. Wayne, Indiana, a Boy Scout troop printed resin wheels for its robot team.² At the Libraries of the University of Florida, mathematical models were printed to illustrate concepts that are difficult to depict in two dimensions, such as fractals and spherical projections of grids.³ To promote learning and creativity, a student printed multi-color globes at the school library of West De Pere High School in Wisconsin.⁴ In Kansas, a high school junior created a functioning prosthetic hand for a nine-year-old family friend

using the 3D printer at the Johnson County Public Library.

These examples highlight a few of the exciting applications of library 3D printing. As this technology continues to take off, library staff should continue to encourage patrons to harness it to provide innovative health care solutions, launch business ventures and engage in creative learning. In order to do so, library staff must have a clear understanding of basic 3D printer mechanics; the current and potential future uses of 3D printers inside and outside of library walls; and the economic and public policy considerations regarding 3D printing.



Prototype of a 3D-printed prosthetic hand

It is important to note that institutions and agencies that provide funding to the library community have already begun to help libraries use 3D printers to effect meaningful community change. For example, in response to President Obama’s call to make science, technology, engineering and mathematics (STEM) education a national priority in 2010 as part of his Educate to Innovate initiative, the Institute of Museum and Library Services (IMLS) and the John D. and Catherine T. MacArthur Foundation launched the Learning Labs in Libraries and Museums program.⁵ This program provided sites in 24 cities and counties with \$100,000 each for the planning and design of an “innovative teen space” known as a “Learning

Lab.”⁶ A number of learning labs offer 3D printing services, including those at the Anythink Wright Farms and Anythink Brighton libraries within the Rangeview Library District in Adams County, Colorado.⁷

History and Overview

In 1983, a young man named Charles Hull had an idea. Hull—who at the time was working for a small firm that made durable coatings for tables using ultraviolet (UV) lamps—thought computer designs of solid objects could be converted into prototypes by fusing together successive layers of curable UV material.⁸ After months of experimentation, Hull pioneered stereolithography: The first 3D printing (or “additive manufacturing”) technique.⁹ All modern 3D printing techniques still follow the same fundamental process Hull developed.

The process begins when computer aided design (CAD) software renders the virtual blueprint of a solid object. A blueprint can be generated from scratch using a modeling program, or by using a camera or a 3D scanner to capture the exact dimensions of an object and convert them into a CAD model. Once CAD software creates an object’s blueprint, a plating and slicing program divides the object into cross-sections. A 3D printer builds the object layer-by-layer, either by extruding sheets of raw material onto a build platform, or by focusing lasers onto thin sheets of raw material. As the sheets cool, they fuse together to render the final object.

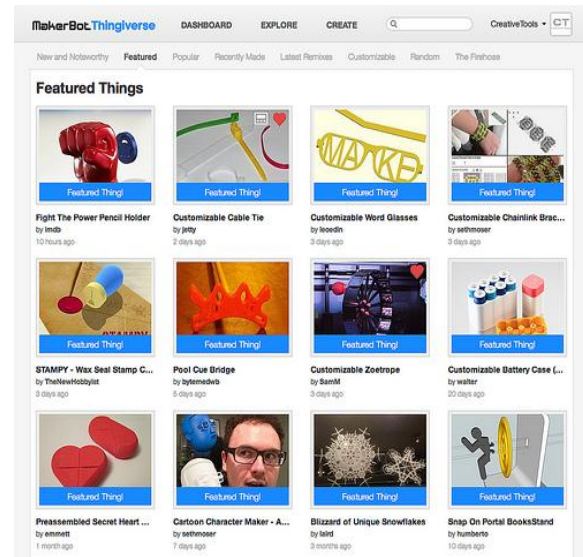
A number of websites provide services related to CAD files for 3D printers. One of the most robust online platforms for CAD file sharing is Thingiverse, 3D printing manufacturer Makerbot’s online repository of open-source, user-generated designs. Other websites will print, ship and even market design

files for users. One of the leading websites providing these services is the Dutch-founded website Shapeways. In addition to building and sending users designs they upload to the site, Shapeways helps those looking to market their designs reach customers around the globe. The site allows users to upload designs to personalized pages known as “shops,” and link these pages to a Paypal account. Shapeways will handle the production and distribution of an item following a sale. The net proceeds from each sale go to the user, minus a 3.5 percent payment processing fee.¹⁰ A number of competing sites offer similar services, including Sculpteo, Ponoko and iMaterialise.

The materials compatible with 3D printing are extensive and growing. Most library 3D printers use plastic. Currently, the most common plastics used in 3D printing are acrylonitrile butadiene styrene (ABS) and polylactic acid (PLA) plastic. Both of these materials lend themselves to the additive manufacturing process because they heat and re-cool easily, but each has its weaknesses as well. The hard, glossy, petroleum-based ABS is highly flammable and prone to cracking if cooled too quickly.¹¹ The brittle, plant-based PLA is prone to cracking along stress zones and sometimes contains toxic dyes and binders.¹²

ABS, PLA and other plastics can be used to create everything from toy figurines to prosthetic limbs to handguns. The objects and structures that can be printed from materials other than plastic are even more varied, but less common. A company in Shanghai can print a ten-story house out of quick-dry cement in less than 24 hours;¹³ the San Diego-based company Organovo Holdings, Inc. is using 3D printers to create a human liver out of human cells;¹⁴ and in 2014,

NASA launched a 3D printer into space to experiment with the creation of spare parts for the International Space Station.¹⁵ With the development of more complex 3D printing applications, bioengineers, metallurgists and other materials scientists are continuing to find new materials compatible with the 3D printing process.



The Thingiverse user interface

Modern 3D printers vary widely in price. Commercial printers—those that can be reliably used for manufacturing and scientific purposes—like creating a dental model or a chemical compound—can cost tens, or even hundreds of thousands of dollars (e.g., the Matsuura LUMEX Advance-25, which starts at over \$800,000 in American markets). “Desktop” 3D printers—those that are targeted to the American household—start as low as \$200 (e.g., the Makible A6-LT).¹⁶ A number of these printers are sold as “kits” of constituent parts that the consumer must assemble at home. Last year, Renovated Design launched a Kickstarter campaign to bring a \$100 desktop 3D printer to market. The printer, known as the “Peachy Printer,” was successfully funded in October

2013 and is under development as of this writing.¹⁷

Economic Implications

With industrialization, America's economy fundamentally changed. Before then, the U.S. economy was driven by the output of small entrepreneurs and artisans, and exchanges of goods and services generally took place locally and on a small scale.¹⁸ With the rise of mass production and large-scale distribution systems, large corporations became the engines of economic growth, and goods began to flow across state and national borders.¹⁹ By and large, America transformed from a society of enterprising small producers to one of consumers subject to the vagaries of corporate production and global commerce.²⁰ Some say 3D printing has the potential to once again place the small producer at the helm of the American economy.²¹

While 3D printers are not yet technologically advanced or affordable enough to allow individuals to cost-effectively print all of the materials and goods they depend on in day-to-day life, these devices have become accessible enough to spawn a "maker movement," which encourages people to independently build and customize home, office and recreational goods.²² Hobbyists across the country use 3D printers to fashion and tinker with everyday items like key chains, coffee mugs and watches; entrepreneurs use 3D printers to build prototypes of goods they are trying to bring to market; and start-ups rely on crowd-sourced items from the maker community to compete with large manufacturers.²³

Libraries are in the vanguard of the maker movement. Makerspaces outside of libraries often require paid monthly or annual memberships. For example, Techshop, a

network of facilities that offers access to metallurgic, mechanical, electrical and prototyping machinery and classes, charges members of its D.C.-Arlington location a fee of \$125 per month or \$1,395 per year.²⁴ In contrast, most libraries offer 3D printing and other creative makerspace services as a library service at no cost beyond charging for the materials used in printing. Libraries with makerspaces offer lectures and special events for aspiring entrepreneurs.²⁵

Though 3D printing has the potential to empower individuals and small businesses, this technology by no means heralds the demise of big industry. Over the past several decades, many large firms have outsourced their manufacturing to foreign countries.²⁶ 3D printing may motivate these firms to bring many of their manufacturing activities back to the United States.²⁷

Many industrial-grade 3D printers can already build goods more cost-effectively than can overseas workers.²⁸ If firms were to begin manufacturing more of their goods with 3D printers on American soil, not only could their production costs drop, but costs related to inventory holdings, shipping and environmental compliance could also diminish.²⁹ 3D printing also can help firms get their goods to market more quickly by allowing them to rapidly and cost-effectively generate prototypes for testing, as well as to produce intricate items that standard production machinery cannot efficiently generate.³⁰

In broad strokes, the economic argument for 3D printing is that allowing this technology to flourish will allow industries of all sizes to accelerate the process for designing, producing and launching new products.³¹ Those who espouse this argument contend that policymakers should imple-

ment sensible regimes that safeguard public health (e.g., ensure proper ventilation) and protect rights holders without unduly limiting learning, innovation, creativity, and the growth of 3D printing technology.³²

3D Printing and Formal Education

In a number of educational institutions, 3D printing technology is helping students develop the science, technology, engineering, art and math (STEAM) skills they need to compete in the global economy. School, college, university and public libraries are leading the effort to promote STEAM education through 3D printing. For example, 3rd graders at the David C. Barrow Elementary School in Athens, Georgia, used their library's 3D printer to design and build their own jewelry as part of a geologic lesson on rocks and minerals.³³ At Barrow, the 3D printer is available to all students and faculty and educators are integrating 3D printing into lesson plans as early as 1st grade.³⁴

At the university level, the DeLaMare Science and Engineering Library at the University of Nevada-Reno became the first university library to provide 3D printing and scanning as a library service to all students in 2012.³⁵ Students are using 3D printers to create prototypes of everything from robot parts and engine blocks to chemical models. Because the library serves all students, it enables collaboration across academic disciplines, from marketing to chemistry.³⁶

Barrow Elementary obtained its 3D printer with the help of MakerBot Academy, an initiative to put a 3D printer in every public school in America.³⁷ In addition to offering printers and materials at discounted rates to schools, Makerbot Industries also makes available curriculum-based printable models—e.g., a frog dissection kit, a T-Rex skull and a miniature Pyramid of Giza—through

Thingiverse.³⁸ MakerBot is one of several manufacturers that have begun a push to bring their products to the education community.

Another such manufacturer is the Canadian firm Tinkerine, which recently launched Tinkerine U, a program aimed at getting 3D printers and 3D printing curricula into North American schools.³⁹ Through Tinkerine U, schools can purchase discounted Tinkerine printers bundled with printing materials, lesson plans and a library of educational 3D models.⁴⁰ Dutch manufacturer Leapfrog also offers schools special discounts and product bundles, as well as two different curricula—one designed for primary school and the other for high school—for teaching students how to use a 3D printer.⁴¹

3D Systems, one of the largest U.S. manufacturers of 3D printers, recently partnered with the American Library Association (ALA) and the Association of Science and Technology Centers to establish the MakerLab Club—“...a community of U.S. libraries and museums committed to advancing 3D digital literacy and providing their members and communities with access to 3D printers and programs.”⁴² Member libraries and museums receive a number of benefits from 3D Systems, including between two and four Cube 2 3D printers, access to workshops, webinars and discounted equipment and monthly access to 3DU, a program of instructional 3D printing modules and resources.⁴³ To apply to become a member of MakerLab Club, a library, museum or science and technology center must be able to demonstrate a commitment to “making” and digital design.⁴⁴ 3D Systems also recently launched a comprehensive effort to integrate 3D printing into American education, called Make.Digital.⁴⁵

Among 3D systems' current partners are LevelUp Village (LUV) and For Inspiration and Recognition of Science and Technology (FIRST) Robotics. LUV offers STEAM classes to students in the United States and in a number of schools abroad.⁴⁶ The company reaches students in such countries as India, Rwanda, Uganda, Mali, Pakistan, and Peru. When students enroll in a LUV class in the U.S., a parallel class is offered in a foreign LUV school.⁴⁷ Students in parallel classes work together through interactive technologies to build common skills and share common experiences. 3D Systems provides participants in LUV's Global Inventors in Training class with a Cube 3D printer, design software and access to an after-school training class.⁴⁸

FIRST is an international youth organization that hosts an annual team robotics competition. 3D Systems supports the competition by making over 400 3D printers available to participating teams across America.⁴⁹

The recent drive by manufacturers to gain traction in schools has captured the attention of top-level government officials. In a recent speech at the 2014 RAPID Conference and Exposition in Detroit, U.S. Commerce Secretary Penny Pritzker gave a plug to M.LAB.21, another 3D Systems initiative to get 3D printers into schools.⁵⁰ As part of this initiative, 3D Systems and manufacturing giant SME will work with industry and education experts to develop 3D printing curricula for schools.⁵¹

The enthusiasm the 3D printing industry has shown for engaging with the education community is exciting. Still, there can be no question that 3D printer manufacturers are designing academic curricula and offering targeted education discounts at least in part because they want to create and grow a

market and develop brand identity with a critical market segment. Therefore, a school or higher education institution considering a partnership with a manufacturer should leverage this market benefit to boost the STEAM skills of its students to the fullest extent possible.

Free Expression Issues

The growth of the 3D printing industry has raised a number of questions related to intellectual freedom and individual liberty. To date, most of these questions have been debated in the context of 3D-printed firearms. To what extent should the government limit the ability to print firearms and components of firearms? Should an individual have to obtain a license for a firearm he or she builds using a 3D printer? What constitutes a 3D-printed gun? Policymakers have recently begun to consider these sorts of questions. In 2013, Philadelphia became the first U.S. city to ban the 3D printing of firearms.⁵² Also in 2013, U.S. Attorney General Eric Holder mentioned 3D printed guns in a public statement recommending the extension of the Undetectable Firearms Act, which bans guns with low metal content.⁵³ However in December 2013, a 10-year extension of the Act made no explicit mention of 3D printed firearms.⁵⁴

Despite the high-profile debate surrounding 3D-printed guns, the individual liberty implications of 3D printing extend far beyond questions of firearm regulation. For example, scientists have already begun to apply 3D printing to the process of making pharmaceuticals. Lee Cronin, a professor of chemistry at the University of Glasgow in Scotland, has been printing chemical compounds with a team of researchers for a number of years.⁵⁵ He hopes that his efforts will enable individuals to one day print all of the pharmaceuticals they need from their

desktops.⁵⁶ The prospect of turning computers into chemistry sets is both exciting and unsettling. Placing the power to concoct drug molecules into the hands of anyone with a computer, CAD software and a 3D printer could potentially help millions of people around the world gain swift access to the medications they need to live healthier lives. However, it also could result in the printing of medications that are untested and unsafe. Lawmakers and the U.S. Food and Drug Administration will have to find a way to regulate the pharmacological uses of 3D printers if these uses become more common.

Another danger of the chemical applications of 3D printing is that those engaged in the illicit drug trade will begin to use 3D printers to create narcotics. This is likely to become more possible as 3D printers become able to render more complex molecules.

3D printers also have the potential to render material that, while legal and unregulated, may pose challenges in the library setting. Individual libraries may set policies that constrain or preclude certain uses of 3D printing, especially those that raise safety concerns. The contribution (see pages 8-9) from the ALA Office for Intellectual Freedom discusses this issue in greater detail.

The 3D printing industry is well aware of the challenges of 3D printers. Recently, manufacturers of 3D printers and public safety advocates have begun to consider the merits of embedding tracking and regulatory mechanisms into the 3D printing process. Manufacturers of 2D printers, such as Epson and Xerox, have long embedded “watermarks” in the form of tiny dots or faint text into their printing processes to ensure that their printers are not used to produce coun-

terfeit postage, currency or other official government materials.⁵⁷

One 3D printing commentator wrote an article in 3DPI—a news source on the 3D printing industry—proposing embedding traceable ID tags in or on 3D-printed objects.⁵⁸ The article suggested either placing tiny, transparent markings on the outside of objects that could be detected with certain forms of light, or embedding shapes on the inside of objects that could be read using terahertz radiation.⁵⁹ Create it REAL, a company that develops 3D printing technology, has discussed developing software that will halt a print job when it recognizes CAD files of components that could be used to build a regulated weapon.⁶⁰

The capability of 3D printers to monitor and track their own output highlights an ironic aspect of modern additive manufacturing technology. On the one hand, this technology “democratizes” the manufacturing process.⁶¹ Individual entrepreneurs and startups with access to a 3D printer and CAD software can build essentially anything they want and can better compete in the marketplace against larger, highly capitalized firms. On the other hand, by digitizing the manufacturing process, the technology facilitates the ease of tracking, regulating and even restraining the production and movement of goods.

How should the library community respond to the concept of embedding tracking and regulatory mechanisms into 3D printers? In addition to promoting public safety, these mechanisms might help libraries avoid or at least minimize a number of liabilities. However, watermarking 3D-printed objects challenges patron privacy, and employing software in 3D printers that would immediately halt certain print jobs could restrict patron ability to make use of public information.

3D Printing, Intellectual Freedom and Library Values

By Deborah Caldwell-Stone, Deputy Director,
ALA Office for Intellectual Freedom

The growing movement among libraries to offer library users opportunities to learn about and interact with new technologies like 3D printing has naturally prompted questions about the application of the profession's core value of intellectual freedom to such efforts. Existing intellectual freedom policies adopted by the ALA state that libraries and librarians should protect and promote intellectual freedom regardless of the format, technology, or means of engagement used to provide learning opportunities in the library.⁶² Thus the intellectual freedom principles espoused in the Library Bill of Rights and the ALA Code of Ethics can be said to naturally extend to those tools, technologies, and services that enable library users to create content, including 3D printers.

A useful analogy can be made between the provision of 3D printing technologies and libraries' provision of typewriters and word processing computers. In providing access to the tools needed to create and disseminate written expression, libraries and librarians do not place limits on the content of library users' prose. Similarly, libraries and librarians should avoid placing limits on library users' free expression and creativity when they use the library's 3D printer to create tools, art, or other material goods.

Existing precedent concerning access to publicly funded library resources support the conclusion that patrons using a publicly funded library's 3D printer enjoy certain rights of access and free expression protected by the First Amendment. For example, courts have set aside library policies or

procedures that restrict use of a library's meeting rooms or other publicly available facilities based upon arbitrary distinctions among users or user groups, such as religion, age, income, immigration status, or housing status. Courts also have set aside policies and practices that restrict use of a library's meeting rooms and facilities based on partisan or doctrinal disapproval of the user's views or speech, or because of a desire to avoid controversy.⁶³

These cases counsel against the adoption of policies or practices that arbitrarily restrict use of the library's 3D printer based on a user's status or constitutionally protected creative expression. Protecting and promoting users' rights of access and free expression with respect to their use of the library's 3D printer does not mean the library cannot adopt some limitations on the use of the 3D printer as long as the limitations are reasonable, related to library use, and do not regulate expressive activity. Such limitations can include rules intended to promote users' safety; assure equitable access to the printer; and protect the library from potential legal liability. The library can also bar any use of the 3D printer for illegal purposes, including the creation of items that are prohibited by local, state or federal law or that violate intellectual property rights.

A written acceptable use policy for the 3D printer is a necessity if the library is to protect users' intellectual freedom while addressing concerns about safety, access, liability, and illegal use of the 3D printer. Effective policies include statements of purpose affirming that the library's intellectual freedom policies apply to 3D printer use; a provision requiring that the 3D printer be used for lawful purposes only; and a declaration informing users that the library's user behavior and acceptable use policies apply

to all uses of the 3D printer. Such broadly written policy statements provide the library with the necessary flexibility to address any potential misuse or abuse of the 3D printer while assuring users the freedom to design and create projects with the new technology.

Adoption of such an acceptable use policy also can provide a framework for discussion and decision making when questions of law, policy, or practice arise. In the context of 3D printing, questions are frequently asked about the use of the library's 3D printer to create potentially controversial objects such as guns, sex toys, and illegal drugs. A written policy addressing patrons' use of the 3D printer will demonstrate that the library has thoughtfully considered these issues and provided its librarians with the tools needed to intervene when users ask to use the 3D printer to create items that threaten the health and safety of other users or are otherwise prohibited by law.

Library policy, however, should not be used to bar users from designing and creating lawful items simply because they may cause controversy. For example, the use of the library's 3D printer to create and assemble a gun could be restricted as a violation of library behavior policies prohibiting the possession of weapons in the library;⁶⁴ but it is none of the library's business if someone chooses to use their time with the 3D printer to create a sex toy.⁶⁵

Libraries providing users with the opportunity to use a 3D printer should be prepared to protect users' privacy in regard to their use of the library's 3D printer. Existing library privacy policies, based on state library confidentiality laws and ALA policies regarding users' privacy and confidentiality, should apply whenever a patron makes use

of any library materials or services, including 3D printing. While the user cannot expect complete privacy in regards to the use of a 3D printer—she may not be able to use the 3D printer without the assistance of a librarian or other library staff member—she should be able to rely on the library's promise that information about her intellectual activities in the library will not be shared with third parties.⁶⁶

Nonetheless, the present controversy over the use of 3D printers to manufacture guns (and the lesser alarm about sex toys and drugs) is a harbinger of the kinds of public policy debates librarians may confront as increasing numbers of libraries acquire 3D printers. Adherence to the profession's core professional values may require librarians to advocate for their library users' freedom to engage with emerging technologies like 3D printers in order to express their creativity and share that expression with others.

Such advocacy can begin today by taking a positive approach when 3D printers are added to the library's technology offerings. 3D printer policies should be informed by the profession's commitment to the kind of intellectual freedom that fosters learning, facilitates access, and promotes engagement. The policy should identify and highlight what 3D printers can do as a useful, innovative technology that offers opportunities to create and share content.

While reasonable rules are necessary to manage access and address potential misuse, fear should not drive policy and procedure, or create the impression that 3D printing is a dangerous technology. Free access depends on support for the library's mission of facilitating the individual's ability to pursue knowledge without limitation.

Intellectual Property Issues

3D printing provides individuals with the ability to cost-effectively build and re-create items at all levels of complexity.⁶⁷ As a result, it forces us to think about intellectual property law in an entirely new context. Lawmakers and the courts will have to decide how, and to what extent, intellectual property concepts should apply to the 3D printing process. It will likely be a while before the answer to this question is clear.

Librarians must continue to encourage their patrons to use library 3D printing services to cultivate new skills, develop new innovations and launch new business ventures. In communities across the country, library 3D printing inspires creative learning and brings the ideas of enterprising Americans from conception to fruition. For it to continue to do so, those of us in the library community must resolve to continue to provide the technology and services our patrons need and our values demand, exhibiting leadership in this emerging technology.

In considering intellectual property concepts in the context of 3D printing, our primary goal should be to understand where our rights and responsibilities begin and end as service providers and users. By arriving at such an understanding, we can better identify disinformation about intellectual property law and jurisprudence and furnish ourselves with the knowledge we need to shape the regulatory frameworks that develop around 3D printing in the coming years.

Patent

The arrival of digitization to the music, film and book industries beginning in the late 1990s engendered a great deal of debate on the subject of copyright.⁶⁸ Now that 3D printing has—in the words legal scholars

Deven Desai and Gerard Magliocca—brought digitization to “the economy of tangible things” for the first time, we need to reexamine patent law in much the same way we have copyright law over the past approximately decade-and-a-half.⁶⁹

In the United States, there are two basic kinds of patents—utility and design. A utility patent may cover a machine, article of manufacture, a composition of matter, or method or process [fn. 35 U.S.C. Section 101]. A design patent covers the ornamental and aesthetic shape of a manufactured item as opposed to its utilitarian function [fn. 35 U.S.C. Section 171]. Both types of patents may be implicated by 3D printing. For example, a company might hold a utility patent covering a method of printing a pair of sunglasses and also hold a design patent on the shape and design of the sunglasses.

Several different forms of patent infringement might result from the 3D printing process:

Direct Infringement

Direct infringement refers to the unauthorized manufacture, use, sale, offer of sale or import to the United States of any patented invention.⁷⁰ Any individual who prints—wittingly or unwittingly—an object under patent could be held liable for direct infringement if he or she utilizes a method or produces an apparatus or device covered by a patent claim.

Three Kinds of Indirect Infringement

Because a library with a 3D printer typically would not be directly involved in the printing of any item, it likely would not face direct patent infringement liability if an individual printed a patented object with its printer. However, libraries must be aware of several possible forms of indirect liability, and take steps to avoid them.

1. Induced infringement: The process of encouraging another to infringe. Proof of this sort of infringement is difficult, as it requires a showing that the defendant had specific knowledge of the patent in question, as well as the intent to cause another to infringe upon that patent.⁷¹ An individual who uploads a CAD file of a patented design to a design-sharing website like Shapeways and is on notice of another's patent rights could be held liable for induced infringement.
2. Contributory infringement: The sale, offer of sale or import to the United States of a component of a patented machine, combination or composition, or of a material or apparatus for use in a patented process [fn. 35 U.S.C. Section 271].⁷² Thanks to the Supreme Court's 2011 decision in *Global-Tech Appliances, Inc. v. SEB S.A.*, to establish contributory infringement, it must be proven—as in cases of induced infringement—that the defendant had prior knowledge of the patent in question.⁷³ An individual who prints a part or component of a patented apparatus, for example, such as the shell of a patented cell phone design, could be held liable for this sort of infringement. It should be pointed out that while prior knowledge of the patent in question is necessary for proving either type of indirect infringement, the doctrine of “willful blindness” holds that prior knowledge is to be attributed to a defendant if he or she (1) “subjectively believe[s] that there is a high probability that a fact exists,” and (2) “take[s] deliberate actions to avoid learning of that fact.”⁷⁴ Companies can often give notice of patent rights by marking their products, packages or even websites with patent numbers [fn. 35 U.S.C. Section 287].
3. Vicarious infringement: While patent law does not explicitly mention vicarious infringement, the courts have defined vicarious patent liability through a number of decisions. The law firm Klemchuk and Kabusta notes:⁷⁵

“Courts have found vicarious liability for direct infringement when the infringing acts are committed by an agent of the accused infringer or a party acting pursuant to the accused infringer's direction or control, and where multiple parties combine to perform every step of a claimed method and one party exercises control or direction over the entire process.”

Trade Secrets and Trade Dress

3D printing may also infringe upon protections of trade secrets in the form of formulas, practices, processes, designs, instruments, patterns or compilations of information.⁷⁶ Obtaining trade secret protection requires proof that the secret is not widely known, that efforts have been made to prevent dissemination of the secret, and that the secret confers a competitive advantage.⁷⁷ 3D printing may well see a proliferation of trade secret claims in the coming years, as manufacturers look to leverage new technologies to find new commercial uses for 3D printers.⁷⁸ Trade dress protects product designs that are inherently distinc-

tive and/or help consumers determine product origin.⁷⁹



The Coca-Cola bottle's unique ornamental features earned it a design patent in 1915. Its distinctive contours and packaging ensures it is protected under trade dress.

Copyright

Copyright protection attaches automatically to creative works like drawings, writings (including software), sculptures, and musical compositions.⁸⁰ Copyright infringements could result from scanning and printing artists' sculptures and copying CAD files that direct 3D printers to render artists' designs.⁸¹ Infringements also might result from printing certain toys like figurines.⁸² There is also debate about whether copyright law protects CAD files for useful (not artistic) objects.⁸³ Yet another question is whether copyright law would address 3D printings of useful items with separable artistic components (e.g., it is likely that the unauthorized printing of a coffee cup with an artistic drawing on the front would constitute copyright infringement).⁸⁴

Intellectual property attorney Bryan Vogel explains that copyright litigation resulting from 3D printing has mostly focused on the Digital Millennium Copyright Act, which has provisions that make it unlawful to circumvent technological measures used to protect copyrighted works [fn. 17 U.S.C. Section 1201]. He cites a recent takedown notice issued by HBO as an example. The

company issued a notice to a site offering to sell a 3D-printed, smartphone charging device shaped like the Iron Throne from the popular HBO hit, *Game of Thrones*.⁸⁵

As with patent law, libraries providing 3D printers must be aware of potential copyright infringement liability under indirect liability theories. Although the Copyright Act does not explicitly mention indirect liability concepts, the courts have recognized theories of induced, contributory or vicarious infringement in the copyright context. As a result, in attempting to avoid secondary liability under this law, persons and organizations must rely on the precedents established by certain legal decisions.

These decisions include:

1. The 1984 "Betamax" decision [*fn75: Sony v. Universal City Studios*, 464 U.S. 417, 220 USPQ 665 (1984)].⁸⁶ In this case, the Supreme Court ruled that Sony, a videocassette recorder (VCR) manufacturer, was not liable for infringement for producing a technology that had the potential to be used for infringing purposes because the technology was capable of substantial noninfringing uses.⁸⁷
2. The 2005 "Grokster" decision [*Metro-Goldwyn-Meyer Studios, Inc. v. Grokster* (04-480) 545 U.S. 913].⁸⁸ The Supreme Court established a precedent for "inducement" liability under the copyright law when it ruled in this case that Grokster, a provider of peer-to-peer file sharing technology, could be held liable for the infringing activity of its users.⁸⁹ The court found, "one who distributes a device with the object of promoting its use to infringe copy-

right, as shown by clear expression or other affirmative steps taken to foster infringement, is liable for the resulting acts of infringement by third parties.”⁹⁰

3. The 1996 “Fonovisa” decision [fn76: *Fonovisa Inc. v. Cherry Auction*, 76 F.3d 259, 37 USPQ2d 1590 (9th Cir. 1996)].⁹¹ In this case, the 9th Circuit Court addressed the concept of vicarious liability under the copyright law. The court ruled that Cherry Auction, an operator of a flea market in California, was vicariously liable for the sale of pirated CDs by vendors at its market.⁹² The court reasoned that Cherry Auction’s vicarious liability stemmed from the fact that the infringing merchants were acting under Cherry Auction’s direction/control, for Cherry Auction’s direct financial benefit.⁹³

Product Liability

As 3D printing takes off, a growing number of people will gain the ability to create and market complex and potentially dangerous products.⁹⁴ Inevitably, some 3D-printed products that are brought to market will be faulty and will result in consumer injuries.⁹⁵ Who, if anyone, can be held liable for these products, is an open question.

One possible liable party is the hobbyist/inventor who printed and sold the item.⁹⁶ Proving liability for such an individual will likely be difficult. Currently, strict product liability only applies to “commercial” sellers.⁹⁷ Legal scholar Nora Freeman Engstrom explains, “Occasional or casual vendors, such as a child who makes and sells tainted lemonade or a housewife who makes and sells contaminated jam, fall outside strict liability’s scope.”⁹⁸ Freeman Eng-

strom goes on to suggest that whether or not a 3D printer of a defective item qualifies as a “commercial” seller is likely to depend upon several things, including: “The relationship of the supposedly-defective product to the printer’s business, if he or she even has a business; the frequency and volume of similar sales; and the existence and nature of any mass marketing.”⁹⁹

Another possible liable party is the company that manufactured the 3D printer.¹⁰⁰ For the company to be held liable, the printer itself—and not just the item in question—has to be proven to have been defective from the time it left the company’s possession.¹⁰¹

Yet another candidate for liability is the programmer who wrote the code for the product’s design.¹⁰² Proving the liability of this party is also likely to be difficult. Currently, strict liability only applies to “tangible personal property” (from the Third Restatement).¹⁰³ Programmers will likely claim that their designs do not qualify as such.¹⁰⁴ In *Winter v. G.P. Putnam’s Sons*, two individuals ingested poisonous mushrooms after reading faulty information from the *Encyclopedia of Mushrooms*.¹⁰⁵ After becoming critically ill, they initiated legal action against the publisher, claiming that the encyclopedia was a defective product.¹⁰⁶ The court ruled against them, finding that while the information contained in the encyclopedia was defective, the tangible encyclopedia itself was not.¹⁰⁷ Freeman Engstrom claims that similar rulings have shielded video game designers from strict product liability. She also points out that the courts are likely to find many programmers to be hobbyists rather than commercial sellers and thus not liable for injuries resulting from the products they design.¹⁰⁸ In addition, she suggests that the courts may re-

gard programmers as architects—a cohort of individuals upon which product liability has historically not been imposed.¹⁰⁹

However, the library community should understand that there may be theories for indirect or vicarious liability that injured parties may use to target libraries and institutions that provide 3D printing technology to members of the public. This may be an issue in particular if the technology is used to produce a dangerous item such as a 3D printed gun or weapon. It may especially become an issue if the item's danger is foreseeable and the library can reasonably guard against risk associated with such items, for example by preventing them from being printed, either through formal policy or technological measures.

The Role of the Library

While a 3D printer is not in the budget for most Americans in 2014, library makerspaces allow anyone with a library card to 3D print a wide array of objects at little to no cost. However, the library's role in leveraging and harnessing this technology cannot end with the push of the power button. Libraries must help their patrons make sense of this technology.

Numerous libraries help their patrons build 3D printing competencies. The Cleveland Public Library currently offers classes and events for patrons on 3D printing.¹¹⁰ The South Butler Community Library in Saxonburg, Pennsylvania requires its patrons to take an orientation class before using its 3D printers.¹¹¹ In Washington, D.C., the Digital Commons at the Martin Luther King, Jr. Memorial Library offers classes on 3D scanning, as well as 3D printing classes specifically designed for children and teens.¹¹²

Jason Griffey, a seasoned library technology consultant and frequent writer for *American Libraries* magazine, recently wrote a comprehensive report on the mechanics and market for 3D printers. In the report, he describes some of the technical competencies library professionals should develop upon integrating 3D printing into their institutions. Griffey states:¹¹³

"I often tell people that running a 3-D printer is like driving a classic car. You can do it even if you don't know anything, but it'll be a whole lot cheaper if you can change the oil yourself. For a 3-D printer, that might include regular cleaning, bed-leveling, and occasionally swapping out a part if necessary.

Other skills that are useful but not necessary would include having someone who is at least aware of the types of modeling programs and could troubleshoot basic things like, "That won't print because of X reason." Libraries might also want to provide their patrons with resources for learning more, so it's a good idea to purchase materials about 3-D printing, modeling, and the like in case you have a patron who wants to deep-dive into the topic."

Griffey offers invaluable advice. However, given the many legal questions 3D printing gives rise to, libraries need to do more than provide their patrons with instruction in the basics of printer mechanics, maintenance, modeling and scanning. Libraries must also help their patrons navigate the complex social, economic, technological and public policy implications of this technology. Thankfully, information scholars are already working to prepare libraries to play this role.

Tomas A. Lipinski, Dean and Professor at the University of Wisconsin-Milwaukee School of Information Studies, adapted a library photocopier warning notice to anticipate the intellectual property issues that may result from the 3D printing process (see Appendix). Efforts like Dr. Lipinski's are the product of a growing feeling among library professionals that the library community needs to develop a set of best practices to guide patron printing behavior.

There is currently little to no jurisprudence that interprets intellectual property, intellectual freedom or product liability concepts in the context of 3D printing. Therefore, in developing any such set of practices, it is in our best interest to think chiefly about what is practicable and consistent with the mission of libraries, and secondarily about what might eventually be held by Congress, regulatory agencies, the state legislatures or the courts to be outside the bounds of the law. By the time Congress and the courts began weighing in on digital copyright issues, librarians had already established their own regimes for applying the Copyright Act to the digital world. Some of these regimes informed subsequent copyright jurisprudence. Librarians would be wise to establish similar regimes for addressing the liability questions raised by 3D printing. This would place the library community in a strong position to guide the direction of the public policy debates that take shape around 3D printing in the coming years.

[There is] a growing feeling among library professionals that the library community needs to develop a set of best practices to guide patron printing behavior...In developing any such set of practices, it is in our best interest to think chiefly about what is practicable, and secondarily about what might eventually be held by Congress, the state legislatures or the courts to be outside the bounds of the law.

To guide the 3D printing behavior of their patrons effectively, librarians must themselves understand the basic mechanics and policy implications of 3D printing. Prominent library organizations already offer programming on 3D printing at conferences and other gatherings of library professionals. It would behoove those who work on public policy and government affairs within

these organizations to produce webinars, podcasts, magazine articles and other targeted products that address important 3D printing policy questions for libraries. Additionally, academic programs in library and information science may want to consider building additive manufacturing, product liability and patent law instruction into their curricula.

Conclusion

3D printing has the potential to empower entrepreneurs and start-ups, help firms of all sizes to bring their products to market more quickly, drive a resurgence in small manufacturing and solve complex engineering and public health problems. Libraries are the on-ramp to this promising technology for many Americans, fostering individual creativity and innovation. Library makerspaces are helping aspiring entrepreneurs, innovators and hobbyists take their ideas from discovery to reality.

The library community must contribute to the budding policy debates surrounding the intellectual freedom, individual liberty, intellectual property and product liability implications of 3D printing. A key question we will have to answer is: How can we shape

public policy to ensure that our patrons—and all Americans—derive the greatest possible benefit from the 3D printing services we offer?

NOTES

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APPENDIX

Warning Notice for 3D Printers and Related Technologies in Libraries

Prepared by Tomas A. Lipinski, Dean and Professor, School of Information Studies, University of Wisconsin—Milwaukee, tlipinsk@uwm.edu.

The Notice:

Library professionals can help both themselves and their patrons minimize liability for any intellectual property infringement that may result from the 3D printing process by posting the following notice above their 3D printer(s):

“NOTICE WARNING CONCERNING COPYRIGHT AND OTHER LEGAL RESTRICTIONS. The copyright (Title 17, United States Code), intellectual property (patent law for example under Title 35, United States Code) and other laws of the United States may govern the making of photocopies or other reproductions of content protected by copyright, patent and other laws. Libraries and archives furnish unsupervised photocopy or other reproducing equipment for the convenience of and use by patrons. Under 17 U.S.C. § 108(f)(2) the provision of unsupervised photocopy or reproducing equipment for use by patrons does not excuse the person who uses the reproduction equipment from liability for copyright infringement for any such act, or for any later use of such copy or phonorecord, if it exceeds fair use as provided by section 107 or any other provision of the copyright law, nor does the provision of unsupervised photocopy or reproducing equipment for use by patrons excuse the person who uses the reproducing equipment from liability for patent, tort (such as products liability) or other laws. This institution reserves the right to refuse to make available or provide access to photocopy or other reproducing equipment if, in its judgment, use of such equipment would involve violation of copyright, patent or other laws.”

Legal Context:

Section 108(f)(1) states that “Nothing in this section ... shall be construed to impose liability for copyright infringement upon a library or archives or its employees for the unsupervised use of reproducing equipment located on its premises: Provided, That such equipment displays a notice that the making of a copy may be subject to the copyright law.” This is an important grant of immunity to section 108-libraries against the worries of ‘downstream’ infringement by library patrons, vis-à-vis the reproduction of copyrighted material through the misuse of reproducing equipment, and the ‘upstream’ secondary liability that might result from a claim of contributory infringement, for example. According to the authors of the White Paper on intellectual property reform, regarding the section 108(f)(1) provision, “no other provider of equipment enjoys any statutory immunity.” Information Infrastructure Task Force, Intellectual Property and the National Information Infrastructure: The Report of the Working Group on Intellectual Property Rights 111, n. 357 (1995). As a notice-fulfilling the section 108(f)(1) posting obli-

gation is not offered by the U.S. Copyright Office, use of the above notice, adapted from the section 108(d) and (e), 37 C.F.R. § 201.14 notice is possible and as many libraries have done already. This notice has been adapted to use in conjunction with the availability of 3D printing technologies in qualifying (section 108(a) libraries and archives):

A practical matter, the notice should be placed on all photocopiers or other reproduction equipment in the library that is accessible by patrons that is capable of reproducing copyrighted, patented, or other content protected by law, not just the photocopier but the computer, printer, scanner, sampler, VCR, 3D printer or any other technology that has a reproducing capacity. (A generic warning notice, sans the section 108(f)(2) patron language, can be used on other photocopiers and reproduction equipment accessible by staff, as the library is not protected under section 108 for their acts of infringement, but such employee-oriented warning notice can be evidence of attempts to control infringement by employees that while having no impact on liability can impact the assessment of damages. Such serves a valuable purpose in the overall risk management and compliance endeavors of the institution as employee use of such photocopying or other reproducing equipment located on its premises, would not be “unsupervised” as required by section 108(f)(1), and therefore the immunity offered by that subsection would not apply.

However, section 108(f)(1) does not offer immunity for other acts of infringement unrelated to the use of photocopying or other reproduction equipment, e.g., allowing a public performance of a video in the library to the Young Organization of African-American Medical Students with the use of the library VCR or DVD player. This would be an issue of the performance right of copyright owners, not the exclusive reproduction or distribution rights that section 108 addresses.


About the Author

Charlie Wapner is an information policy analyst for the ALA Office for Information Technology Policy. Charlie works on a broad range of topics that includes copyright, licensing, telecommunications and E-rate, and provides support for the ALA's Policy Revolution! initiative sponsored by the Bill & Melinda Gates Foundation. Charlie comes to the American Library Association from the Office of former U.S. Representative Ron Barber (D-AZ) where he was a legislative fellow.

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The Office for Information Technology Policy advocates for public policy that supports and encourages the efforts of libraries to ensure access to electronic information resources as a means of upholding the public's right to a free and open information society.