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When Copyright Can Kill: How 3D Printers Are Breaking the Barriers Between “Intellectual” Property and the Physical World

Matt Simon

Pace University School of Law, matthewsimon@optonline.net

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When Copyright Can Kill: How 3D Printers Are Breaking the Barriers Between “Intellectual” Property and the Physical World

Abstract

This article examines copyright’s applicability to 3D printing technology, by analyzing the facts surrounding the (formerly) proposed development of a fully 3D printable firearm. Critical to this analysis however, is an understanding of how copyright has traditionally protected intellectual property, and why 3D printers do not fit into this conventional framework. As 3D printing is advancing at an extraordinarily rapid rate, any discussion of this topic would be incomplete without reference to the “moving target” that is 3D printing technology. In the short time between when this article was initially submitted for evaluation to the PIPSELF Law Forum in December 2012, and when it will be published in May 2013, many new uses for 3D printing have already been demonstrated, and indeed some of the issues discussed in this article have already become outdated, all within a six month timespan.

This article discusses at length, the efforts of the Defense Distributed project to develop a 3D printable firearm. When the article was originally submitted in 2012, Defense Distributed had already managed to prove the feasibility of using 3D printed firearms components, but the gun utilizing the printed component promptly broke apart after only successfully firing 6 shots. However, in February 2013, Defense Distributed released a new video, demonstrating a redesigned 3D printed component that was successfully used to fire over 600 rounds without a structural failure. Other recent developments in 3D printing include a company whose goal is to produce 3D printable cultured leather and edible meat products.

Finally, in January 2013, the organization Public Knowledge released a whitepaper entitled “What’s the Deal with Copyright and 3D Printing?” written by Michael Weinberg. As both the whitepaper and this article discuss the same basic principles, but do so by analyzing slightly different areas of the law, I view the whitepaper as a companion piece to this article.

UPDATE (5/5/13): Defense Distributed has completed (and successfully test fired) the world’s first entirely 3D printed pistol.

UPDATE (5/10/13): In the timespan of a single *week* after the release of the first 3D printed pistol, the U.S. State Department has initiated procedures to force Defense Distributed to remove all its 3D printable gun components from the Internet, with the State Department claiming it needs to review the files for compliance with the International Traffic in Arms Regulations (ITAR). Further there are other measures being proposed by Congressman Steve Israel to outright ban 3D printed guns. However, considering that the 3D printable pistol was already downloaded over 100,000 times before the recent ITAR action, and the fact that the inherent design of the Internet means that many websites are foreign based, and therefore entirely outside the jurisdiction of the U.S., it appears to be an increasingly futile effort to force “removal” of these files from the Web. These files are still widely available on the Internet, and likely will continue to remain so, as websites like The Pirate Bay will continue to host & distribute 3D firearm files, regardless of any laws passed or litigation filed attempting to compel their removal.

Keywords

3D printers, firearms, guns

WHEN COPYRIGHT CAN KILL: HOW 3D PRINTERS ARE BREAKING THE BARRIERS BETWEEN “INTELLECTUAL” PROPERTY AND THE PHYSICAL WORLD

Matt Simon*

I. Introduction: Background To 3D Printing & Why It Is Important:

3D printing represents the greatest technological advancement since the creation of the internet. Its vast potential for truly innovative usage ensures this technology will quickly become a predominant force in the global marketplace, and eliminate the physical barriers of the world by allowing the entire globe to share physical objects instantaneously. This article will explore copyright issues related to 3D printing and will examine the issue of if an individual may obtain derivative works protection in a 3D design file created based upon a preexisting object.

a. What Are 3D Printers?

3D printers utilize a process called “additive manufacturing” that allows them to create real, working, physical objects, all based off a specialized computer file. Simply put, “[e]ssentially, a 3D printer is a machine that can turn a blueprint into a physical object. Feed it a design for a wrench, and it produces a physical, working wrench. Scan a coffee mug with a 3D scanner, send the file to the printer, and produce thousands of identical mugs...[b]ecause they create objects by building them up layer-by-layer, 3D printers can create objects with internal, movable parts. Instead of having to print individual parts and have a person assemble them, a 3D printer can print the object already assembled. Of course, a 3D printer can also print individual

* Matthew Simon (matthewsimon@optonline.net) is a student at Pace University School of Law and expects to earn his J.D. in May 2013. Mr. Simon received his Bachelor of Arts degree from the University at Albany, Nelson A. Rockefeller College of Public Affairs and Policy.

parts or replacement parts. In fact, some 3D printers can print a substantial number of their own parts, essentially allowing them to self-replicate.”¹

The technical details behind how 3D printers utilize the “additive manufacturing” (AM) process to produce objects is surprisingly simple, as the “tools are effectively modified ink-jet printers that deposit successive layers of material until a three-dimensional object is built up”² this allows 3D printers to use significantly less material than traditional manufacturing methods, and allows 3D printers to work with a staggering amount of different source materials including thermoplastics like ABS (the hard plastic Legos are made from), metals, clays, and even living cells depending on the printer.³ All 3D printing systems work in the same basic way by utilizing a 3D design file (also known as Computer Aided Design ‘CAD’ files) and processing it through specialized software which slices the data into two-dimensional horizontal cross-sections (each about 0.1mm thick, about the diameter of a single human hair).⁴ While traditional manufacturing methods like machining and drilling have long been the preferred means of production, inherently they have drawbacks, because you must start with a larger amount of material and then gradually remove bits of it, it is more wasteful than AM, which only uses the materials it needs.⁵

¹ Michael Weinberg, *It Will Be Awesome If They Don't Screw It Up: 3D Printing, Intellectual Property, and the Fight Over the Next Great Disruptive Technology*, PUBLIC KNOWLEDGE (Nov. 2010), <http://publicknowledge.org/it-will-be-awesome-if-they-dont-screw-it-up>.

² *Difference Engine: The PC all over again?*, ECONOMIST (Sept. 9, 2012, 7:31 AM), <http://www.economist.com/blogs/babbage/2012/09/3d-printing>.

³ *Id.*

⁴ *How Z Corporation's 3DP technology works*, Z CORPORATION (2012), <http://www.zcorp.com/en/3dp/spage.aspx>.

⁵ *A Closer look at 3D Printing with 3D Printing UK [Video Inside]*, GADGETSBOY UK (May. 30, 2012, 11:37 AM), <http://www.gadgetsboy.co.uk/a-closer-look-at-3d-printing-with-3d-printing-uk-video-inside/>.

Additionally, AM allows designers to build objects that are impossible to create manually or through traditional manufacturing techniques, such as the “Penrose Triangle,”⁶ an “impossible object” illusion which was not possible to create in the physical space,⁷ until a 3D printing enthusiast⁸ released the 3D design file for such an object relatively recently.⁹

b. From Firearms To Burritos: What Are The Limits Of 3D Printing?

3D printers have continued to evolve such that they are, and increasingly will be, capable of producing articles from a wide variety of materials including but not limited to metals,¹⁰ plastics,¹¹ foods,¹² glass,¹³ and living cells.¹⁴ Given the myriad of input materials a 3D printer can utilize, it should be no surprise that creative individuals have actually used or theorized the use of 3D printers to create articles that others may find: repulsive (“adult” products),¹⁵ terrifying (fully 3D printable guns),¹⁶ delicious (customized cookies¹⁷ and candy¹⁸ or burritos¹⁹ from

⁶ Eric W Weisstein, *Penrose Triangle*, WOLFRAM MATHWORLD, mathworld.wolfram.com/PenroseTriangle.html.

⁷ Eric W Weisstein, *Impossible Figure*, WOLFRAM MATHWORLD, mathworld.wolfram.com/ImpossibleFigure.html.

⁸ Brian Rideout, *Printing the Impossible Triangle: The Copyright Implications of Three-Dimensional Printing*, 5 J. Bus. Entrepreneurship & L. 161, 166 (2011), <http://digitalcommons.pepperdine.edu/jbel/vol5/iss1/6/>.

⁹ Suzanne LaBarre, *Impossible Penrose Triangle: Now Possible With 3-D Printing?* FAST CODESIGN (Feb. 14, 2011), <http://www.fastcodesign.com/1663226/impossible-penrose-triangle-now-possible-with-3-d-printing-updated>.

¹⁰ Robert Dehue, *3D Printing Metal*, 3D PRINTING (Apr. 27, 2012), <http://3dprinting.com/materials/metal/3d-printing-metal/>.

¹¹ *3D Printing Plastic*, BITS FROM BYTES, bitsfrombytes.com/content/3d-printing-materials (Nov. 24, 2012).

¹² Karen Baker, *Order 3D Printed Pasta at Google’s Cafeterias*, PSFK (Aug. 20, 2012), <http://www.psfk.com/2012/08/3d-printed-pasta-google-cafeteria.html>.

¹³ *Solar-powered 3-D printer prints glass from sand*, KURZWEIL (June 29, 2011), <http://www.kurzweilai.net/solar-powered-3-d-printer-prints-glass-from-sand>.

¹⁴ Wilson WC Jr., *Cell and Organ printing 1: protein and cell printers*, *Nat’l Ctr. for Biotechnological Info.*, NATIONAL LIBRARY OF MEDICINE (June, 2003), <http://www.ncbi.nlm.nih.gov/pubmed/12740942>.

¹⁵ Matthew Epler, *GOP Candidate’s Popularity shapes ‘Grand Ole Party’ Sex Toys (Photos)*, DAILY BEAST (May 16, 2012), <http://www.thedailybeast.com/galleries/2012/05/16/gop-approval-rating-sex-toys-photos.html> & <http://mepler.com/Grand-Old-Party> & http://itp.nyu.edu/~mae383/files/GOP_PDF_web.pdf.

¹⁶ Christopher Danzig, *This Gun is Your Gun, This Gun is My Gun: A 2L’s Quest To Make Printable Firearms*, ABOVE THE LAW (Aug. 28, 2012, 1:22 PM), <http://abovethelaw.com/2012/08/this-gun-is-your-gun-this-gun-is-my-gun-a-2ls-quest-to-make-printable-firearms/>.

¹⁷ *3-D Printer Makes Customized Cookies (Video)*, WIRED (Jan. 23, 2012), <http://www.wired.com/video/3d-printer-makes-customized-cookies/1409776093001>.

¹⁸ *CandyFab: The Revolution Will be Caramelized*, CANDYFAB WIKI, wiki.candyfab.org/ (last visited Nov. 4, 2012).

Burittob0t), or even something with potential moral and ethical considerations (printable living organs²⁰ and cell tissue²¹). Additionally, not only can 3D printers create intricate designs inside of an object while it builds it from the ground up, but 3D printers also allow an individual to manufacture a single prototype item at a much lower cost than through traditional means.

While many of the potential uses of 3D printers are still in the realm of fiction, numerous real world applications of this technology have already been successfully demonstrated. One of the more revolutionary real-world developments²² in 3D printing technology²³ has been the release of Organovo Corporation's commercial BioPrinter²⁴ which already has the ability to print functional (albeit still imperfect) veins using a patient's own cells. While Organovo's technology is currently very "good at printing blood vessels...they are still learning to condition them to be good, strong blood vessels",²⁵ and the company predicts that the device could potentially create whole organs in the future. As Hod Lipson an associate professor of mechanical and aerospace engineering at Cornell University has explained, 3D bioprinting actually prints with live cells which have been inserted into a hydrogel ink and are physically printed into a finished article.²⁶

¹⁹ Tom Cheshire, *BurritoB0t: The 3D Printer That Creates Mexican Snacks in Five Minutes*, WIRED UK (Aug. 16, 2012), <http://www.wired.co.uk/magazine/archive/2012/09/play/press-print-to-pig-out>.

²⁰ Colin Barras, *Cell squirting needles could 'weave' new organs*, NEW SCIENTIST (Oct. 12, 2007, 4:06 PM), <http://www.newscientist.com/article/dn12780-cellsquirting-needles-could-weave-new-organs.html>.

²¹ Jesse Emspak, *Tissue.prn: Desktop Printer Technology Used to Lay Down Regenerated Skin Cells to Treat Burns in Mice*, SCIENTIFIC AMERICAN (June 17, 2010), <http://www.scientificamerican.com/article.cfm?id=desktop-printer-technology-lay-down-cells>.

²² B.R. Ringeisen, *Jet-based Methods to Print Living Cells*, Nat'l Ctr. for Biotechnological Info., NATIONAL LIBRARY OF MEDICINE (Sept., 2006), <http://www.ncbi.nlm.nih.gov/pubmed/16895314>.

²³ Alexander B Owczarczak, *Creating Transient Cell Membrane Pores Using a Standard Inkjet Printer (Video)*, JOURNAL OF VISUALIZED EXPERIMENTS (May, 2012) <http://www.jove.com/video/3681/creating-transient-cell-membrane-pores-using-a-standard-inkjet-printer>.

²⁴ *NovoGen MMX Bioprinter*, ORGANOVO CORP., <http://www.organovo.com/products/novogen-mmx-bioprinter> (last visited Nov. 24, 2012).

²⁵ Dave Bullock, *Sir, Your Liver Is Ready: Behind the Scenes of BioPrinting*, WIRED (July 11, 2010), <http://www.wired.com/rawfile/2010/07/gallery-bio-printing>.

²⁶ *Can 3D Printers Reshape the World?*, NPR (June 22, 2012, 1:00 PM), <http://www.npr.org/2012/06/22/155582850/can-3d-printers-reshape-the-world>.

Currently, Prof. Lipson and his associates Larry Bonassar²⁷ and Jonathan Butcher²⁸ at Cornell University have been able to print “cartilage, meniscus of the knee, and they are working on printing spinal disks and heart valves. Bones, bone tissue and cartilage are kind of the lowest-hanging fruit, so to speak, because they are very amorphous and are very simple structures, but have little vascularity. That is where the state of the art lies.”²⁹ Pushing the boundaries of the medical 3D printing technology, Lee Cronin, a chemistry Professor at the University of Glasgow, is developing a method for printing pharmaceuticals³⁰ and has already demonstrated the ability to print the reagents and catalysts necessary for the chemical reaction that produces ibuprofen.³¹ 3D printers have also been used to create a prosthetic beak for a bald eagle³² that was injured in an encounter with a hunter.³³

Meanwhile, various organizations have enabled novel consumption streams for consumers. For example, an electronic synthesizer manufacturer released 3D design files on the commercial design file website Shapeways³⁴ so their customers can purchase and 3D print their own replacement parts.³⁵ To allow the ultimate customization of cell phones, Sculpteo, released 3DPCase,³⁶ an iPhone application that allows users to design and print their own custom iPhone

²⁷ *Faculty Profile - Lawrence Bonassar*, CORNELL UNIVERSITY, College of Engineering, <http://www.engineering.cornell.edu/research/faculty/profile.cfm?netid=lb244> (last visited Nov. 25, 2012).

²⁸ *Faculty Profile - Jonathan Butcher*, CORNELL UNIVERSITY, Department of Biomedical Engineering, <http://www.bme.cornell.edu/people/profile.cfm?netid=jtb47> (last visited Nov. 25, 2012).

²⁹ NPR, *supra* note 26.

³⁰ Lee Cronin, *Print your own medicine*, TED (2013), ted.com/talks/lee_cronin_print_your_own_medicine.html.

³¹ Tim Adams, *The ‘chemputer’ that could print out any drug*, GUARDIAN (July 21, 2012, 5:00 PM), <http://www.guardian.co.uk/science/2012/jul/21/chemputer-that-prints-out-drugs>.

³² *Restoring Beauty the Bald Eagle's Beak*, GUARDIAN (Sept. 8, 2012, 4:00 PM), http://www.guardian.co.uk/science/grrlscientist/2012/sep/08/1?CMP=twf_fd.

³³ *About Us*, KINETIC ENGINEERING GROUP, kineticengineeringgroup.com/about.html (last visited Nov. 24, 2012).

³⁴ *Teenage Engineering Make CAD Files Available to 3D Print Replacement Parts*, SHAPEWAYS (Sept. 24, 2012), <http://www.shapeways.com/blog/archives/1647-Teenage-Engineering-Make-CAD-Files-Available-to-3D-Print-Replacement-Parts.html>.

³⁵ Geeta Dayal, *Synth manufacturer lets customers 3D print their own parts*, WIRED UK (Oct. 1, 2012), <http://www.wired.co.uk/news/archive/2012-10/01/3d-print-synth-parts>.

³⁶ Sculpteo, *3DPCase*, ITUNES (Dec. 18, 2012), <https://itunes.apple.com/us/app/3dpcase/id543127545?mt=8>.

cases. Sculpteo's CEO and co-founder Clément Moreau, indicates that "his company is trying to make 3D printing more accessible to the average user by reducing the time and energy needed to create a 3D design."³⁷ Jay Leno, a well-known classic car aficionado, has his own 3D printer that is used to print out spare parts for his car collection; as such parts which would be difficult or impossible³⁸ to obtain otherwise. Urbee, on the other hand, is the world's first car to have its entire exterior produced by a 3D printer.³⁹ An even more extreme example of how the current boundaries of 3D printing are being tested is the case of Enrico Dini, of Monolite UK and inventor of the D-Shape 3D printer that can print full-size "housing structures" out of stone.⁴⁰

Finally, while a fully 3D printable firearm does not exist yet (though people are working on it), a fully functional firearm was developed by US gunsmith Michael Guslick (aka "HaveBlue"),⁴¹ who created his contraption utilizing a 3D printed "base" and standard off the shelf gun components. HaveBlue uploaded his "reinforced AR-15 lower receiver" to the gratis Thingiverse⁴² 3D design file repository website for other users to freely download, print and modify. HaveBlue's creation, while not an assault rifle, is a fully functioning .22 caliber pistol. Although not fully created on a 3D printer, the "lower receiver, in a legal sense at least, is what actually constitutes a firearm. Without a lower receiver, the gun would not work; thus, the receiver is the actual legally-controlled part. In short, this means that people without gun

³⁷ Karissa Bell, *New App Lets Users Design and 3D-Print iPhone Cases*, *Wired* (Sept. 07, 2012, 7:25 PM), <http://www.wired.com/gadgetlab/2012/09/app-brings-3-d-printing-to-iphone-cases/>.

³⁸ Jay Leno, *Jay Leno's 3D Printer Replaces Rusty Old Parts*, *POPULAR MECHANIC* (June 8, 2009), <http://www.popularmechanics.com/cars/jay-leno/technology/4320759>.

³⁹ *Urbee 3D printed car goes on display in Canada*, *BBC* (Sept. 21, 2011), bbc.co.uk/news/technology-15007018.

⁴⁰ *D-Shape 3D printer can print full-sized houses*, *GIZMAG* (Feb. 24, 2012), gizmag.com/d-shape-3d-printer/21594/.

⁴¹ Mark Gibbs, *The End of Gun Control?*, *FORBES* (July 28, 2012, 4:24 PM), <http://www.forbes.com/sites/markgibbs/2012/07/28/the-end-of-gun-control/>.

⁴² HaveBlue, *Reinforced AR-15 Lower Receiver*, *THINGIVERSE* (Sept. 21, 2011), thingiverse.com/thing:11770.

NOTE: While Thingiverse has changed their TOU to disallow firearms components, the Defense Distributed project now hosts and distributes this and other firearms 3D design files. <http://defcad.org/defdist-ar-15-lower-receiver/>.

licenses, or people who have had their licenses revoked, could print their own lower receiver and build a complete, off-the-books gun.”⁴³

Given the wide variety of currently viable 3D printing output, it should be no surprise that evaluating 3D design files and 3D printed objects under blanket generalizations is rather difficult. Given that some of that output is medical, scientific, functional, or utilitarian in nature, it is questionable whether copyright law is even the correct realm of intellectual property law in which to attempt to obtain protection, with the field of patent law perhaps being more germane to these types of discoveries or processes.

c. Why 3D Printers Will Change The World

The current capabilities of 3D printing technology pale in comparison to the future potential this technology holds. While bioprinting currently only allows researchers to create simpler structures such as veins, in the future entire organs could be custom printed.⁴⁴ To a certain extent, 3D printers are only limited by the creativity and ingenuity of the individuals operating them. For example, 3D printers such as the Fab@Home⁴⁵ are built from off-the-shelf parts, and all of its design and software is open source, meaning that all information about the device is licensed to allow free dissemination, modification, and reuse of the information.

Because of the open source nature of the Fab@Home project and the 3D printing community in

⁴³ (Note: the AR-15 is the civilian version of the military M-16 Assault Rifle) Sebastian Anthony, *The world's first 3D-printed gun*, EXTREME TECH (July 26, 2012), extremetech.com/extreme/133514-the-worlds-first-3d-printed-gun.

⁴⁴ Boland T, *Application of inkjet printing to tissue engineering*, *Nat'l Ctr. for Biotechnological Info.*, NATIONAL LIBRARY OF MEDICINE (Sept., 2006), <http://www.ncbi.nlm.nih.gov/pubmed/16941443>.

⁴⁵ *The Printers: Model 1, Model 2, and beyond*, FAB@HOME, <http://www.fabathome.org/?q=node/10> (last visited Nov. 25, 2012).

general, if an individual wants to create something that is beyond the physical limitations of their machine, they can modify the unit, until it is able to function in the manner desired.⁴⁶

For example, Cody Wilson is in the process of developing a fully 3D printable firearm. While this is not currently possible with 3D printers, sometime in the near future it could be a reality through the Defense Distributed⁴⁷ project⁴⁸ that he has founded. This is not to say that Mr. Wilson has not had any setbacks, where recently the project raised enough money to lease an enterprise-grade 3D printer from Stratasys, Inc., the company later terminated the contact and reacquired the machine after learning the projects intentions.⁴⁹

3D printer technology is only as useful as it is because of the existence of preexisting 3D design files, without which it would be necessary to design everything from scratch and only custom make “new” articles. As a corollary, it is only in conjunction with the use of the Internet and repository websites like Thingiverse⁵⁰ and Shapeways⁵¹ that 3D printer technology lends itself to widespread adoption. Like the file-sharing networks before it, individuals upload their files for others to freely download and modify. However, there are significant differences in this industry. For example, Thingiverse is a site where users create, modify and share files freely, only generally asking for attribution, while the Shapeways Marketplace is the leading commercial offering that actually sells 3D design files. Due to the open by design nature of the 3D printing ecosystem (especially free sites like Thingiverse), every time a user uploads a new or

⁴⁶ *Id.*

⁴⁷ *Create the World's First 100% 3D Printable Gun*, DEFENSE DISTRIBUTED, <http://defensedistributed.com/proofgun-2/> (last visited Nov. 25, 2012).

⁴⁸ Robin Miller, *Should We Print Guns? Cody R. Wilson Says 'Yes'*, SLASHDOT (Sept. 5, 2012, 12:05 PM), <http://hardware.slashdot.org/story/12/09/04/1837209/should-we-print-guns-cody-r-wilson-says-yes-video>.

⁴⁹ Robert Beckhusen, *3-D Printer Company Seizes Machine From Desktop Gunsmith*, WIRED (Oct. 1, 2012), <http://www.wired.com/dangerroom/2012/10/3d-gun-blocked/>.

⁵⁰ *What Is Thingiverse*, MAKERBOT THINGIVERSE, <http://www.thingiverse.com/about> (last visited Nov. 25, 2012).

⁵¹ *About Us (Marketplace)*, SHAPEWAYS, <http://www.shapeways.com/about/> (last visited Nov. 25, 2012).

modified file, the utility of the entire 3D printer community is enhanced. The potential social impact of a site where users can literally share physical objects for free, across the globe, is astounding. Thingiverse in particular is a very interesting example of leveraging the power of the community, as most works on the site are governed by one of the Creative Commons licenses,⁵² which are generally fairly permissive and allows for the use/modification of the files so long as the original author is attributed on any derived or modified works.⁵³

Adding to the more common use of 3D printers is the fact that their price has come down significantly in recent years. While in the past they were prohibitively expensive, costing in the range of \$25,000⁵⁴ through over \$1,000,000, new devices are exponentially cheaper and include the MakerBot Replicator,⁵⁵ which is available for under \$2,000, and the RepRap,⁵⁶ which is available for around \$500. The most interesting thing about the RepRap is that even though it is one of the cheapest 3D printers currently available, it has the ability to “self-replicate” and can print out all of its own parts (except the circuit boards).⁵⁷ There is even a very basic 3D printer called the SeeMeCNC⁵⁸ available for under \$200, among others ranging in price from sub \$1000 to \$25,000 and up for machines that can work with metals.⁵⁹ The convergence of these factors will essentially ensure that 3D printers go from relatively unheard of, to a common household name in the near future just as personal computers did. However, because of the established infrastructure already in place for computers and the internet, the dissemination of 3D printer

⁵² *About the Licenses*, CREATIVE COMMONS, <http://creativecommons.org/licenses/> (last visited Nov. 25, 2012).

⁵³ Frank Polcino, *The Creative Commons: A Supplement to Copyright in Today's Technological Culture*, 2 Pace I.P. Sports & Ent. L. F. 210 (Apr. 17, 2012), <http://digitalcommons.pace.edu/pipsself/vol2/iss1/10/>.

⁵⁴ *Price Compare-3D Printers*, 3DERS, <http://www.3ders.org/pricecompare/3dprinters/> (last visited Nov. 25, 2012).

⁵⁵ *The MakerBot Replicator*, MAKERBOT, <http://store.makerbot.com/replicator.html> (last visited Nov. 25, 2012).

⁵⁶ *Prusa Mendel Full RepRap Kit (Excluding Printed Plastic Parts)*, MIXSHOP, http://mixshop.com/index.php?main_page=product_info&cPath=24&products_id=94 (last visited Nov. 25, 2012).

⁵⁷ *RepRap Main Page*, REP RAP, http://www.reprap.org/wiki/Main_Page (last visited Nov. 25, 2012).

⁵⁸ *SeeMeCNC H-1.1 3D Printer Kit*, FABRICADE 3D, fabricade3d.com/index.php?option=com_zoo&task=item&item_id=73&Itemid=113 (last visited Nov. 25, 2012).

⁵⁹ *3D Printer Price Compare (Old)*, 3DERS (Dec. 16, 2011), <http://www.3ders.org/3d-printer/3d-printer-price.html>.

technology might occur more rapidly than that of personal computing as people are generally more interested in physical objects they can touch than the ethereal advantages posed by the early internet and computers.

II. 3D Printers And The Law

Classifying 3D printer design (CAD) files and 3D printed objects under current copyright law requires an understanding of what copyright law is and is not statutorily designed to protect. Under 17 U.S.C. § 102(a), copyright protection is available for original works of authorship that are fixed in an tangible medium of expression from which they can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device and includes eight categories of protected works (literary, musical, dramatic, pantomimes, pictorial, audiovisual, sound recordings, and architectural works).⁶⁰ Of these eight possible categories, 3D design files (aka CAD files) and 3D printed objects might be classified as § 102(a)(1) literary works, § 102(a)(5) pictorial, graphic, and sculptural works, or § 102(a)(8) architectural works.

However, the grant of protection in § 102(a) is severely limited by the restrictions set forth in 17 U.S.C. § 102(b), which states that “in no case does copyright protection for an original work of authorship extend to any idea, procedure, process, system, method of operation, concept, principle, or discovery, regardless of the form in which it is described, explained, illustrated, or embodied in such work.”⁶¹ The restrictions put in place by § 102(b) are necessary because “process,” as defined under the Patent Act 35 U.S.C. § 100(b), refers to the “process, art or method, and includes a new use of a known process, machine, manufacture, composition of

⁶⁰ Copyright Act, 17 U.S.C. § 102(a) (1990), <http://www.copyright.gov/title17/92chap1.html#102>.

⁶¹ Copyright Act, 17 U.S.C. § 102(b) (1990), <http://www.copyright.gov/title17/92chap1.html#102>.

matter, or material”⁶² thereby precluding processes from obtaining copyright protection, as they are in the exclusive domain of patent law.

The view that copyright protection was only eligible for the statutorily defined subject matter under § 102(b) was further solidified by the landmark Supreme Court decision in Baker v. Selden, where the Court held that “the claim to an invention or discovery of an art or manufacture must be subjected to the examination of the Patent Office before an exclusive right therein can be obtained, and it can only be secured by a patent from the government.”⁶³ Baker v. Selden was also an extremely influential case for establishing the “idea-expression dichotomy,” a legal doctrine which dictates that if the “expression” to be copyrighted is too tightly interwoven with the “idea” behind the work then the entire concept is uncopyrightable as the protectable expression is merged with the unprotectable idea.⁶⁴ The idea-expression dichotomy works in conjunction with the § 102(b) restrictions to ensure that the distinction between copyrightable subject matter and patentable subject matter is adhered to. If one was permitted to obtain copyright protection for an invention merely because the inventor wrote down on paper a description of the idea or process, the inventor would be circumventing the rigorous prerequisites of patent law and keeping this new knowledge out of the public domain for an extended period of time. Copyright law was not implemented solely to protect the intellectual property rights holders investment in creating their works, but rather as stated in the Constitution to “promote the progress of science and useful arts.”⁶⁵ A basic tenet of this is that no one can enjoy copyright protection in facts, which a “process or idea” would consist of.

⁶² Patent Act, 35 U.S.C.A. § 100(b) (2011), www.gpo.gov/fdsys/pkg/PLAW-112publ29/html/PLAW-112publ29.htm.

⁶³ Baker v. Selden, 101 U.S. 99 at 102 (1879).

⁶⁴ *Id.*

⁶⁵ U.S. Constitution, Art.1, § 8, <http://www.copyright.gov/title17/92preface.html>.

Therefore, even if it is determined that 3D design files are capable of being protected by copyright, issues arise when considering items such as food, living cells, and organs. Copyright protection cannot exist for “facts” or scientific progress because this must be protected solely by patent law. In Publications Int'l, Ltd. v. Meredith Corp., an individual ‘invented’ new foodstuff recipes and attempted to preclude others from using her recipes, but the court ruled that while the recipes “were at some time original, there can be no monopoly in the copyright sense in the ideas for producing certain foodstuffs. Nor can there be copyright in the method one might use in preparing and combining the necessary ingredients. Protection for ideas or processes is the purview of patent.”⁶⁶ This conclusion is further supported by Professor Nimmer, who describes the view that recipes are copyrightable “seems doubtful because the content of recipes are clearly dictated by functional considerations, and therefore may be said to lack the required element of originality, even though the combination of ingredients contained in the recipes may be original in a noncopyright sense.”⁶⁷ Subsequently, if recipes cannot be copyrighted because they are dictated by functional considerations, 3D design files also appear to be dictated by functional considerations, as their function is purely being a set of instructions for 3D printing. Therefore in regards to 3D design files and 3D printed objects, each must be analyzed independently as the fundamental aspects of each type of article require the consideration of countervailing factors.

a. Can 3D Design Files and/or 3D Printed Objects Be Subject To Copyright Law?

3D design files as a category of articles are inherently limited by the restrictions set forth in § 102(b) and the bar set by the idea-expression dichotomy. Further, 3D design files must be sufficiently original as dictated by § 102(a) to warrant copyright protection in the first place. Notwithstanding any of the possible articles that a 3D design file can produce, the file itself is

⁶⁶ Publications Int'l, Ltd. v. Meredith Corp., 88 F.3d 473 at 481 (7th Cir. 1996).

⁶⁷ Melville B. Nimmer & David Nimmer, NIMMER ON COPYRIGHT, § 2.18[I] at 2-204.25-.26 (May 1996).

merely a digital, 3D representation of a potential physical object. It does not matter whether the 3D design file is a representation of a toy, food, an automotive part, or even an organ, the file itself is simply a 3D representation that is physically constrained by the technical limitations of the printer to be used in conjunction with the design file. For example, logic dictates that if you are printing on a MakerBot printer (which for arguments sake assume) can only produce objects that are 20cm tall, than any 3D design file to be used with the MakerBot cannot depict anything that is taller than 20cm. Irrespective of how creative or expressive the author is in designing their file, they cannot create a functional 3D model that is incompatible with some physical aspect of their 3D printer.

However, this is not to say that 3D design files can never be subject to copyright, because 3D design files, similarly to photographs (as both depict an image), can be, but are not per se copyrightable. Photographs, for instance, have been determined to be copyrightable as far back as 1884 with the Court holding in Burrow Gilies Lithographic Co. v. Sarony, that pictures can be copyrightable “so far as they are representatives of original intellectual conceptions of the author”.⁶⁸ Additionally, the creative bar for protectable expression is set very low, as a New York District Court expressed in Bridgeman Art Library, Ltd. v. Corel Corp. that “there is little doubt that many photographs, probably the overwhelming majority, reflect at least the modest amount of originality required for copyright protection”.⁶⁹ This is a result of the determination that while “[e]lements of originality...may include posing the subjects, lighting, angle, selection of film and camera, evoking the desired expression, and almost any other variant involved...but ‘slavish copying’, although doubtless requiring technical skill and effort, does not qualify.”⁷⁰

⁶⁸ Burrow-Giles Lithographic Co. v. Sarony, 111 U.S. 53 at 58 (1884).

⁶⁹ Bridgeman Art Library, Ltd. v. Corel Corp., 36 F. Supp.2d 191 at 196 (S.D.N.Y. 1999).

⁷⁰ *Id.* at 197.

Further, the court in Meshwerks, Inc. v. Toyota Motor Sales U.S.A., Inc., held that “digital wire-frame computer models that depicted unadorned images of manufacturer's vehicles without any individualizing features were not sufficiently original to warrant copyright protection.”⁷¹ This case was so determined, because even though Meshwerks had obtained a registration certificate for its models from the copyright office (upon which the court presumes validity in a work), an opponent in a copyright infringement suit may overcome the presumption that the holder of a registration certification holds a valid right, by producing sufficient evidence that the work(s) in question were not in fact entitled to copyright protection.⁷² In Meshwerks, the 3D design files were designed to be accurate representations of preexisting Toyota cars (minus the Toyota decals); and therefore the court ruled that the representations were not sufficiently original to warrant protection, because the 3D wireframe model was essentially a result of slavish copying. The entire purpose of Meshwerks Corp. creating the 3D design file was to make an accurate depiction of Toyota vehicles in a 3D form. Though the court held in Meshwerks that the 3D design file was not copyrightable, it acknowledged that “digital imaging is a relatively new and evolving technology and that Congress extended copyright protection to original works of authorship fixed in any tangible medium of expression, now known or later developed.”⁷³ Accordingly, even the Meshwerks court acknowledged that “[d]igital modeling can be, surely is being, and no doubt increasingly will be used to create copyrightable expressions. Yet, just as photographs can be, but are not per se, copyrightable, the same holds true for digital models.”⁷⁴

⁷¹ Meshwerks, Inc. v. Toyota Motor Sales U.S.A., Inc., 528 F.3d 1258 (10th Cir. 2008).

⁷² Palladium Music, Inc. v. EatSleepMusic, Inc., 398 F.3d 1193, 1196 (10th Cir. 2005).

⁷³ Meshwerks, 528 F.3d at 1258.

⁷⁴ *Id.* at 1268.

Consequently, by adhering to prior case law, if a 3D design file merely represents an accurate 3D depiction of a preexisting physical object, then the file may not be protectable subject matter. However, a file that depicts an original work of expression may be in fact copyrightable. This distinction is well illustrated by the Penrose triangle, a physical object, unique to the 3D printing world. The Penrose triangle as first published by Penrose & Penrose in a 1958 British Psychology Journal article⁷⁵ is an optical illusion that actually consists of a 2D figure that is interpreted by the brain as a 3D object, even though it is not possible for such an object to exist. Nevertheless, it was proven possible by Dr. Ulrich Schwanitz, who devised a way to create a 3D object that resembled the 2D representation of the Penrose triangle and posted a video online showcasing his results.⁷⁶ Dr. Schwanitz's work would appear to be subject to copyright protection, as it is clearly an original work of authorship, in light of the fact that previous to his work, the object was considered to be an impossible theoretical optical illusion.

3D printed objects, on the other hand, must be analyzed under an entirely different framework due to their physical nature. While both the idea-expression dichotomy and originality are still factors, the utility and functionality of a 3D printed object must be taken into consideration separately from the object's creative and artistic expression, if any. Under current copyright law, a 3D printed object may be subject to copyright protection, if the expressive "authorship can be identified separately from the utilitarian aspects of an object. Thus a useful article may have both copyrightable and uncopyrightable features. For example, a carving on the

⁷⁵ Lionel S. Penrose & Robert Penrose, *Impossible Objects: A Special Type of Illusion*, 49 Brit. J. Psychol. 31 (1958).

⁷⁶Rideout, *supra* note 8.

back of a chair or a floral relief design on silver flatware could be protected by copyright, but the design of the chair or flatware itself could not.”⁷⁷

Additionally, under the Denicola “conceptual separability” test used in Brandir Int’l, Inc. v. Cascade Pac. Lumber Co., if the design elements of an object reflect a “merger of aesthetic and functional considerations, the artistic aspects of a work cannot be said to be conceptually separable from the utilitarian elements. Conversely, where design elements can be identified as reflecting the designer’s artistic judgment exercised independently of functional influences, conceptual separability exists.”⁷⁸ Therefore, under both the conceptual separability and the idea-expression doctrines, a 3D printed object may be covered by copyright law if the low bar for creative expression sufficient to satisfy the originality requirement is met, and any expressive portion of the work is separable from the utilitarian or functional aspects.

b. Under What Category Of Statutorily Protected Works 3D Design Files Or 3D Printed Objects Should Be Classified?

Questioning whether 3D design files and 3D printed objects should be copyrightable, and more importantly, determining the correct category of classification for both these type of articles, is consistent with the arduous and contentious history of obtaining protection for new technologies, given that previously revolutionary technologies such as photography and computer software were highly debated in their time. As such, one of the initial questions involves what categories, if any, to place 3D design files and 3D printed objects. After establishing that some 3D design files can be protectable by copyright, and that 3D printed objects can be protected so long as the expressive content is separable from the utilitarian

⁷⁷ *Copyright Registration for Works of the Visual Arts, Copyright Information Circulars and Factsheets #40*, COPYRIGHT.GOV (Sept. 2012), <http://www.copyright.gov/circs/circ40.pdf>.

⁷⁸ *Brandir Int’l, Inc. v. Cascade Pac. Lumber Co.*, 834 F.2d 1142 at 1145 (2d Cir. 1987).

aspects, the next step in the inquiry is to determine which of the statutorily protected categories 3D design files and printed objects should be classified under.

i) § 102(a)(1) (Literary Works)

Under the Copyright Act, literary works are defined as “[w]orks, other than audiovisual works, expressed in words, numbers, or other verbal or numerical symbols or indicia, regardless of the nature of the material objects, such as books, periodicals, manuscripts, phonorecords, film, tapes, disks, or cards, in which they are embodied.”⁷⁹ 3D Printers create their physical world objects based upon the data provided to them by 3D design files (CAD files) which can seem misleadingly similar to computer software and code. But in order to fully appreciate the difficulty of classifying 3D design files and 3D printed objects as literary works (as computer software is categorized) the history of software protection must be explored.

For a time, those in the computer industry could not obtain copyright in their computer software, either in source or object code form, as it was generally felt that computer code did not warrant copyright protection.⁸⁰ Later, the position was taken that software should be limited to Trade Secret protection.⁸¹ Early in this debate and before Congress expressly amended the copyright act to include software, the U.S. Copyright Office issued an announcement that it had established workable criteria for limited acceptance of computer programs for copyright registration.⁸² Computer programs could be registered subject to the following criteria being met:

⁷⁹ Copyright Act, U.S.C. 17 § 102(a)(1), <http://www.copyright.gov/title17/92chap1.html#102>.

⁸⁰ *Case Law Developments Relating to Copyright Protection for Computer Software (The Early Days)*, LADAS, <http://www.ladas.com/Patents/Computer/Copyright.USA.html#CopyCaseLaw> (last visited Nov. 25, 2012).

⁸¹ Michael S. Keplinger, *Computer Software – Its Nature and Its Protection*, 30 Emory L. J. 483 (1981).

⁸² *Announcement SML-47*, (May 1964), OFFICE OF THE REGISTER OF COPYRIGHTS (May, 1964).

(1) whether the program as such is ‘writing of an author’ and thus copyrightable, and (2) the Copyright Office will consider registration for a computer program as a ‘book’ in Class A if: The elements of assembling, selecting, arranging, editing, and literary expression that went into the compilation of the program are sufficient to constitute original authorship.⁸³

Following the explosion in growth and commercial profitability of the early computer industry, Congress amended the Copyright Act in 1976 to explicitly include computer software.⁸⁴ Further advancements in the computer software industry during the 1980’s lead Congress to amend the Act again, enacting the Computer Software Copyright Act (“CSA”) of 1980, which defined a “computer program” as “a set of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result.”⁸⁵ Even after the enactment of the CSA, there was still some doubt in the industry and in the legal community about the appropriateness of including computer software within the scope of copyright law and the scope of protection that the law could afford. While the CSA statutorily defined the phrase, “computer software”, the functional scope of this definition was highly debated, with one legal scholar opining that “the term ‘computer software’ is not precise and is difficult to define either in a legal or a technological sense. To some, the term encompasses both computer programs and databases; to others, it means any computer product or service that is not actual hardware.”⁸⁶

Notwithstanding the initial debate over the scope of protection for “computer software,” by the mid 1980’s, it was firmly settled that computer software was proper copyrightable subject

⁸³ *Circular 310*, COPYRIGHT OFFICE (Jan. 1965).

⁸⁴ *Software Under the 1976 Act*, DIGITAL LAW ONLINE, <http://digital-law-online.info/lpdi1.0/treatise17.html> (last visited Nov. 25, 2012). Also see H.R. Rep. No. 94-1476 at 54.

⁸⁵ Computer Software Copyright Act of 1980, Pub. L. No. 96-517 (1980).

Note: In 1980, the definition of “computer program” was added to section 101 and placed at the end. The Intellectual Property and High Technology Technical Amendments Act of 2002 amended section 101 by moving the definition for “computer program” from the end of section 101 to be in alphabetical order, after “compilation.” See Pub. L. No. 107-273.

⁸⁶ Keplinger, *supra* note 81.

matter. In Digital Communications Associates, Inc. v. Softklone Distrib. Corp., the court held that “it is now well-established under the amended 1976 Act that a computer program is a ‘work of authorship’ and is subject to copyright protection. Under the Act, computer programs are classified as ‘literary works’...and case law under the Act also clearly establishes that copyright protection extends to both a program's source code, written in conventional human language and symbols, and object code, written in machine readable binary language.”⁸⁷

Computer software is classified as a “literary” work because of the creative expression the programmer necessarily uses in determining how to write source code (which is human-readable), to accomplish a given task. As announced by the Copyright Office prior to the amendment of the Copyright Act, the first requirement for a computer program to be classified as a literary work depends on “whether the program as such is “writing of an author” and thus copyrightable.”⁸⁸ The Copyright Office initially started accepting computer programs for registration because technically they can be classified as “works of authorship” similar to that of a book. This is due to the nature of computer programs, which are comprised of source code which is then built into object (binary) code. Source code is the human-readable and writeable, letters, numbers, and symbols that make up the syntax (i.e. “grammar”) of a programming language. Object code (also known as “binary code”), on the other hand, is the machine-readable code (in 1’s and 0’s) that our computers actually process; and is “built” by taking the human-compatible source code and running it through a “machine-language” translator called a compiler.⁸⁹ Computer software in source and binary code form therefore, is protected as a

⁸⁷ *Digital Communications Associates, Inc. v. Softklone Distrib. Corp.*, 659 F. Supp. 449 (N.D. Ga. 1987). Also see *Apple Computer, Inc. v. Franklin Computer Corp.*, 714 F.2d 1240 (1983) (source & object code are protectable); *Whelan Associates, Inc. v. Jaslow Dental Laboratory, Inc.*, 797 F.2d at 1234 (1986) (protection beyond literal code).

⁸⁸ Announcement SML-47 (May 1964) and Copyright Office Circular 310 (Jan. 1965), *supra* note 80 & 81.

⁸⁹ Allen, *Frances E., A History of Language Processor Technology in IBM*, IBM JOURNAL OF RESEARCH AND DEVELOPMENT (Sept. 1981), <http://ieeexplore.ieee.org/servlet/opac?punumber=5288520>.

literary work because of the programmer's range of options in selecting, arranging and editing his work, which in source code form exists in a human-readable state, and may amount to literary expression sufficient to constitute an original work of authorship.

3D design files and even 2D design files do not appear to be capable of being classified under the scope of literary works due to fundamental differences in how they are created, as compared to computer software development.⁹⁰ Simply put, both 3D design files and computer software are electronic data stored in computer memory to be used with the assistance of a machine as provided for in § 102(a). However, the functional differences between these two types of files ultimately lead to the argument that 3D design files cannot be classified as analogous to computer software, and therefore cannot be classified as a "literary work" because they are in no way, shape, or form, the "writing" of an author, as computer source code is.⁹¹

A 3D design file is not dictated by the same considerations as those that govern computer code. When a programmer is creating software, there are multiple ways to code any particular feature, and it is the programmer's range of choice in selecting how to accomplish their goal that amounts to creative expression equivalent to that of authorship, taken together with the fact that human-readable source code is in the form of a "writing." A 3D design file created by hand in CAD software,⁹² or created by using a laser scanning device⁹³ is devoid of any of this type of authorship, and cannot be considered a "writing." If a 3D design file has extra support structures built into it, it would not be for aesthetic reasons, but rather would be due to the structural

⁹⁰ **Note:** 3D design files are generated in two ways: 1) Via usage of 3D scanner and 2) Generated in CAD software. Compare this to computer software development which can (though impractical) be written on a piece of paper.

⁹¹ **Note:** 3D design files never exist in a "source code" (i.e. human-readable) form, therefore they cannot be considered the "writing of an author" and be protected as literary works.

⁹² *3d Design Software 101*, MAKERBOT, www.makerbot.com/support/guides/design/ (last visited Nov. 25, 2012).

⁹³ Sarah Mitroff, *Matterport's scanner can create a 3D model from anything*, VENTURE BEAT (Mar. 27, 2012), <http://venturebeat.com/2012/03/27/matterport-3d-scanner/>.

limitations of the materials and printer being used. There is no “expression” like in a programmer’s choice of code, because the 3D Design file never exists in a human-readable form. Unlike computer source code which individuals can comprehend and write, there is no such human readable source code associated with a 3D design file. Thus, there can be no literary creative expression in something that 1) cannot be a “writing” and 2) is entirely binary code (i.e. comprised solely of 1’s and 0’s unintelligible by humans without the aid of special software).

Similarly, 3D printed objects do not fit within the plain meaning or congressional definition of “literary works” whatsoever. Literary works protect items such as books, periodicals, manuscripts, phonorecords, film, tapes, disks, or cards, in which such works are embodied. While these items are physical, as 3D printed objects are, they are also potentially subject to copyright protection given that the requisite legal standard for originality is met. Generally, 3D printed objects cannot be classified as “books” or any other sort of literary work, but may certainly be protectable subject matter as pictorial, graphic, and sculptural works. One of the potential exceptions to this generalization, and a recurring theme in the difficulty of classifying where 3D printing technology falls, is that if an author designs a 3D printed brail and/or text sheet, vinyl records,⁹⁴ player piano roll, or other ‘information’ based item, this object may qualify for “literary work” protection, as the information it contains and not the object itself would be protectable, given the information printed satisfied the originality requirements.

ii) § 102(a)(5) (Pictorial, graphic, and sculptural works)

Of the three relevant categories of copyrightable subject matter pursuant to the Copyright Act, “pictorial, graphic, and sculptural works” is the obvious best categorization so long as the

⁹⁴ James Trew, *3D printed record puts a new spin on digital music (video)*, ENGADGET (Dec. 21, 2012), <http://www.engadget.com/2012/12/21/3d-printed-record/>.

work contains enough creative expression separable from its utilitarian or functional aspects. The Copyright Act defines “pictorial, graphic and sculptural works” as:

“[t]wo-dimensional and three-dimensional works of fine, graphic, and applied art, photographs, prints and art reproductions, maps, globes, charts, diagrams, models, and technical drawings, including architectural plans. Such works shall include works of artistic craftsmanship insofar as their form but not their mechanical or utilitarian aspects are concerned; the design of a useful article, as defined in this section, shall be considered a pictorial, graphic, or sculptural work only if, and only to the extent that, such design incorporates pictorial, graphic, or sculptural features that can be identified separately from, and are capable of existing independently of, the utilitarian aspects of the article”.⁹⁵

The leading case outlining the delineation between expressive art protectable by copyright law, and useful or functional items which are unprotectable is the Supreme Court decision in Mazer v. Stein which ruled that an article having a utilitarian function may be copyrightable. In Mazer, the court held that “works of art which are incorporated into the design of useful articles, but which are capable of standing by themselves as art works separate from the useful article, are copyrightable”⁹⁶ where the example used in the Mazer case was an ornamental lamp base.⁹⁷

When Congress was drafting the Copyright Act of 1976, the lead Committee added new language into the Act in an effort to “make clearer the distinction between works of applied art protectable under the bill and industrial designs not subject to copyright protection. The declaration that ‘pictorial, graphic, and sculptural works’ include ‘works of artistic craftsmanship insofar as their form but not their mechanical or utilitarian aspects are concerned’ is classic language: it is drawn from Copyright Office regulations promulgated in the 1940's and expressly endorsed by the Supreme Court in the Mazer case.”⁹⁸ The Congressional History of the

⁹⁵ Copyright Act, U.S.C. 17 § 102(a)(5) (2010), <http://www.copyright.gov/title17/92chap1.html#102>.

⁹⁶ Mazer v. Stein, 347 U.S. 201 (1954).

⁹⁷ *Id.*

⁹⁸ See H.R. Rep. No. 1476 (1976) and U.S.C.C.A.N. 5659, 5667-68 (1976).

Copyright Act amendments clearly show that the definition of “useful article” referred to “an article having an intrinsic utilitarian function that is not merely to portray the appearance of the article or to convey information.”⁹⁹ This aspect of the amendment was added in an effort to implement the Supreme Court’s Mazer decision.

Therefore, under the definition provided by Congress and the delineation set forth in Mazer, a useful article may simultaneously contain copyrightable and non-copyrightable features, provided that the idea behind the pictorial or sculptural work is not merged with its functional aspects and the expression satisfies originality. If these conditions are met, then a copyright can be afforded to the expressive aspects of the work existing independently of the utilitarian aspects.

3D design files can be subject to copyright protection under pictorial works that are “technical, mechanical, engineering, or architectural drawings.” The court’s holding in Forest River, Inc. v. Heartland Recreational Vehicles, LLC., settled the issue of whether technical drawings can be protected as pictorial works. The court in Forest River stated that a “manufacturer’s...floor plan was entitled to copyright protection as a technical drawing, but not as an architectural work” and that the “copyright in a technical drawing of a non-architectural useful article, precluded a competitor from using copies of that drawing to construct the useful article”.¹⁰⁰ Here, the competitor was precluded from manufacturing competing commercial goods, due to the nature in which they misappropriated the original copyrighted “technical drawing” floor plans. Notably, the protection given to “technical drawings” and other pictorial works does not extend to the “design of the article that is portrayed, for example, as a drawing or

⁹⁹ *Id.*

¹⁰⁰ Forest River, Inc. v. Heartland Recreational Vehicles, LLC., 753 F.Supp.2d 753 (N.D. Ind. 2010).

photograph of an automobile or a dress design...may be copyrighted, but that does not give the artist or photographer the exclusive right to make automobiles or dresses of the same design.”¹⁰¹

Moreover, 3D design files that are protected as mechanical, technical and engineering drawings do not grant the intellectual property rights holder with the ability to prevent a third party from creating a utilitarian object based upon the drawing, in cases where no unauthorized reproductions of the drawing are subsequently used in creating the copied utilitarian object. An example of this would be engineering drawings related to a highway sign. These engineering drawings themselves could not be copied without violating the copyright held by the author/assignee; however, the copyright would not be infringed by a third party constructing a highway sign based on the legally acquired engineering drawing. The policy consideration behind this is that while an intellectual property rights holder can own the copyright of a particular article, they do not own the rights to the subject matter that the article depicts.¹⁰²

An additional limitation on the protection of 3D design files as pictorial works was addressed by the court in RBC Nice Bearings, Inc. v. Peer Bearing Co., where the court noted that “ball bearing drawings in manufacturers' catalogs were clearly intended to be accurate depictions of bearings themselves, and thus did not warrant copyright protection.”¹⁰³ Therefore, if a 3D design file is an accurate representation of a preexisting, purely utilitarian item such as a ball bearing, then that type of 3D design file may not be able to be protected by copyright, due to the lack of sufficient originality. It is thereby entirely possible that because of 3D design files inherent nature to accurately depict a potential, physical, purely functional object, many 3D

¹⁰¹ *Copyright Registration for Works of the Visual Arts*, COPYRIGHT.GOV, www.copyright.gov/circs/circ40.pdf.

¹⁰² Arnold Silverman, *Copyright Protection for Engineering Drawings*, MINERALS, METALS & MATERIALS SOCIETY (1995), <http://www.tms.org/pubs/journals/JOM/matters/matters-9509.html>.

¹⁰³ *RBC Nice Bearings, Inc. v. Peer Bearing Co.*, 676 F.Supp.2d 9 at 21 (D. Conn. 2009).

design files may not be subject to extensive copyright protection. However, returning to the Meshworks argument, a 3D design file may be, but is not per se, copyrightable.

3D printed objects on the other hand, clearly fall within the plain meaning of “pictorial works” as defined by Congress. The only caveat to this blanket support of the conclusion that 3D printed objects can be protected as pictorial works, is the requirement that the work have creative expression separable from its mechanical or utilitarian aspects, as dictated in Mazer and its progeny. Logically other than the fact that the 3D printed object was produced in a 3D printer, there is no difference between a “normal” sculpture or pictorial work and the 3D printed object.

iii) § 102(a)(8) (Architectural works)

Architectural works are a relatively recent addition to US copyright law. The Berne Convention Implementation Act of 1988 amended section 101 of the Copyright Act by adding the World Intellectual Property Organization (WIPO) definition¹⁰⁴ of “architectural work.” Congress then moved to further amend the definition pursuant to the Architectural Works Copyright Protection Act (AWCP) of 1990 and declared “architectural works” as protectable subject matter.¹⁰⁵ Architectural works are now defined as “the design of a building as embodied in any tangible medium of expression, including a building, architectural plans, or drawings. The work includes the overall form as well as the arrangement and composition of spaces and elements in the design, but does not include individual standard features.”¹⁰⁶ The AWCP also added 17 U.S.C. § 120,¹⁰⁷ which limited the grant of protection by explicitly preventing IP rights holders from preventing the “making, distributing, or public display of pictures, paintings,

¹⁰⁴ See Pub. L. No. 101-650, 104 Stat. 5089, 513317 & Circular 92, <http://www.copyright.gov/title17/92appm.html>.

¹⁰⁵ Copyright Act, 17 U.S.C. § 102(a)(8) Footnote #3 (1990), <http://www.copyright.gov/title17/92chap1.html#1-3>.

¹⁰⁶ Copyright Act, 17 U.S.C. § 101 (2010), <http://www.copyright.gov/title17/92chap1.html#101>.

¹⁰⁷ Pub. L. No. 101-650 (1990).

photographs, or other pictorial representations of the work, if the building in which the work is embodied is located in or ordinarily visible from a public place.”¹⁰⁸ Public policy dictates that the owner of an architectural work should not be able to remove something which is already in the public sphere (such as a building) and thereby limit an individual’s personal expression by preventing dissemination of any representation or depiction of the architectural work.

Considering that the Copyright Act affords dual protection to architectural plans as both “architectural works” under § 101(a)(8) and as “pictorial works” under § 101(a)(5); 3D design files and 3D printed objects might best be generalized as being classified under the amorphous “architectural plans” construct, leaving the determination of whether they are covered under § 101(a)(8) or § 101(a)(5) to the particularities of the item, analyzed on a case-by-case basis.

Just as some individuals can make the argument that it is a stretch to classify all computer programs as “literary works,” the same can be said to hold that all 3D printed objects should be classified as § 101(a)(8) architectural works. Currently, § 101(a)(8) only refers to brick and mortar buildings, but the creation of a 3D printed object is technically “building” something (3D printing is really just “additive manufacturing” which in turn can be classified as “small scale building”). The same 3D design CAD files and software is utilized for both 3D printing and traditional architectural work, so the argument can be made that they should be subject to the same copyright protections, if they are technically engineered in the same fashion, with the same software, the same files, and are governed by generally applicable laws of science and physics. Additionally, 3D design files could potentially be categorized as technical/architectural drawings, therefore falling under § 101(a)(5). Therefore, because architectural drawings as defined by § 101 can be either “pictorial” architectural drawings, or actual physical architecture,

¹⁰⁸ Copyright Act, 17 U.S.C. § 120 (1990), (<http://www.copyright.gov/title17/92chap1.html#120>).

using this framework would allow the courts to use their judgment in making this determination on a case-by-case basis.

c. Can An Individual Obtain An Independent Derivative Copyright In A 3D Design File Based Upon Preexisting Copyrighted Works?

Under 17 U.S.C. § 101 derivative works are defined as “works based upon one or more preexisting works, such as a translation, musical arrangement, dramatization, fictionalization, motion picture version, sound recording, art reproduction, abridgment, condensation, or any other form in which a work may be recast, transformed, or adapted. A work consisting of editorial revisions, annotations, elaborations, or other modifications, which, as a whole, represent an original work of authorship, is a “derivative work.”¹⁰⁹ This definition is limited by the grant of protection given to compilations and derivative works under 17 U.S.C. § 103(a) which states that the subject matter of derivative works protects only those works created using preexisting materials, which were not used or obtained unlawfully.¹¹⁰ Derivative work rights are further subjected to the delineation between preexisting materials and the work that the new author has contributed to the article, and where copyright in such derivative work does not imply “any exclusive right in the preexisting material. The copyright in such work is independent of, and does not affect or enlarge the scope, duration, ownership, or subsistence of, any copyright protection in the preexisting material.”¹¹¹ The implications of this are demonstrated in Entertainment Research Group, Inc. v. Genesis Creative Group, Inc., where the court held that “three-dimensional inflatable costumes based upon two-dimensional cartoon characters were not sufficiently original to be copyrightable as derivative work.”¹¹² Furthermore in Entertainment,

¹⁰⁹ Copyright Act, 17 U.S.C. § 101, <http://www.copyright.gov/title17/92chap1.html#101>.

¹¹⁰ Copyright Act, 17 U.S.C. § 103(a), <http://www.copyright.gov/title17/92chap1.html#103>.

¹¹¹ Copyright Act, 17 U.S.C. § 103(b), <http://www.copyright.gov/title17/92chap1.html#103>.

¹¹² Entertainment Research Group, Inc. v. Genesis Creative Group, Inc., 122 F.3d 1211 (9th Cir. 1997).

the opinion noted that the District Court had previously determined that if the costumes could be considered sculptural works, due to their utilitarian nature, they would not be covered by copyright.¹¹³ In Entertainment, the manufacturer of the three-dimensional costumes unsuccessfully attempted to prevent the owner of the preexisting work from manufacturing the costumes at any other proprietor. The decision of the court in Entertainment is consistent with precedent and the two part derivative work test set forth in Durham Indus., Inc. v. Tomy Corporation. In Durham the court ruled that in order to support a copyright claim in a derivative work, “First...the original aspects of a derivative work must be more than trivial. Second, the original aspects of a derivative work must reflect the degree to which it relies on pre-existing material”,¹¹⁴ with the copyright of such work not enlarging any rights of the derivative author. Thus, whenever a three-dimensional work is created from a two-dimensional work, the courts will decline to extend derivative copyright protection, unless the author of the derivative work has added appropriate levels of originality that are non-trivial. The aforementioned settled law on derivative works rights would appear to suggest, that 3D design files created from preexisting materials would only warrant copyright protection if their author adds significant features to the digital representation that would be considered creative expression, but not additional utilitarian or functional features.

In regards to 3D printers and their corresponding 3D design files, it would seem that a creator of 3D design files does not necessarily need to violate the lawful copyright holder’s rights in a technical drawing to make an exact replica in 3D modeling software. The availability

¹¹³ *Id.*

¹¹⁴ *Durham Indus., Inc. v. Tomy Corp.*, 630 F.2d 905 at 909 (2d Cir. 1980).

of laser scanning devices¹¹⁵ that allow any end-user to simply scan an object and be presented with an accurate 3D representation on the computer screen, or even hand created 3D design files based on preexisting objects, would seem to lend more support to the idea of transformative independent creation, rather than infringing copying. However this argument is purely speculative at this point, because the technology is still too new to have clear authority to rely on. In Meshworks, the 3D wireframe model was laser scanned and then further edited by hand, while in the Penrose example, the creator of a derivate Penrose triangle made his 3D digital model from only watching the video released by Dr. Schwanitz. A case in which a 3D design file was made solely by use of an automated laser scanner (with no human assisted editing) therefore might not rise to the requisite level of originality to be protected by copyright, but this issue has not been addressed by the courts. Further the original intellectual property rights holder in a technical drawing (which 3D design files are best classified), only has protection of their specific instance of creative expression in the two-dimensional technical drawing, and cannot enjoy a monopoly on the concept behind the drawing. Therefore, current policy dictates that so long as the end-user creator of a 3D design file did not misappropriate the protected technical drawings in creating their transformative digital three-dimensional representation of a preexisting object, they would not be infringing the preexisting copyright of the technical drawing.¹¹⁶

The Penrose Triangle example discussed earlier illustrates this principle. To briefly summarize, the original creator of the first physical Penrose triangle, Dr. Schwanitz, did not upload his 3D design file to the Thingiverse site, instead demonstrating its possibility through a video he publicly released. Merely based upon viewing this video, another user of the

¹¹⁵ *Portable 3D Scanners: HandyScan 3D*, CREAFORM 3D, <http://www.creaform3d.com/en/metrology-solutions/portable-3d-scanner-handyscan-3d> (last visited Nov. 25, 2012).

¹¹⁶ Arnold Silverman, *Copyright Protection for Engineering Drawings*, MINERALS, METALS & MATERIALS SOCIETY (1995), <http://www.tms.org/pubs/journals/JOM/matters/matters-9509.html>.

Thingiverse website (username “artur83”)¹¹⁷ devised how to create a similar or “derivative” structure and uploaded his design to the Thingiverse website under a public domain license so that anyone may freely download and modify his design.

Following artur83’s release of an open source licensed Penrose triangle, a second user named “chylld”¹¹⁸ permissibly downloaded artur83’s file and further modified it to his liking, and then released this (at least to his knowledge), non-infringing derivative work on Thingiverse again under an open and permissive license. The first user “artur83” only created his potentially “derivative” work of Dr. Schwanitz’s physical Penrose triangle because Dr. Schwanitz did not release a version of the file himself. But following the dissemination of the new Penrose files, Dr. Schwanitz filed the first ever 3D printing lawsuit¹¹⁹ which alleged that the two electronic models of the Penrose Triangle had infringed on his copyright. However, in this threatened litigation, Schwanitz did not specify whether he was asserting copyright in the structure itself, the 3D design file, or just the image of the Penrose triangle.¹²⁰ Ultimately Dr. Schwanitz dropped his complaint, but more importantly, it is not currently clear whether he had valid copyright in his creation to begin with, as his “original” Penrose triangle was in turn, based off the original optical illusion Triangle.¹²¹

Also undecided, are the rights of Thingiverse users who independently created 3D design files of a Penrose triangle, with other users subsequently downloading, modifying, and then re-releasing derivative works of the Triangle, all fully within the open and permissible terms under

¹¹⁷ Artur83, *Penrose Triangle*, THINGIVERSE (Feb. 21, 2011), <http://www.thingiverse.com/thing:6456>.

¹¹⁸ Chylld, *Penrose Triangle Illusion*, THINGIVERSE (Feb. 21, 2011), <http://www.thingiverse.com/thing:6474>.

¹¹⁹ *Copyright Policy*, THINGIVERSE BLOG (Feb. 18, 2011), <http://blog.thingiverse.com/2011/02/18/copyright-and-intellectual-property-policy>.

¹²⁰ Rideout, *supra* note 8.

¹²¹ *Ulrich Schwanitz - Penrose Triangle - 3D Design Takedown*, ELECTRONIC FRONTIER FOUNDATION (EFF), www.eff.org/takedowns/ulrich-schwanitz-penrose-triangle-3d-design-takedown (last visited Nov. 25, 2012).

which artur83's triangle was licensed. As this particular case never made it to trial, and as Dr. Schwanitz filed his infringement suit under rights granted by the Digital Millennium Copyright Act (DMCA) and not those covered by U.S.C Article 17 (the Copyright Act), there does not seem to be a clear answer to this issue. As previously noted, pictorial, graphic and sculptural works under which 3D design files might best be classified, are some of the types of articles which in general do not afford the intellectual property rights holder with the ability to prevent a third party from creating a utilitarian object based upon the drawing, given that no unauthorized reproductions of the drawing were utilized in creating the copied utilitarian object.¹²²

Given that Dr. Schwanitz did not release his 3D design files, it would appear absent a showing of misappropriation (and most likely a federal computer hacking charge given the unpublished nature of Dr. Schwanitz work); artur83's Penrose triangle would appear to be a non-infringing independent creation, deserving derivative copyright protection. Dr. Schwanitz might be entitled to protection of his physical 3D printed Penrose triangle, in addition to his 3D design file of this object under § 102(a)(5) as a sculptural work and technical drawing, respectively, if he can prove his creation was sufficiently original.

Dr. Schwantiz could also have had a valid claim had he released the Penrose triangle on a commercial site like Shapeways, with artur83 paying to download the file subject to a non-permissive license, and subsequently misappropriating this material by relicensing and redistributing the file. But there is no evidence of this, and therefore it would appear that artur83 and consequently chylid can enjoy copyright protection in their creations, among other derivative works authors, so long as they do not use materials unlawfully or otherwise acquired through

¹²² Arnold Silverman, *Copyright Protection for Engineering Drawings*, MINERALS, METALS & MATERIALS SOCIETY (1995), <http://www.tms.org/pubs/journals/JOM/matters/matters-9509.html>.

misappropriation. The intellectual property rights holder of technical drawings does not possess a right to prevent others from creating items of the same subject matter; they only enjoy rights in their creative expression of that subject matter.

Another intriguing example is provided by Cody Wilson and the Defense Distributed project. To summarize, Michael Guslick, a user of Thingiverse had created and uploaded a 3D design file for an AR-15 lower receiver (the part of a weapon that is the “base” and essentially holds the firearm together). This 3D design file is obviously based upon the preexisting metal AR-15 lower receiver, and the question of whether Mr. Guslick can enjoy derivative copyright protection in his work is uncertain. The AR-15 was first produced by the Colt Corporation which almost certainly holds a copyright in the technical drawings of the original AR-15 lower receiver.

This situation is similar to the Penrose triangle example, because Mr. Wilson has permissibly obtained and used Mr. Guslick’s creation, but the derivative work protection in Mr. Guslick’s file itself is questionable, since it theoretically could be deemed to be an infringing derivative work, rather than an independent transformative creation. Recently Mr. Wilson has taken this file, and proved its ability to be used in an actual AR-15 which promptly broke apart due to stress, but only after 6 shots had successfully been fired.¹²³ This fact is important because while Mr. Wilson was able to demonstrate that the 3D printed plastic lower receiver does work, Mr. Wilson now has intentions to further modify the file to increase its structural reliability.

While these modifications themselves likely would not be protectable as a derivative work due to their inherent functionality, Mr. Wilson also intends to dramatically reshape the

¹²³ Robert Beckhusen, *3D Printed Gun Only Lasts 6 Shots*, WIRED (Dec. 2012), <http://www.wired.com/dangerroom/2012/12/weaponeers/>.

trigger guard and including custom markings for identifiers such as the “safe” position,¹²⁴ and these additions would likely contain enough non-trivial original creative expression to qualify for derivative work protection. But again, Mr. Wilson’s ability to enjoy protection at all depends on the assumption that Mr. Guslick’s file though independently created, was not an infringing derivative work. If Colt’s original AR-15 lower receiver copyrighted as a two-dimensional technical drawing encompasses a derived three-dimensional design CAD file (technical drawing) of the same object, then Mr. Guslick’s distribution of the file would be an infringing use, in turn making also making Mr. Wilson’s use infringing.

III. Conclusion

The convergence of multiple disruptive technologies (3D printers + the Internet + open source licensing movement) has created an environment where current regulatory schemes are ill equipped to deal with the rapidly changing technology landscape.

a. When Copyright Can Kill

Generally, most federal regulatory systems have been administered in a very top-down heavy handed approach. Organizations such as the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF), and the regulatory schemes for publishers, and media in general as governed by the Federal Communications Commission (FCC) have tended to work on the general proposition that publishing and manufacturing are processes controlled by a select group of individuals, thus making them easier to regulate as the barriers for entry into the market are quite high. For a new media publisher or a new commercial manufacturer to enter the market they must make a substantial investment in equipment and establishing a physical presence and workforce, in addition to obtaining all required licenses and adhering to any safety regulations.

¹²⁴ *Id.*

3D printing technology as used in conjunction with the Internet and websites like Thingiverse where users intentionally release files for others to freely share and modify, completely breaks this assumption about the means of production.

Armed with a laptop and a 3D printer, any individual located anywhere in the world can create and share new works (as the internet currently allows), but now they can also produce physical manifestations of these creations. The capability for an average individual to be able to print every replacement part they will ever need, to be able to print food, to be able to potentially print guns or organs, and all from the comfort of their own home does not mesh well with the current regulatory system where everything is comprehensively monitored because it is easy to track where items are being produced and who is buying the materials to make them.

The 3D printed gun example is particular illuminating on this issue. As analyzed it is likely that Cody Wilson may enjoy derivative work protection in his modified AR-15 lower receiver 3D design file. If this is the case, and as Mr. Wilson fully intends to release all his design files (including the under development fully 3d printable gun) under open source licensing to allow for free use and modification, then copyright law cannot stop the distribution of his files. Even if Colt Corporation does not approve or license the use of their AR-15 lower receiver, if the 3D design file is an independently created transformative work, then Colt cannot exercise any ability to enjoin the distribution of these files on the internet. Compounding this problem for any potential legislator who would like to end the Defense Distributed project is the fact that the project's proposed fully 3D printable firearm is currently not illegal under any state

or federal firearm legislation¹²⁵ because these federal firearms regulations do not encompass “Individuals who produce guns for personal use, as they fall outside the major regulatory system; they are not required to be licensed, as they are not “engaging in the business” of manufacture.¹²⁶ As long as a person is not otherwise prohibited from possessing a firearm and conforms to applicable state laws, he or she may legally make a non-NFA firearm.”¹²⁷

b. Why The Personal Manufacturing Revolution Is Here To Stay

Even though 3D printing is a relatively nascent technology, commercial sales of 3D printers have grown over 35,000% since 2007.¹²⁸ To Jeff Moe,

founder of Aleph Objects Inc., a Loveland, Colorado-based maker of the less-expensive machines, this change is similar to the supercomputers of the 1970s that were only affordable to the major corporations, and now we’re in a period analogous to the 1980s, where the personal computer came about; now we have personal printing, not only does that mean that people can print in their homes, but also the engineers can even do it at companies as well.¹²⁹

3D printers will enable the next wave of technological revolution, the Web 4.0 “Physical Web” transition. With the Internet (and sites like Thingiverse) and personal 3D printers, anyone anywhere in the world can simultaneously create a new object and download countless preexisting works to print. 3D printing is a “disruptor like no other, and even though it is still in its infancy, personal 3D printing technology already shows the same disruptive potential as the original printing press. Just as moveable type spread across Europe and democratized

¹²⁵ Peter Jensen-Haxel, *3d Printers, Obsolete Firearm Supply Controls, and the Right to Build Self-Defense Weapons Under Heller*, 42 Golden Gate U. L. Rev. 447 at 459 (2012), digitalcommons.law.ggu.edu/ggulrev/vol42/iss3/6/.

¹²⁶ 18 U.S.C.A. § 921(a)(21)(A).

¹²⁷ “For your information, per provisions of the Gun Control Act (GCA) of 1968. 18 U.S.C. Chapter 44, an unlicensed individual may make a ‘firearm’ as defined in the GCA for his own personal use, but not for sale or distribution.” (emphasis in original). However, anyone building a firearm must still use the requisite number of domestic parts. See 27 C.F.R. § 478.39. *Firearms Technology*, BUREAU OF ALCOHOL, TOBACCO, and FIREARMS, www.atf.gov/firearms/faq/firearms-technology.html.

¹²⁸ Max Raskin and Ilan Kolet, *Personal 3-D Printer Sales Jump 35,000% Since 2007*, BLOOMBERG (Oct. 24, 2012), <http://www.bloomberg.com/news/2012-10-24/personal-3-d-printer-sales-jump-35-000-since-2007.html>.

¹²⁹ *Id.*

knowledge, the proliferation of 3D printers eventually promises to democratize *creation*.¹³⁰

Broken dishwasher part? Download the relevant CAD file and print it out in plastic. While Amazon made trips to the store seem dated, 3D printing will make ordering (some) things online feel positively quaint”.¹³¹ The Internet already has severely disrupted the established players in the media industry, allowing websites like the Huffington Post to rise in popularity, as the readership and revenues for traditional print media continues to decline, and so too will 3D printers slowing start to chip away at traditional manufacturing’s revenues.

c. Conclusion: How Copyright Law Should Adapt To Appropriately Cover 3D Printing Technology

As technology moves forward, it often advances faster than the law can adapt. Copyright law will need to be continuously adapted and updated to cover the ever evolving technology that is 3D printing, and this is consistent with past examples of the application of Copyright law to new developments. One example can be found in the circumstances preceding the Semiconductor Chip Protection Act (SCP) of 1984. When 17 U.S.C. § 901 (SCP) was being drafted, it was an attempt to address a problem in the semiconductor industry, where unscrupulous individuals were “slavishly copying” chip design by literally slicing away at chips to determine how they functioned, and then replicating their internal structure and wiring which was not subject to copyright protection. 17 U.S.C. § 901 was designed to protect the internal structure of the chips (known as “mask works”) under copyright law, but the legislation was made moot even before its enactment due to the breakneck pace of the computer industry. The advancements since 1979 when the SCP legislation was being drafted, made “slavish copying”

¹³⁰ *The Printed World*, ECONOMIST (Feb. 10 2011), www.economist.com/node/18114221?story_id=18114221.

¹³¹ *The Next Napster – Copyright questions as 3D printing comes of Age*, ARS TECHNICA (May, 2011), <http://arstechnica.com/tech-policy/2011/04/the-next-napster-copyright-questions-as-3d-printing-comes-of-age/>.

largely impossible by the time the act was in force of law in 1984.¹³² Due to the open nature of the 3D printing community, any legislation passed to cover these boundaries of the 3D printing space will need to take into consideration the moving target that is 3D printing technology.

This analysis is also consistent with the history of computer software protection. Early on computer software was not eligible to be protected as a copyrighted work, but Congress later amended the Copyright Act to explicitly include software. 3D printing technology currently bears a lot of similarities to the early computer industry. It is currently mostly in the realm of hobbyists and geeks, but as the technology progresses and becomes easier to use, more individuals will embrace it. As shown by the advanced methods of inserting watermark protection into 3D design files,¹³³ piracy and infringement of these types of files is already an issue for those in the industry. The almost limitless variety of objects that can be produced by 3D printers makes it difficult to classify 3D design files or 3D printed objects under the same general terms.

Given the potential implications of wide spread adoption of 3D printing technology, it would only be logical for Congress to address these early issues before they blossom into real problems. While extreme examples like a fully 3D printable firearm are not yet possible, it is only a matter of time until it is within the scope of reality and other equally questionable items are surely to be produced. The history of copyright in the US and the early computer industry should be used a guide for how to address these issues and effectively regulate this new market

¹³² Steven P. Kasch, *The Semiconductor Chip Protection Act: Past, Present, and Future*, BERKELEY L. J. (1993), <http://www.law.berkeley.edu/journals/btlj/articles/vol7/Kasch.pdf>.

¹³³ Ho-Kyun Park, *Blind watermarking for Copyright Protection of 3D CAD drawings*, IEEE (Feb. 20, 2006). <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&arnumber=1625568>.

so they are proactively solving issues, instead of merely reacting to them once they have already emerged as problematic.