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3-D Printed Guns: A Developing Technology with Dangerous Potential

Jonathan Danielczyk*

Since the beginning of time, technology has been in a constant state of advancement, for better or for worse.¹ From the invention of the printing press, to the development of the steam engine, to the creation of steel, technological advancements have molded our world into what it is today.² However, technology has also acted as a catalyst for some of the world's greatest catastrophes.³ From the invention of the guillotine to the exploitation of people through online identity theft, technology has also shown its ability to simultaneously cause harm.⁴ But, technology may become most dangerous when intertwined with lethal weapons such as guns.⁵

Gun control in the United States has long been a hotly-contested issue.⁶ There are approximately 270 million guns in the United States—a figure that represents the highest total number of guns and number per capita in the world.⁷ For many people, it is no longer a surprise to hear that there has been a gun-related crime or a shooting

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¹ *Ancient Civilizations: 2d. First Technologies: Fire and Tools*, USHISTORY.ORG, <http://www.ushistory.org/civ/2d.asp> (last visited Feb. 3, 2017).

² See, e.g., Evan Andrews, *11 Inventions that Changed History*, HISTORY (Dec. 18, 2012), <http://www.history.com/news/history-lists/11-innovations-that-changed-history>.

³ See, e.g., Attila Nagy, *25 of the Deadliest Explosions Man Ever Made*, GIZMODO (Jan. 17, 2013, 9:00 AM), <http://gizmodo.com/5976153/25-of-the-deadliest-explosions-man-ever-made> (listing events such as the Halifax explosion of 1917 and the detonation of the world's first atomic weapon in New Mexico in 1945).

⁴ Ejaz Abbasi, *Top 10 Most Dangerous Scientific Inventions of All Time*, PURBAT (Mar. 31, 2016), <http://purbat.com/top-10-dangerous-scientific-inventions-time/>; Nick Clements, *Identity Theft: How to Protect Yourself or Resolve It*, FORBES (Sept. 14, 2016, 11:01 AM), <http://www.forbes.com/sites/nextavenue/2016/09/14/identity-theft-how-to-protect-yourself-or-resolve-it/#2aa75cbb122d>.

⁵ Daniel C. Tirone & James Gilley, *3D Printing: New Threat to Gun Control and Security Policy?*, U.S. NEWS & WORLD REPORT (July 19, 2016, 8:53 AM), <http://www.usnews.com/news/articles/2016-07-19/3-d-printing-new-threat-to-gun-control-and-security-policy>.

⁶ *Should More Gun Control Laws Be Enacted?*, PROCON.ORG, <http://gun-control.procon.org/> (last visited Jan. 15, 2017).

⁷ *Id.*

in a nearby area.⁸ Local news reports have become riddled with stories of horrific crimes being committed, and, as a society, we have become calloused to such occasions. In 2016 alone, more than 15,000 people were killed by a firearm and over 30,000 people were injured in gun-related incidents.⁹ Worse yet, it appears that the development and spread of new technologies, particularly three-dimensional printing, may only compound the problem.¹⁰

Three-dimensional (hereafter referred to as “3-D”) printing may revolutionize the way guns are manufactured, reinvent the way they are used, and exacerbate the stories we hear on the news.¹¹ With this technology, it is more a reality than ever that a firearm completely undetectable by standard metal detectors could be manufactured from the comfort of one’s home.¹² This all-too-real possibility creates a new and evolving area of potential criminal activity that needs to be acknowledged and addressed by legislation.

Imagine a world where individuals can manufacture their own completely untraceable firearm on their office desks. Some might be surprised to know that this world is already a reality.¹³ Currently, anyone with the raw materials, a few hundred dollars’ worth of machinery, and basic metalworking skills can manufacture his or her own untraceable, entirely legal gun.¹⁴ Now imagine eliminating the need for the expensive equipment and technical skills. That is precisely what 3-D printers do. The advancement of 3-D printing technology has given everyone with a 3-D printer and Internet access the ability to build their own arsenal—adults and children alike.

Section I of this Article will summarize various aspects of 3-D printing, including the manufacturing processes that allow one to manufacture a gun as well

⁸ Lois Beckett et al., *America’s gun problem is so much bigger than mass shootings*, THE GUARDIAN (June 21, 2016, 7:00 AM), <https://www.theguardian.com/us-news/2016/jun/21/gun-control-debate-mass-shootings-gun-violence>.

⁹ *Past Summary Ledgers*, GUN VIOLENCE ARCHIVE, <http://www.gunviolencearchive.org/past-tolls> (last updated Jan. 15, 2017).

¹⁰ Bryan Borzykowski, *When 3D Printing Gets Into the Wrong Hands*, FORBES (May 6, 2016, 12:41 PM), <http://www.forbes.com/sites/zurich/2016/05/06/when-3d-printing-gets-into-the-wrong-hands/#64bae41e24a6>.

¹¹ Janet Gilger-VanderZanden, *Are 3D Guns Legal?*, CRIMINAL DEFENSE LAWYER, <http://www.criminaldefenselawyer.com/resources/are-3d-guns-legal.htm> (last visited Dec. 29, 2016) [hereinafter Gilger-VanderZanden I].

¹² *Id.*

¹³ *Id.*

¹⁴ Janet Gilger-VanderZanden, *Homemade Guns: Are They Legal? Must They Be Registered?*, CRIMINAL DEFENSE LAWYER, <http://www.criminaldefenselawyer.com/resources/homemade-guns-are-they-legal-must-they-be-registered> (last visited Jan. 7, 2017) [hereinafter Gilger-VanderZanden II].

as the materials necessary. Section II will explain and analyze the current federal laws that regulate firearms. Section III will identify and analyze laws of various states that regulate or intend to regulate 3-D printed firearms. Finally, Section IV will identify the need for Pennsylvania to consider laws particularly targeting 3-D printed firearms, discuss the advantages and disadvantages of doing so, and propose a solution to an emerging problem.

I. OVERVIEW OF 3-D PRINTING

3-D printing is one of the most “futuristic” technologies available, allowing a manufacturer, a term which now includes private users, to customize and personalize even the most complex products.¹⁵ Although the science behind 3-D printing has existed since the 1980s, recent technological advancements have made it far more economically feasible on a large scale.¹⁶ This revolutionary concept has been used across a vast range of areas, including everything from the manufacturing of discrete medication bottles¹⁷ to the assembling of the exterior shell of a robot.¹⁸ In fact, this technology has become so prominent that it is now being implemented into elementary school curriculums,¹⁹ influencing the classroom experiences of today’s youngest minds.²⁰ However, as will be discussed below, 3-D printing may also push the bounds of legality.²¹

3-D printing, also called “additive manufacturing,” is a process by which a printer places successive layers of raw materials upon one another, which eventually add up to the final, predesigned product.²² Conversely, “traditional manufacturing” is the process of shaping a product by cutting down materials into a specific shape.²³ One of the most common types of 3-D printing is a process called Fused Deposition

¹⁵ Gilger-VanderZanden II, *supra* note 14.

¹⁶ *Id.*

¹⁷ Hannah Rose Mendoza, *Nursing Students Design 3D Printed Pill Boxes For HIV/AIDS Patients*, 3DPRINT.COM (May 19, 2016), <https://3dprint.com/134363/3d-printed-pill-boxes-hiv-aids/>.

¹⁸ Tyler Koslow, *Play “Simon Says” and Take a Selfie With Fastest-3D Printed InMoov Robot Ever*, 3DPRINT.COM (Apr. 27, 2016), <https://3dprint.com/131613/stevens-3dprint-robot/>.

¹⁹ Eddie Krassenstein, *4th Graders in New Jersey Design and 3D Print Boats that Float in Order to Learn Geometry*, 3DPRINT.COM (Feb. 25, 2015), <https://3dprint.com/46986/4th-grade-geometry-class-3dp/>.

²⁰ *Id.*

²¹ Gilger-VanderZanden I, *supra* note 11.

²² *Id.*

²³ *Id.*

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Modelling (“FDM”).²⁴ FDM works by slicing the digital model, called a computer aided design (“CAD” file), into hundreds, sometimes thousands, of thin layers, usually about 0.1 millimeters thick.²⁵ The printer then replicates each layer on the printing bed, one layer on top of another.²⁶ This process is analogous to building a brick wall: one builds upon a lower layer of material, one layer at a time, from the ground up. The finished product, which may take up to several hours to complete depending on its size and the material used, should be a complete physical copy of the CAD file.²⁷

Today, 3-D printers have the capability to print using a wide variety of materials²⁸—a feature that provides nearly endless opportunities. Current technologies allow 3-D printers to use materials such as plastic, wood, metal, ceramics, concrete, molecules, and human cells.²⁹ Some printers even have the ability to use multiple materials at once, allowing fully-functioning circuit boards to be printed.³⁰ However, such versatility comes with a price. Consequently, when presented with the option, most at-home consumers will opt for the cheapest possibility—plastic.³¹ In addition to being one of the cheapest materials for 3-D printers, the plastic used, called thermoplastics industry-wide for its ability to melt and be molded, is also one of the most accessible 3-D printable materials available to consumers.³²

The recent technological trend in 3-D printing has made it easier and cheaper for consumers to purchase 3-D printers for their own in-home use.³³ No longer do consumer-targeted 3-D printers carry the crippling price tag of \$10,000.³⁴ A simple

²⁴ Scott J. Grunewald, *What You Need to Know About 3D Printed Guns and Why You Don't Need to Fear Them*, 3DPRINT.COM (June 23, 2016), <https://3dprint.com/139537/3d-printed-guns/>.

²⁵ *Id.*

²⁶ *Id.*

²⁷ *Id.*

²⁸ Grunewald, *supra* note 24.

²⁹ Adam Thierer & Adam Marcus, *Guns, Limbs, and Toys: What Future For 3D Printing?*, 17 MINN. J.L. SCI. & TECH. 805, 808 (2016).

³⁰ *Id.*

³¹ *What Material Should I Use for 3D Printing?*, 3DPRINTINGFORBEGINNERS.COM (Feb. 10, 2013), <http://3dprintingforbeginners.com/filamentprimer/>.

³² *See* Grunewald, *supra* note 24.

³³ Thierer, *supra* note 29.

³⁴ Grunewald, *supra* note 24.

Internet search reveals that in-home 3-D printers sell for as little as \$200,³⁵ and individuals can build their own 3-D printers for just over \$50 (and some technical know-how).³⁶ Given the plummeting costs of in-home printers, Gartner, a technology research company, expected nearly 500,000 shipments of 3-D printers would be placed worldwide in 2016, and they are forecasting that shipments of 3-D printers will grow by 100% every year until 2018.³⁷ Moreover, Siemens, a manufacturing and electronics company, estimates that 3-D printing will become 50% cheaper and up to 400% faster over the next five years.³⁸ Considering that prices of 3-D printers have already dropped to well below \$1,000,³⁹ fully-functioning and capable 3-D printers could be in nearly every home within ten years.⁴⁰ This would allow anyone with a 3-D printer and an Internet connection to not only manufacture random household odds and ends, but also print working firearms.⁴¹

Although tradition and logic would suggest that the best material to use when manufacturing a 3-D printed firearm would be metal, cost is a significant obstacle.⁴² For instance, a company named Solid Concepts used 3-D printing to manufacture metal handguns and sold them for \$11,000, a steep price that is undeniably unattractive to many consumers.⁴³ Even though metal may be the more durable and intuitive material for a 3-D printed gun, its price tag drives away most potential buyers.⁴⁴ Thus, began the movement for the design and construction of 3-D printed plastic firearms.⁴⁵

The full potential of the conceptual 3-D printed gun was realized in 2013 when Cody Wilson, founder of the non-profit and Second Amendment group Defense

³⁵ Matthew Hughes, *4 Affordable 3D Printers You Can Buy for Your Home*, MAKEUSEOF.COM (Dec. 13, 2013), <http://www.makeuseof.com/tag/4-affordable-3d-printers-you-can-buy-for-your-home/>.

³⁶ Kelly Hodgkins, *Build Your Own 3D Printer for \$50 and Change*, DIGITAL TRENDS (Dec. 18, 2015), <http://www.digitaltrends.com/cool-tech/cheap-3d-printer/>.

³⁷ Thierer, *supra* note 29.

³⁸ *Id.*

³⁹ Brian Voo, *10 Affordable 3D Printers You Can Get Right Now*, HONGKIAT, <http://www.hongkiat.com/blog/affordable-3d-printer/> (last visited Dec. 29, 2016).

⁴⁰ Dianna Labrien, *Does 3D Printing Have a Future for Consumers?*, TECH.CO (June 18, 2016, 6:00 PM), <http://tech.co/3d-printing-future-consumers-2016-06>.

⁴¹ *Id.*

⁴² Grunewald, *supra* note 24.

⁴³ *Id.*

⁴⁴ *Id.*

⁴⁵ Gilger-VanderZanden I, *supra* note 11.

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Distributed, created the first fully-functioning 3-D printed plastic firearm⁴⁶—a feat that landed him a place on *Wired Magazine*’s lists of the *15 Most Dangerous People in the World*⁴⁷ and *The Most Dangerous People on the Internet*.⁴⁸ Named “The Liberator,” Wilson’s handgun was made almost entirely of plastic, with only a standard metal nail used as the firing pin to initiate the explosion needed to propel the bullet.⁴⁹ In addition to the video evidence of the successful test shoot, Defense Distributed posted the digital design CAD file to their website.⁵⁰ Available on the Internet for download at the simple click of a button, plans for The Liberator were downloaded over 100,000 times in just two days.⁵¹ The downloadable plans were eventually taken down from Defense Distributed’s website pursuant to a cease and desist order issued by the Department of State, but not before they had been downloaded over one million times.⁵²

Although taken down from the site, the plans for The Liberator continued to appear on various file sharing sites, like Pirate Bay, where they have become one of the most popular downloads among 3-D printable files.⁵³ But, due to Pirate Bay’s user-to-user interface, its traffic is nearly impossible to measure.⁵⁴ Possibly even more awe-striking, in the two days following the unveiling of The Liberator, 560,000 people visited Defense Distributed’s website and about 2.8 million people viewed The Liberator’s YouTube video.⁵⁵

⁴⁶ *Id.*

⁴⁷ Staff of Danger Room, *The 15 Most Dangerous People in the World*, WIRED (Dec. 19, 2012, 6:30 AM), <https://www.wired.com/2012/12/most-dangerous-people/?pid=1696> (At only 24 years old, Cody Wilson was ranked as the 14th most dangerous person in the world.).

⁴⁸ Wired Staff, *The Most Dangerous People on the Internet Right Now*, WIRED (Jan. 1, 2015, 6:30 AM), <https://www.wired.com/2015/01/dangerous-people-internet-right-now/> (At 26 years old, Cody Wilson was ranked as the fifth most dangerous person on the internet.).

⁴⁹ Gilger-VanderZanden II, *supra* note 14.

⁵⁰ *Id.*

⁵¹ Interestingly, downloads in Spain initially surpassed those in the United States. However, downloads by Americans have since retaken the pole position. Andy Greenberg, *3D-Printed Gun’s Blueprints Downloaded 100,000 Times in Two Days (With Some Help from Kim Dotcom)*, FORBES (May 8, 2013, 5:12 PM), <http://www.forbes.com/sites/andygreenberg/2013/05/08/3d-printed-guns-blueprints-downloaded-100000-times-in-two-days-with-some-help-from-kim-dotcom/#218026488c68> [hereinafter Greenberg I].

⁵² Todd Sperry, *U.S. Requires Group to Remove 3-D Gun Instructions From Its Website*, CNN (May 13, 2013, 10:51 AM), <http://www.cnn.com/2013/05/09/politics/3-d-guns/>.

⁵³ Greenberg I, *supra* note 51.

⁵⁴ *Id.*

⁵⁵ *Id.*

The Liberator was a nightmare turned reality for the anti-gun community. It was small and compact, could be made at home, and was virtually undetectable by conventional security equipment.⁵⁶ However, because The Liberator was made almost entirely of plastic, it could only be fired a handful of times before the plastic cracked due to the explosion from the bullet.⁵⁷ The Liberator's continued production, at the time of its release, was deemed impractical due to this lack of durability.⁵⁸

Nevertheless, as with almost all technologies, a new idea emerged and provided a solution to the durability issue.⁵⁹ In 2014, only a year following the release of The Liberator, a machinist from Pennsylvania proposed a solution.⁶⁰ He created a new style of bullet that has a thicker steel shell and holds the projectile deep enough inside the casing to enable the casing to absorb the shock from the explosion and protect the fragile plastic firearm.⁶¹ With the newly-designed bullets, even a gun made from the cheapest plastic could be fired repeatedly without losing its structural integrity, cracking, or deforming.⁶² 3-D guns are quickly becoming more practical firearms, and, considering the technology's plummeting costs,⁶³ should be addressed by authorities.

II. FEDERAL 3-D PRINTED GUN LAWS

With the introduction of The Liberator, Cody Wilson and Defense Distributed opened a new line of dialogue for gun control activists. In response to and realization of a growing technology, the federal Bureau of Alcohol, Tobacco, Firearms and Explosives (hereinafter referred to as "ATF") added a section of its website devoted specifically to 3-D printing technology.⁶⁴ This may be evidence that increased accessibility to 3-D technology will only convolute the hot topic of gun control, and with new technological variables entering the discussion, current legislation may

⁵⁶ Greenberg I, *supra* note 51.

⁵⁷ Andy Greenberg, *The Bullet That Could Make 3-D Printed Guns Practical Deadly Weapons*, WIRED (Nov. 5, 2014, 6:30 AM), <https://www.wired.com/2014/11/atlas-314-3-d-printed-guns-bullets/> [hereinafter Greenberg II].

⁵⁸ *Id.*

⁵⁹ *Id.*

⁶⁰ *Id.*

⁶¹ *Id.*

⁶² Greenberg II, *supra* note 57.

⁶³ Thierer, *supra* note 29, at 809.

⁶⁴ See *Firearms Q&As*, ATF, <https://www.atf.gov/questions-and-answers/firearms-qas> (last visited Feb. 4, 2017).

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need to be revised and amended in order to adequately meet the needs of today's society.

Currently there are no federal regulations specifically against the manufacturing of 3-D printed firearms, but there is legislation under which 3-D printed guns fall.⁶⁵ Under the Gun Control Act of 1968 (hereinafter referred to as "GCA"), a person "engaged in [the] business" of dealing in firearms must first obtain a license to do so from the government.⁶⁶ In relation to gun manufacturers, the GCA defines "engaged in business" as "a person who devotes time, attention, and labor to manufacturing firearms as a regular course of trade or business with the principal objective of livelihood and profit through the sale or distribution of the firearms manufactured[.]"⁶⁷ While the GCA requires profit-seeking gun makers to be licensed, it does not prevent a private citizen from manufacturing a gun for his or her own personal use, provided that the guns are not sold or transferred and the manufacturer is not statutorily prohibited from possessing a firearm.⁶⁸

In addition to requiring that firearm manufacturers, distributors, and similar individuals or organizations are licensed, the GCA also requires that firearms be registered and bear a serial number that may be used to trace the gun if necessary.⁶⁹ It is through this process, the typical buyer/seller relationship, that a purchaser must pass the required background checks, the primary means by which the government regulates firearms.⁷⁰ However, an individual with some machinery skills and a desire to avoid the background checks can manufacture his or her own unregistered, legal firearm.⁷¹ 3-D printers make this homemade approach exponentially easier, leaving the question of whether 3-D printed firearms should require a serial number.

Generally, under the GCA, a gun must be registered and bear a serial number if it is, among other things, "the frame or receiver [of a weapon.]"⁷² A receiver is the section of a firearm that houses its mechanical components and projects the bullet.⁷³ Some gun buyers, for hobby or sport, purchase finished receivers and assemble the

⁶⁵ Gilger-VanderZanden I, *supra* note 11.

⁶⁶ 18 U.S.C. § 922 (2012).

⁶⁷ 18 U.S.C. § 921(a)(21) (2012).

⁶⁸ See 18 U.S.C. § 922 (2012); see also Gilger-VanderZanden II, *supra* note 14.

⁶⁹ 18 U.S.C. § 922 (2012).

⁷⁰ Gilger-VanderZanden II, *supra* note 14.

⁷¹ *Id.*

⁷² 18 U.S.C. § 921(c) (2012).

⁷³ Gilger-VanderZanden II, *supra* note 14.

remaining parts themselves, including the gun's barrel, stock, etc.⁷⁴ Because a finished receiver is recognized as a firearm by the GCA, such a purchaser would be required to pass the background checks, and the gun would be registered with a serial number.⁷⁵

Conversely, the GCA does not reach unfinished receivers, also called 80%, blank, or partial receivers.⁷⁶ These receivers need not be registered with authorities and are not given serial numbers.⁷⁷ Individuals may purchase an unfinished receiver and the remaining parts and assemble the weapon into a fully-functional, completely untraceable, legal firearm.⁷⁸ It is for this reason that guns constructed in this way are deemed "ghost guns."⁷⁹ Much like these self-manufactured weapons, 3-D printed guns are also "ghost guns," completely untraceable and unidentifiable by the government.⁸⁰ Because current legislation allows for 3-D printed guns to go unregistered,⁸¹ it is nearly impossible for the government to estimate how many "ghost guns" are in circulation, making it even more difficult to police and enforce what laws are currently in place.⁸² Such a task may only become more difficult with the influence of groups like Defense Distributed and the rapid expansion of the 3-D printing market.

While the idea of 3-D printed guns is relatively new, the manufacturing of one's own firearms is not a novel concept in our society.⁸³ Since the introduction of the gun, individuals have crafted cheap, unregistered models for a variety of purposes, both legal and illegal.⁸⁴ Popular in the 1930s and 1940s and referred to as "zip guns," these crude instruments were often constructed from taped-together pieces of pipe

⁷⁴ *Id.*; see B. Gil Horman, *Building a Custom AR-15 at Home*, NRA AMERICAN RIFLEMAN (Oct. 31, 2014), <https://www.americanrifleman.org/articles/2014/10/31/building-a-custom-ar-15-at-home/>.

⁷⁵ Gilger-VanderZanden II, *supra* note 14.

⁷⁶ *Id.*

⁷⁷ *Id.*

⁷⁸ Gilger-VanderZanden II, *supra* note 14.

⁷⁹ See, e.g., *id.*

⁸⁰ Gilger-VanderZanden II, *supra* note 14.

⁸¹ *What is ATF doing in regards to people making their own firearms?*, ATF, <https://www.atf.gov/firearms/qa/what-atf-doing-regards-people-making-their-own-firearms> (last visited Jan. 8, 2017).

⁸² Gilger-VanderZanden I, *supra* note 11.

⁸³ Adrienne LaFrance, *The 3-D-Printed Gun is Retro, Not Futuristic*, THE ATLANTIC (Jan. 13, 2016), <http://www.theatlantic.com/technology/archive/2016/01/gunslingers-and-the-mythology-of-making-your-own-weapon/423771/>.

⁸⁴ *Id.*

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and rubber bands.⁸⁵ Zip guns are makeshift but serve their purpose for their makers as cheap alternatives that do not require a background check.⁸⁶ With the rapid expansion of 3-D printing technologies, it is likely that these primitive zip guns will be replaced by the 3-D printed guns as the primary choice when an untraceable firearm is desired.⁸⁷

Although “ghost guns,” both 3-D printed and otherwise assembled, do not fall within the grasp of the GCA,⁸⁸ their inability to be traced is only one of several major issues. 3-D printed guns, particularly those printed entirely from plastic, also pose a major threat to security as they are undetectable by a standard metal detector.⁸⁹ However, the concept of undetectable guns was addressed by Congress in 1988 when it passed the Undetectable Firearms Act (hereinafter referred to as “UFA”).⁹⁰ In an attempt to preempt the manufacturing of undetectable firearms, the UFA has been reauthorized multiple times—in 1998, 2003, and 2013.⁹¹

The UFA requires all firearms to contain, at a minimum, 3.7 ounces of metal, so that they may be detectable by standard metal detectors.⁹² While the UFA makes it unlawful to possess or manufacture a firearm that does not contain this amount of metal, it does not eliminate the ability for a firearm to be made that is only compliant at its owner’s discretion.⁹³ For instance, a 3.7-ounce piece of metal can be easily removed from a fully functional, plastic gun, effectively making it undetectable when its owner sees fit.⁹⁴ Not requiring the metal piece to play an integral role in the firearm’s functionality provides an opportunity for people to game the system and make compliance a calculated decision and leads to issues with enforcement.⁹⁵ Such

⁸⁵ *Id.*

⁸⁶ *Id.*

⁸⁷ *Id.*

⁸⁸ Gilger-VanderZanden II, *supra* note 14.

⁸⁹ Gilger-VanderZanden I, *supra* note 11.

⁹⁰ Jennifer Bendery, *House Passes Ban on Plastic Guns As Senate Eyes Broader Reforms*, HUFFINGTON POST (Dec. 3, 2013, 5:14 PM), http://www.huffingtonpost.com/2013/12/03/gun-control-chuck-schumer_n_4379325.html.

⁹¹ *Id.*

⁹² 18 U.S.C. § 922(p) (2012).

⁹³ Andy Greenberg, *Bill to Ban Undetectable 3D Printed Guns is Coming Back*, WIRED (Apr. 6, 2015, 7:00 AM), <https://www.wired.com/2015/04/bill-ban-undetectable-3-d-printed-guns-coming-back/> [hereinafter Greenberg III].

⁹⁴ Greenberg III, *supra* note 93.

⁹⁵ *Id.*

a glaring loophole was opposed by many, but all efforts to remedy this perceived legislative shortcoming and broaden the UFA's reach have fallen short.⁹⁶

III. STATE AND LOCAL LAWS

The 3-D printing of guns is not a novel concept to the technological world, and numerous countries around the world have entirely criminalized their manufacture and use.⁹⁷ Singapore, a country known for its strict gun laws, even made their use punishable by death.⁹⁸ In the United States, some jurisdictions on the state and local levels have been more proactive than others in anticipating approaching issues.⁹⁹

In 2013, Philadelphia became the first U.S. city to ban the manufacture of 3-D printed guns.¹⁰⁰ In an admittedly pure anticipatory move, Philadelphia outlawed the manufacturing of any 3-D printed firearm or any piece thereof in an attempt to stay ahead of creative criminals.¹⁰¹ While Philadelphia's \$2,000 fine for violators¹⁰² falls understandably short of Singapore's penalty of death,¹⁰³ the prohibition also draws attention to a new and emerging line of technology that may require a revolutionary line of legislation.¹⁰⁴

⁹⁶ One proposal, the Undetectable Firearms Modernization Act of 2015, H.R. 2699, 114th Cong. (2015), would prohibit the manufacture or possession of a firearm which could be made undetectable by removing a non-functioning piece of metal inserted merely to satisfy the statute. The proposal would require that the 3.7 ounce or larger piece of metal be essential to the functionality of the firearm. Then, ideally, without the metal piece, the gun would be undetectable, but it would also be nonfunctioning. Greenberg III, *supra* note 93.

⁹⁷ See e.g., Freya Berry & Stephen Addison, *Britain Updates Rules Banning 3D-Printer Guns*, REUTERS (Dec. 5, 2013, 10:22 AM), <http://www.reuters.com/article/us-britain-guns-idUSBRE9B40OV20131205>; Bridget Butler Millsaps, *New South Wales, Australia: Parliament Passes Law Banning Possession of 3D Files for Guns*, 3DPRINT.COM (Nov. 20, 2015), <https://3dprint.com/106940/australia-ban-3d-files-guns/>.

⁹⁸ Alec, *Using 3D Printed Guns in Singapore Punishable by Death, LGBT Controversy Reveals*, WWW.3DERS.ORG (June 27, 2016), <http://www.3ders.org/articles/20160627-using-3d-printed-guns-in-singapore-punishable-by-death-lgbt-controversy-reveals.html>.

⁹⁹ See, e.g., Joshua Rhett Miller, *Philadelphia Poised to Become First City to Ban 3D-Printed Guns*, FOX NEWS (Nov. 26, 2013), <http://www.foxnews.com/us/2013/11/26/philadelphia-poised-to-become-first-city-to-ban-3d-printed-guns.html>.

¹⁰⁰ *Id.*

¹⁰¹ Miller, *supra* note 99.

¹⁰² *Id.*

¹⁰³ Alec, *supra* note 98.

¹⁰⁴ Dean Weingarten, *Philadelphia City Council Breaks Law with Ban on 3D Printed Guns*, AMMOLAND (Nov. 26, 2013), <http://www.ammoland.com/2013/11/philadelphia-city-council-breaks-law-with-ban-on-3d-printed-guns/#axzz4VDv03PQf>.

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Nevertheless, there is doubt as to whether, if challenged, Philadelphia's prohibition on 3-D printed guns would be deemed valid.¹⁰⁵ Pennsylvania's Uniform Firearms Act states that "[n]o county, municipality, or township may in any manner regulate the lawful ownership, possession, transfer, or transportation of firearms, ammunition or ammunition components when carried for purposes not prohibited by the laws of this Commonwealth."¹⁰⁶ Indeed, there is movement in the Pennsylvania Senate to clarify and reinforce this statute in an effort to ensure the uniformity of gun laws across the Commonwealth.¹⁰⁷ Thus, in the absence of Pennsylvania law on the subject,¹⁰⁸ Philadelphia's well-intentioned ban on 3-D printed guns may only serve the purpose of starting the conversation.¹⁰⁹

Likewise, in an effort to eliminate the confusion that state law preemption can bring to local laws, multiple states have been trying to combat the growing concern about 3-D printed firearms for years.¹¹⁰ California, the first to succeed in its fight against 3-D weapons, passed legislation which was signed into law by Governor Jerry Brown in July of 2016.¹¹¹ While the law was created in response to the 3-D technology boom, it also tackled the broader issue of "ghost guns" in general.¹¹² Under the new California law, anyone who manufactures or assembles their own weapons, including those printed on a 3-D printer, must first apply for and obtain a serial number or other mark of identification from the U.S. Department of Justice, which includes passing a background check.¹¹³ Now, Californians who purchase an

¹⁰⁵ Weingarten, *supra* note 104.

¹⁰⁶ 18 PA.CON.S.TAT. § 6120 (2014).

¹⁰⁷ *Pennsylvania: Preemption Legislation Making a Comeback This Session*, NRA – INSTITUTE FOR LEGISLATIVE ACTION (NRA-ILA) (Jan. 31, 2017), <https://www.nraila.org/articles/20170131/pennsylvania-preemption-legislation-making-a-comeback-this-session>.

¹⁰⁸ *See Pennsylvania Gun Laws*, NRA-ILA (Nov. 12, 2014), <https://www.nraila.org/gun-laws/state-gun-laws/pennsylvania/>.

¹⁰⁹ Weingarten, *supra* note 104.

¹¹⁰ *See* Aubrey Bloomfield, *3D Printed Guns: Some States are Already Moving to Ban Them*, POLICY.MIC (May 10, 2013), <https://mic.com/articles/40863/3d-printed-guns-some-states-are-already-moving-to-ban-them#.h4potD7GT> (The states reported to be attempting to create legislation aimed at 3-D printed guns are California, New York, and Washington, D.C.).

¹¹¹ Michael Byrne, *California Passed a Law Requiring Registration of 3D-Printed Guns*, VICE MOTHERBOARD (July 25, 2016, 9:47 AM), <http://motherboard.vice.com/read/california-passes-law-requiring-registration-of-homemade-guns>.

¹¹² *Id.*

¹¹³ Byrne, *supra* note 111.

unfinished receiver or print their own 3-D firearm in hopes of avoiding the screening process and carrying a “ghost gun” are unable to legally do so.¹¹⁴

Another important aspect of the California law, the sale or transfer of self-assembled or manufactured weapons, is also prohibited.¹¹⁵ One possible explanation for the transfer/sale prohibition is operator safety.¹¹⁶ Homemade weapons may be crudely constructed and a danger to not only their manufacturers in the course of production, but also their operators.¹¹⁷ Although strictly criticized by the NRA and other pro-gun organizations,¹¹⁸ California’s new legislation may represent a plausible change to gun laws that may be acceptable to both parties moving forward.¹¹⁹

New Jersey, on the other hand, is considering enacting legislation that is more specific than California’s.¹²⁰ The Garden State is eyeing legislation that would specifically outlaw guns, receivers, and magazines that are manufactured using 3-D printing technology or additive manufacturing and are undetectable by metal detectors or x-ray machines commonly used in airports.¹²¹ Unlike California’s law, New Jersey’s proposed bill does not allow for the manufacturing of noncompliant 3-D printed firearms, regardless of licensing status.¹²² Additionally, if this bill is enacted, merely possessing a 3-D printed gun would qualify as a second-degree felony punishable by a fine of up to \$150,000, a prison sentence of five to ten years, or both.¹²³ Combated with an increase in accessibility to firearms on the horizon, New Jersey is following in the footsteps of Philadelphia¹²⁴ and California¹²⁵ and has greatly raised the metaphorical stakes for noncompliance.

¹¹⁴ *Id.*

¹¹⁵ *Id.*

¹¹⁶ *Id.*

¹¹⁷ *Id.*

¹¹⁸ Byrne, *supra* note 111.

¹¹⁹ Katie Armstrong, *California Passes New 3D Printed Gun Laws*, 3D PRINTING INDUSTRY (July 27, 2016), <https://3dprintingindustry.com/news/california-passes-new-3d-printed-gun-laws-90177/>.

¹²⁰ Eyrageon Eidam, *7 Tech Policy Issues to Watch in 2016*, GOVERNMENT TECHNOLOGY (Feb. 3, 2016), <http://www.govtech.com/state/7-Tech-Policy-Issues-to-Watch-in-2016.html>.

¹²¹ *Id.*

¹²² *Id.*

¹²³ Eidam, *supra* note 120; *see* S.B. 363, 217th Leg., 2016 Sess. (N.J. 2016).

¹²⁴ *See, e.g.*, Miller, *supra* note 99.

¹²⁵ *See, e.g.*, Byrne, *supra* note 111.

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However, New Jersey, a state known for its harsh stance on gun control,¹²⁶ has a plausible reason to place a prohibition on 3-D printed guns.¹²⁷ Even though New Jersey lacks reciprocity with Pennsylvania and other surrounding states for certain gun privileges, such as licenses to carry concealed firearms,¹²⁸ the majority of guns used in connection to crimes committed within the state of New Jersey are brought in from other states.¹²⁹ In fact, it is estimated that as many as two-thirds of these guns are traced back to out-of-state purchases.¹³⁰ Traditionally, these trafficked guns came from southern states, where gun laws are generally more lax.¹³¹ Yet, in recent years, New Jersey has seen an increasing number of guns being trafficked from its neighbor, Pennsylvania.¹³²

IV. PENNSYLVANIA'S NEED FOR NEW LEGISLATION

The Commonwealth of Pennsylvania's gun laws are much less restrictive than those of other states around the country.¹³³ In fact, Pennsylvania, along with 30 other states, allows the open carrying of a firearm in public without a permit.¹³⁴ This freedom is only restricted within the City of Philadelphia, where individuals are required to obtain a permit to engage in open or concealed carry of a firearm, a provision not enacted by local officials but written into the Pennsylvania statute

¹²⁶ Jacqueline L. Urgo, *Christie Pardons Woman Arrested Under Gun Law*, PHILLY.COM (Apr. 3, 2015, 11:59 PM), http://www.philly.com/philly/news/new_jersey/20150403_Christie_pardons_Philadelphia_mom_snagged_by_N_J_gun_law.html.

¹²⁷ Gregor Aisch & Josh Keller, *How Gun Traffickers Get Around State Guns Laws*, N.Y. TIMES (Nov. 3, 2015), http://www.nytimes.com/interactive/2015/11/12/us/gun-traffickers-smuggling-state-gun-laws.html?_r=0.

¹²⁸ Urgo, *supra* note 126.

¹²⁹ Aisch, *supra* note 127.

¹³⁰ *Id.*

¹³¹ *Id.*

¹³² *Id.*

¹³³ *Open Carrying*, LAW CENTER TO PREVENT GUN VIOLENCE, <http://smartgunlaws.org/gun-laws/policy-areas/firearms-in-public-places/open-carrying/> (last visited Jan. 13, 2017).

¹³⁴ *Id.* (The only exception to this is the City of Philadelphia, where the open carrying of a firearm is prohibited unless the individual is licensed.).

itself.¹³⁵ With already conflicting gun laws,¹³⁶ New Jersey's proposed legislation¹³⁷ should at least hint to the Pennsylvania legislature that a change may be in order.

Currently, Pennsylvania does not have legislation in place banning the possession or manufacture of self-assembled guns.¹³⁸ This includes those made by a 3-D printer or any other additive manufacturing, save for Philadelphia's preempted attempt in 2013.¹³⁹ Notwithstanding the increasing availability of 3-D printed guns, Pennsylvania has seen its traditional gun sales nearly double in the last decade.¹⁴⁰ In fact, Pennsylvania saw a record number of the required background checks in 2016 with roughly 1.14 million,¹⁴¹ indicating that more citizens are legally obtaining firearms. However, 3-D printing provides an opportunity to evade the background check process, and with the recent boom in 3-D printing technologies and the plummeting prices associated with 3-D printing, it is possible that more guns are in circulation than ever before.¹⁴²

Although enacting legislation similar to California or New Jersey may sound appealing to some, legislation like this brings with it its own unique set of advantages and disadvantages.¹⁴³ Because enforcement of a prohibition against a good created in the home is difficult, if not impossible,¹⁴⁴ increased regulation and penalties would ideally serve as a deterrent for home users. This would prevent home users from developing their own 3-D printed weapons. In the case of the proposed New Jersey law where the penalties for noncompliance reach \$150,000 and up to ten years in

¹³⁵ 18 PA. CONS. STAT. ANN. § 6108 (2014).

¹³⁶ LAW CENTER TO PREVENT GUN VIOLENCE, *supra* note 133.

¹³⁷ See S.B. 363, 217th Leg., 2016 Sess. (N.J. 2016).

¹³⁸ NRA-ILA, *supra* note 108.

¹³⁹ Miller, *supra* note 99.

¹⁴⁰ Jared Whalen, *By the Numbers: Gun Sales and Licenses in Pa.*, PHILADELPHIA INQUIRER, http://www.philly.com/philly/news/Gun_Sales_and_Licenses_in_Pa.html (last visited Jan. 13, 2017).

¹⁴¹ Kurt Bresswein, *Pennsylvania Set Record for Firearms Background Checks in 2016*, LEHIGH VALLEY LIVE (Jan. 26, 2017, 8:32 AM), http://www.lehighvalleylive.com/news/index.ssf/2017/01/pennsylvania_set_record_for_fi.html.

¹⁴² Bresswein, *supra* note 141.

¹⁴³ Gilger-VanderZanden I, *supra* note 11.

¹⁴⁴ Ryan Whitwam, *US State Department Begins the Nearly Impossible Task of Banning 3D Printed Guns Online*, EXTREME TECH (July 8, 2015, 9:30 AM), <https://www.extremetech.com/extreme/209461-us-state-department-begins-the-nearly-impossible-task-of-banning-3d-printed-guns-online>.

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prison,¹⁴⁵ it is unlikely that people would jeopardize their freedom and their reputation by knowingly printing a prohibited 3-D firearm.¹⁴⁶

Secondly, legislation, such as those enacted in California and proposed in New Jersey, may at least halt the growth of “ghost guns” by silencing them at their source.¹⁴⁷ Prohibiting the manufacture of 3-D guns, in turn, prohibits the posting of the necessary CAD files to the Internet by large companies like Defense Distributed.¹⁴⁸ By de-legitimizing these organizations and preventing their growth, their reach becomes shorter and their influence smaller.¹⁴⁹ Although CAD files for 3-D guns will likely be available on the Internet virtually forever, prohibiting their download and manufacture is a very important step in the effort to combat untraceable weapons.¹⁵⁰

Similarly, proponents of increased regulation suggest that a law that is proactive in nature is necessary to properly manage a relatively new and growing technology like 3-D printing.¹⁵¹ Philadelphia’s 2013 action banning 3-D gun production, although likely unenforceable under Pennsylvania law,¹⁵² brought attention to an issue on the horizon.¹⁵³ As the market for at-home 3-D printers rises and their costs fall, consumers need to be made aware of the potential for misuse and abuse that may come. State-wide legislation may do just that.

While the advantages of increased regulation are numerous, there are also significant disadvantages that need to be weighed.¹⁵⁴ One of the primary arguments against the regulation of 3-D printed guns is the effect that such legislation would have on the intellectual property aspect of the 3-D printing industry as a whole.¹⁵⁵ As a new and emerging technology, 3-D printing relies on individuals to push the boundaries of the current methods and innovate new capabilities.¹⁵⁶ However,

¹⁴⁵ See S.B. 363, 217th Leg., 2016 Sess. (N.J. 2016).

¹⁴⁶ Alex Yablon, *Mandatory Minimums: Can Tougher Sentences Curb Gun Violence*, THE TRACE (Aug. 5, 2015), <https://www.thetrace.org/2015/08/mandatory-minimum-gun-violence-policy/>.

¹⁴⁷ Whitwam, *supra* note 144.

¹⁴⁸ *Id.*

¹⁴⁹ *Id.*

¹⁵⁰ Whitwam, *supra* note 144.

¹⁵¹ Gilger-VanderZanden I, *supra* note 11.

¹⁵² See 18 PA.CON.S.TAT. § 6120 (2014).

¹⁵³ See, e.g., Miller, *supra* note 99.

¹⁵⁴ See Gilger-VanderZanden I, *supra* note 11.

¹⁵⁵ *Id.*

¹⁵⁶ Gilger-VanderZanden I, *supra* note 11.

restricting or outright prohibiting the development of 3-D printed guns may prevent the innovative drive that the 3-D printing industry flourishes off.¹⁵⁷ For instance, technologies developed to manufacture a 3-D printed weapon may ultimately be critical to the development of a technology such as bioprinting, the printing of human parts for medical purposes.¹⁵⁸

Additionally, and maybe equally as persuasive, those against increased restriction on 3-D printed guns argue that such legislation would infringe on all individuals' constitutionally-given right to possess firearms for personal use.¹⁵⁹ The Second Amendment has been a hotly contested issue for decades and probably will remain the center of the gun control debate for some time.¹⁶⁰

Finally, those in opposition of increased 3-D printing regulation argue that enforcement is not practical, maybe even impossible, without fundamental changes to how technology works.¹⁶¹ Because CAD files are downloaded from the Internet, they are freely exchanged, similar to illegally downloaded music.¹⁶² Even with the government's best efforts, there are parts of the Internet that are not controlled and can harbor illegal files.¹⁶³ Regardless of where the files are obtained, it would be a massive task for law enforcement to police individuals for compliance.¹⁶⁴ A 3-D printed gun could potentially be manufactured, used, and immediately melted, never to be seen again by law enforcement or consumers.¹⁶⁵ Taken together, these two points make it virtually impossible for law enforcement to prevent the manufacture of 3-D printed guns and trace any of those already produced.¹⁶⁶

In spite of this limitation, there may be a way manufacturers of 3-D printers could solve this issue and minimize any illegal conduct facilitated by their

¹⁵⁷ Gilger-VanderZanden II, *supra* note 14.

¹⁵⁸ *Id.*

¹⁵⁹ PROCON.ORG, *supra* note 6.

¹⁶⁰ *See generally id.*

¹⁶¹ Whitwam, *supra* note 144.

¹⁶² *See generally id.*

¹⁶³ *Id.*

¹⁶⁴ *Id.*

¹⁶⁵ J.D. Truccille, *With 3D-Printed Guns Beyond Control, DIY Nukes Are the Chic New Concern*, REASON.COM (Oct. 6, 2015), <http://reason.com/archives/2015/10/06/with-3d-printed-guns-beyond-control-diy>.

¹⁶⁶ *Id.*

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products.¹⁶⁷ Some proponents of increased regulation argue that it is possible for 3-D printers to contain a programming code that would recognize when its user is attempting to manufacture a gun or any part thereof.¹⁶⁸ Such programming would not allow the printer to print the illegal material and, if connected to the Internet, could potentially report any illegal attempts to do so directly to the authorities.¹⁶⁹

V. CONCLUSION

As an up-and-coming technology, the full potential of 3-D printing has yet to be realized, and its movement toward at-home consumers may cause problems that remain undiscovered. Paired with the inconsistencies between various state and federal laws, the continued development of 3-D printed weapons could pose a major threat to our nation's security. Left untouched, current trends could allow for the issue of untraceable weapons to spiral out of control and beyond repair. 3-D printing is undoubtedly one of the world's most revolutionary technologies, but it could become one of the world's most dangerous if left without limits.

¹⁶⁷ Whitwam, *supra* note 144.

¹⁶⁸ *Id.*

¹⁶⁹ Ryan Whitwam, *How DRM Will Infest the 3D Printing Revolution*, EXTREME TECH (Oct. 16, 2012, 7:42 AM), <https://www.extremetech.com/extreme/137955-how-drm-will-infest-the-3d-printing-revolution>.