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Candidate session number

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School name

Examination session (May or November)

May 2015

Year

2015

Diploma Programme subject in which this extended essay is registered:

ITGS

(For an extended essay in the area of languages, state the language and whether it is group 1 or group 2.)

Title of the extended essay:

To what extent does the 3D printing of
firearms pose a risk on the security of our society?

Candidate's declaration

This declaration must be signed by the candidate; otherwise a mark of zero will be issued.

The extended essay I am submitting is my own work (apart from guidance allowed by the International Baccalaureate).

I have acknowledged each use of the words, graphics or ideas of another person, whether written, oral or visual.

I am aware that the word limit for all extended essays is 4000 words and that examiners are not required to read beyond this limit.

This is the final version of my extended essay.

Candidate's signature: _

Date:

February 27

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Name of supervisor (CAPITAL letters) _____

Please comment, as appropriate, on the candidate's performance, the context in which the candidate undertook the research for the extended essay, any difficulties encountered and how these were overcome (see page 13 of the extended essay guide). The concluding interview (viva voce) may provide useful information. These comments can help the examiner award a level for criterion K (holistic judgment). Do not comment on any adverse personal circumstances that may have affected the candidate. If the amount of time spent with the candidate was zero, you must explain this, in particular how it was then possible to authenticate the essay as the candidate's own work. You may attach an additional sheet if there is insufficient space here.

worked very hard on the creation of his extended essay. He analyzed a unique and fascinating topic and the societal issues around it. He made good use of his research to support his arguments.

This declaration must be signed by the supervisor; otherwise a mark of zero will be issued.

I have read the final version of the extended essay that will be submitted to the examiner.

To the best of my knowledge, the extended essay is the authentic work of the candidate.

As per the section entitled "Responsibilities of the Supervisor" in the EE guide, the recommended number of hours spent with candidates is between 3 and 5 hours. Schools will be contacted when the number of hours is left blank, or where 0 hours are stated and there lacks an explanation. Schools will also be contacted in the event that number of hours spent is significantly excessive compared to the recommendation.

I spent 2 hours with the candidate discussing the progress of the extended essay.

Supervisor's signature: _____

Date: March 11/15

Assessment form (for examiner use only)

Candidate session number		
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Criteria	Achievement level					
	Examiner 1	maximum	Examiner 2	maximum	Examiner 3	
A research question	<input type="text" value="2"/>	2	<input type="text"/>	2	<input type="text"/>	
B introduction	<input type="text" value="2"/>	2	<input type="text"/>	2	<input type="text"/>	
C investigation	<input type="text" value="4"/>	4	<input type="text"/>	4	<input type="text"/>	
D knowledge and understanding	<input type="text" value="4"/>	4	<input type="text"/>	4	<input type="text"/>	
E reasoned argument	<input type="text" value="4"/>	4	<input type="text"/>	4	<input type="text"/>	
F analysis and evaluation	<input type="text" value="3"/>	4	<input type="text"/>	4	<input type="text"/>	
G use of subject language	<input type="text" value="3"/>	4	<input type="text"/>	4	<input type="text"/>	
H conclusion	<input type="text" value="2"/>	2	<input type="text"/>	2	<input type="text"/>	
I formal presentation	<input type="text" value="4"/>	4	<input type="text"/>	4	<input type="text"/>	
J abstract	<input type="text" value="2"/>	2	<input type="text"/>	2	<input type="text"/>	
K holistic judgment	<input type="text" value="3"/>	4	<input type="text"/>	4	<input type="text"/>	
Total out of 36		<input type="text" value="23"/>	<input type="text"/>		<input type="text"/>	

Name of examiner 1: _____ Examiner number: _____
(CAPITAL letters)

Name of examiner 2: _____ Examiner number: _____
(CAPITAL letters)

Name of examiner 3: _____ Examiner number: _____
(CAPITAL letters)

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IB Assessment Centre use only: A: _____

Extended Essay

Subject Area: ITGS

To what extent does the 3D printing of firearms pose a risk on the security of our society?

February 27, 2015

3809 Words



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Abstract

This paper deals with an investigation on the security concerns present with self-manufactured firearms by the means of 3D printing. The research question is titled “To what extent does the 3D printing of guns pose a risk on the security of our society?” The scope of this investigation is rather broad, with analysis done on a magnitude of secondary sources along and of a primary survey to provide insight on the subject. In our technology-focused society, the convenience and anonymity of personal 3D printers are aspects which result in security concerns for self-manufactured firearms. Specifically, this paper will consider the role which the Internet plays in offering accessibility of firearms blueprint (CAD) files to all users along with the anonymity that 3D printers in the home environment would possibly offer for users to build items that have the capacity to cause injury. In addition, the concept of additive manufacturing—using plastic pellets to build an object that is far more complex—results in its ability to circumvent firearm regulations that are currently present in North America. This paper will analyse the Canadian Firearms Program and the American Firearms Control Legislature under conceptual forecasts on the potential security issues involving personal 3D printers. The conclusion that was reached suggests that existing legislature is nowhere near capable of mitigating the risks imposed by the 3D printing of firearms. Further regulation by Internet surveillance or by direct regulations on the production of 3D printers themselves must be made in order to combat the advancing security risk of the 3D printing of firearms.

(260 Words)

Abstract misplaced in EE

J= 2

A. Introduction

In recent years, the usage of 3D printing in a consumerist setting has emerged in popularity, with a notable amount now found in homes, schools and workplaces. The ability for users to produce any three-dimensional object from a CAD model highlights its potential to consumers as a means of creating functioning machinery. Yet, concerns with the 3D printing of precarious items, specifically firearms is without a doubt accentuating. Companies such as Defence Distributed are dedicating themselves to distributing free, functioning CAD firearm models to the public via the Internet. This is substantially significant in this study owing to the fact that the Internet provides a medium of access to a global demographic. It is theorized that this heightened degree of access (induced by the Internet) combined with the convenience and anonymity of personalized 3D printing are the principle aspects which result in the security concerns for self-manufactured firearms.

evidence
needed

signif

This research question is relevant to our current societal situation in that it enables us to further investigate the potential issues with 3D printed firearms. Since this technology is not yet fully established, its future impact on people as well as its circumvention of modern gun restriction policies must be assessed. Although the general opinion regarding the private production of firearms through the 3D printing of CAD models is viewed to be a threat, this study will explore the extent and the validity of such matters. Hence, the social and ethical issues related to this problem will be security and policies.

worth

B= 2

B. IT System/Background

With the intent of suggesting the convenience of 3D printing firearms—this of which will be argued as one of the key factors responsible for the security concerns, a brief overview of the IT system will be necessary.

The process of 3D printing is currently known as additive manufacturing. Contrary to conventional manufacturing which cuts large material components to produce the desired object, additive manufacturing efficiently constructs objects through a layering process. The primary step is the creation of a design file for the particular object. A computer-aided design (CAD) software will be utilized to generate a detailed three-dimensional model, which will act as a blueprint for the 3D printer. The 3D printer itself is a peripheral computer device that creates tool paths from the CAD files and subsequently builds the actual object. The construction process consists of using spools of thermoplastic filaments, which are fed through the cartridge head and extruded, in thin two-dimensional layers. The layers are repeatedly placed on top of each other and are thermally-bound to form a finished object. The filament used, though usually made up of thermoplastics (such as PLA and ABS), can be changed depending on the desired structure of the object. Since the object is slowly built, millimetres at a time, 3D printers offer incredible precision when producing objects from CAD plans. In regard to firearm manufacturing, the interchangeable materials and 3D printing precision are factors that enable the production of functioning firearms.

Currently, the technology to print firearms is still in its development stage; the prototypes are deficient in all respects to its factory-made counterparts. Yet, the evaluation of potential dangers concerning the 3D-printed firearms remains chief, owing to the fact that there exists a rapid progression of R&D efforts to design a working CAD model for a fully 3D printable firearm. On May 2013, Cody Wilson—founder of Defence Distributed revealed “the Liberator”, a functioning

pistol composed of fifteen 3D printed plastic parts and a metal nail used as a firing pin.¹ The designs for the pistol were released on the internet and within a month of the release, there were details of a Wisconsin man successfully printing a working model using a \$1,725 printer and roughly \$25 of PLA plastic². Considering personal 3D printers have only appeared on the market this past decade, the rapid development of CAD designs to create operational pistols indicates the innovative potential of firearm printing in the future. *no evidence*

The production of personal 3D printers has risen drastically over the past few years, with an average growth in production of 346% annually from 2008-2012³. In addition, the value of the 3D printing industry is expected to grow to \$8.41 billion by 2020, a compound annual growth rate of 23%.⁴ These statistics underline the development of 3D printing technology as they are exponentially increasing in significance on the market. Moreover, according to analysts, the 3D printers are deviating from a "niche-industry into a more ubiquitous consumerist setting"⁵. This is evidently supported by release of personal 3D printers from major retailers such as Staples, Costco and Walmart. Consumer 3D printers are progressively developing into a feasible technology for the middle socio-economical class, with companies such as Makerbot, Cubify, Flashforge and TypeA Machines retailing units for \$300-\$4000⁶.

✓ ¹ "Meet The 'Liberator': Test-Firing The World's First Fully 3D-Printed Gun." Forbes. Forbes Magazine, n.d. Web. 23 Feb. 2015. <<http://www.forbes.com/sites/andygreenberg/2013/05/05/meet-the-liberator-test-firing-the-worlds-first-fully-3d-printed-gun/>>.

✓ ² the Liberator 3D weapons and the First Amendment pg.1396

✓ ³ "Growth of Personal Printers." TCT. N.p., n.d. Web. 23 Feb. 2015. <<http://www.tctmagazine.com/blogs/industry-snapshot/growth-of-personal-printers/>>.

✓ ⁴ "HOME › Press Releases › 3D Printing Market worth \$8.43 Billion by 2020." 3D Printing Market worth \$8.43 Billion by 2020. N.p., n.d. Web. 23 Feb. 2015. <<http://www.marketsandmarkets.com/PressReleases/3d-printing.asp>>

✓ ⁵ SSRN-id2186936

✓ ⁶ Louie, Contributor Gilman. "I 3D-Printed An AR-15 Assault Rifle - And It Shoots Great!" Business Insider. Business Insider, Inc, 04 Dec. 2013. Web. 26 Feb. 2015. <<http://www.businessinsider.com/i-3d-printed-an-ar-15-assault-rifle--and-it-shoots-great-2013-12>>.

*incomplete descrip of
IT system
no images provided
re 3D printing or of
3D printing of firearms*

C. Security Concerns of 3D Printing

This paper argues for the theory that security concerns of 3D printed firearms is attributed to the internet-facilitated access to CAD files, along with the anonymity and convenience of household 3D printing.

The Internet has produced a digital platform for the distribution of information and computerized files. In fact, a detailed packet flow analysis on the Internet2 network, conducted by the National Bureau of Economic Research determined that in the period from 2003 to 2009, file sharing traffic grew ten-fold (from roughly 1 terabyte in 2003, to nearly 10 terabytes in 2009)⁷. These statistics from Internet2, a high-speed network used by a large number of U.S universities clearly indicates the expansion of the online file-sharing library. To further emphasize this point, a similar study on global file-sharing traffic projected file sharing traffic to reach 6803 petabytes per month by the year 2018 (an increase of 11% from 2013)⁸. Within the growing online file-sharing library, CAD blueprint files for the 3D printing of firearms are ever the more numerous. There are many websites with extensive free collections of CAD files; GRABCAD for instance claims to offer “a community of 1,490,000 engineers and 520,000 CAD files”⁹.

? too
general!

However, it is imperative to understand the security concerns that arises with this extensive collection of CAD blueprint files. With over 78.6% of North Americans having some sort of internet connection¹⁰, there is an enormous accessibility that individuals have to download these design files. Since these CAD files are designed to be read by all machines (in same manner as a

⁷ Lerner, Joshua, and Scott Stern. Innovation Policy and the Economy 2009. Chicago, IL: U of Chicao, 2010. Web.

⁸ "Global Internet Traffic through File Sharing 2013-2018 | Statistic." Statista. N.p., n.d. Web. 26 Feb. 2015. <<http://www.statista.com/statistics/267182/forecast-for-global-internet-traffic-through-file-sharing/>>.

⁹ "Most Downloaded Models." - GrabCAD. N.p., n.d. Web. 26 Feb. 2015. <<http://grabcad.com/library/>>.

¹⁰ "North America Internet Usage Statistics, Population and Telecommunications Reports." North America Internet Usage Statistics, Population and Telecommunications Reports. N.p., n.d. Web. 24 Feb. 2015. <<http://www.internetworldstats.com/stats14.htm>>.

PDF file), access to the CAD of a firearm is comparable to actually obtaining the firearm.

Broad
generaliza-
tion

Considering the market trends of 3D printers becoming increasingly ubiquitous in the household environment, the previous statement must be taken with greater caution. As a consequence, the liberal distribution of CAD files can potentially cause harm to society by giving unauthorized people access to dangerous weapons. This concern is echoed forward by the recent events, specifically the Sandy Hook Shooting¹¹ and the Aurora movie theatre shooting¹², where individuals gained illegal access of weapons, which thereby lead to the mass murder of innocent civilians. The frequency of such events, is expected to rise with the development of 3D printing technology.

not
3D
printed
weapons

speculation, no evidence

Furthermore, the Internet is an extremely dynamic resource, resulting in an uncontrollable environment for the release of such files. Upon the release of the fully printable “Liberator” CAD file, it was downloaded over 100,000 times before being “removed from public access” by The Office of Defense Trade Controls Compliance (for concerns over international weapons shipping laws). The number of downloads is utterly shocking, yet this pales in comparison to the resilience of the CAD file to survive on the Internet. Even today, despite being removed from the DefCad databases, the original “Liberator” files exist on file-sharing sites like the Pirate Bay— where users can illegally download them without restriction¹³. ✓

The circumvention of regulations that the Internet fosters elevates the security concern that people have. For instance, issues could occur if an individual was decisive about committing an act of

¹¹ <http://www.globalresearch.ca/school-shooting-expert-threatened-over-sandy-hook-investigation-was-told-if-he-didnt-back-off-bad-things-are-going-to-happen/5369574>

¹² "Gunman Turns 'Batman' Screening into Real-life 'horror Film' - CNN.com." CNN. Cable News Network, n.d. Web. 23 Feb. 2015. <<http://www.cnn.com/2012/07/20/us/colorado-theater-shooting/>>.

¹³ "Liberator - First 3D Printable Gun (download Torrent) - TPB." Liberator - First 3D Printable Gun (download Torrent) - TPB. N.p., n.d. Web. 26 Feb. 2015. <http://thepiratebay.se/torrent/8449468/Liberator_-_First_3D_Printable_Gun>.

violence; he or she could easily download the CAD files for firearms like the "Liberator" from the Internet and print the firearms using readily available 3D printing technology. Owing to the fact that personal 3D printers have progressed to a point of intuitivism similar to their 2D (inkjet) counterparts, the entire process outlined above can be achieved by the greater demographic; there is no need for a college-level education in specialized sciences to construct the pistol. Henceforth, using the self-manufactured firearms, casualties of civilians from mass shootings can potentially occur.

vague

speculation

Statistics of crime distributions and Internet usage suggest a relationship that adds a new dimension of concern to consider on the occurrence of violent acts from a specific age group. As of June 2014, the distribution of Internet users was found to be the greatest between 15 to 34 years of age, with a 53.3% proportion of total users¹⁴. Comparatively, the age distribution of American homicide perpetrators also peaks at 48.9% between the ages of 17-34 years as of 2011¹⁵. The relationship that this highlights is the accessibility of the Internet, specifically CAD files onto an already homicide-susceptible population. Considering the previously mentioned data, teens and young adults are the most active Internet users throughout age-groups.

F:
argument
based
on
analysis

For the purposes of this essay, I designed an experiment in which test subjects between the ages of 14-18 were requested to find a CAD file for a 3D printable firearm (E.g DEFCAD Liberator¹⁶). The tests were done providing the subjects solely with a basic concept of what a CAD file:

Need
more
details
on
methodology

✓ ¹⁴ "Age Distribution of Internet Users Worldwide 2014 | Statistic." Statista. N.p., n.d. Web. 26 Feb. 2015. <<http://www.statista.com/statistics/272365/age-distribution-of-internet-users-worldwide/>>.

✓ ¹⁵ FBI. FBI, 21 Sept. 2012. Web. 26 Feb. 2015. <<http://www.fbi.gov/about-us/cjis/ucr/crime-in-the-u.s/2011/crime-in-the-u.s.-2011/tables/expanded-homicide-data-table-3>>.

✓ ¹⁶ <https://archive.org/details/Liberator>

“CAD (Computer-Aided Design) files may contain 2D or 3D designs. They are generated by CAD software programs, which can be used to create models or architecture plans. 2D CAD files are often referred to as drawings, while 3D files are often called models, parts, or assemblies”¹⁷

The test subjects were given complete liberty to use computers and the Internet—web browsers, search engines, P2P sharing clients etc.—to locate and download the file. The time taken to perform this task was recorded, as shown by the data chart below.

Age	Time Taken (seconds)
15	Unsuccessful
16	210
16	193
17	129
17	338
14	420
18	170
17	166
17	153
17	243
17	124
17	91
16	Unsuccessful
17	132
16	100
16	145
17	166
17	138
Average	182.375

¹⁷ "CAD File Types." CAD File Formats. N.p., n.d. Web. 26 Feb. 2015. <<http://fileinfo.com/filetypes/cad>>.

Though this investigation is limited by the small sample size, the mean time taken of 3 minutes and 2 seconds (excluding the two unsuccessful tests) helps to emphasize the accessibility of these potentially dangerous CAD files on the internet. When performing the task, the vast majority utilized a search engine to be directed to a website server carrying the CAD file. Others creatively explored forums where they were able to locate the file from what other users posted. A select few even used P2P clients and Torrents to download the file. These methods are all possible ways that individuals in society can obtain the files needed to print a functioning plastic firearm. Furthermore, with the increase of users sharing CAD files on the internet, the accessibility will also inevitably increase in the future. As the study helped to confirm, individuals within this age-group were capable of navigating databases in which the firearm CAD files were illegally stored with much ease. Combining this aspect of the age group with its respective homicide perpetration rate, the relationship between the two comes onto into analysis. By applying the heightened violence that this age group demonstrates along with their proficiency in the Internet, one can anticipate crime rates to rise from this age group once personal 3D printing becomes established within society. It is frightening to imagine the consequences that we may face because of the dangerously powerful printed firearms that are being placed in the hands of the youth.

speculation
not enough
descrip.
of partici-
pants

only a
selected
group

Based on the theory being proposed, the subsequent factor—the convenience and anonymity of personal 3D printing is equally significant in determining the extent of potential security concerns. Purchasing and operating personal 3D printers is limitless in the sense that there are yet no regulations that govern its usage (elaborated in section D). By placing these three-dimensional printing machines in the home environment, there is anonymity that exists for the user. Compared to buying firearm parts at retail stores or through online avenues, there is much less surveillance

The focus of access seems to target teens, but
RQ has no age restrictions

and contact with others. This is particularly attractive for those with the goal of printing devices such as firearms.

With online retailers such as: Cubify, MakerBot and 3DPrintersOnlineStore offering 3D printers to consumers, the process of gaining access to one is highly favourable to the user. Since all orders are made via an inquiry on the company website and conducted through a secure payment gateway (eg: Paypal) where funds are transferred to the merchant account over the internet, it is relatively convenient for all users with internet access no matter their personal situation (criminal record, age)¹⁸. This has an effect on the security of the people, since the amount of personal 3D printed firearms will increase as a result of this convenience for individuals to purchase 3D printers. *safety*

An additional aspect to considering in terms of anonymity is the material used by personal 3D printers. The thermoplastics (ABS, PLA) currently on the market are in the form of pellets and are unexclusive to firearms. Anonymity exists because when an individual orders the thermoplastic pellets, it is ambiguous whether his intent is to construct dangerous firearms or rather to create a plastic architectural model. As contrasted to traditional means of self-manufacturing firearms, where the material supplier is likely aware of the buyer's intentions, secrecy is furthered by making this information obscure to even the supplier. Additive manufacturing, unique to 3D printers makes it difficult to define raw materials which may pose security risks as if before. If technology advances to the point where firearms may be fully built from thermoplastics, the anonymous distribution of harmlessly appearing materials bypasses current shipping regulations.¹⁹ *speculative as stated*

✓ ¹⁸ "How Does E-Commerce Work?" Getting Started. N.p., n.d. Web. 26 Feb. 2015.
<<http://www.shopsite.com/help/quickstart/ecom-intro-03.html>>.

✓ ¹⁹n. pag. Web. <<http://www.nyu.edu/mail.services/pdf/Shipping%20Hazardous%20Materials.pdf>>

D. The Circumvention of Existing Federal Firearm Regulations

This section of the paper will analyse the federal firearm regulatory schemes present in North America, specifically focusing on Canada and United States of America.

1. Canadian Firearms Program

In Canada, as per the Firearms Act, a license is required in order to “possess or borrow a firearm or to acquire, by any means, a firearm or ammunition”²⁰. Under normal circumstances, an application for the license will request for personal information, personal history, a photograph of the applicant and a reference signature to verify the applicant.²¹ The application process is done by the federal government to ensure that only verified persons can gain access to firearms, and that following a purchase of a firearm, the information can be traced back to its buyer. In addition, a registrar will be kept by the federal government of Canada to record “every licence, every registration certificate for a prohibited firearm or a restricted firearm”²². This system of minimizing security risks appears ineffective in the future with the rise of personal 3D printed firearms. Persons with criminal records, who do not satisfy the requirements when applying for a firearms license, can bypass these measures by illegally manufacturing firearms themselves using 3D printing technology. Therefore, the registrar database of firearm licenses will be unable to make records of such persons, as well as unregistered, prohibited firearms that have been illegally manufactured in the country using personal 3D printers. In the event of a violent act where these 3D printed firearms

✓ ²⁰“Common Menu Bar Links.” Firearm Owners and Users Aged 18 and Older. N.p., n.d. Web. 26 Feb. 2015. <<http://www.rcmp-grc.gc.ca/cfp-pcaf/fs-fd/owner-propretaire-eng.htm>>.

✓ ²¹ Section, Business Process Analysis, RCMP GRC 5614e (n.d.); n. pag. Web.

✓ ²² “Firearms Act (S.C. 1995, C. 39).” Legislative Services Branch. N.p., n.d. Web. 26 Feb. 2015. <<http://laws-lois.justice.gc.ca/eng/acts/F-11.6/page-25.html#h-28>>.

were used, it will be more difficult for authorities to trace those directly involved since the firearms used have never been registered with the Canadian Firearms Program.

In certain circumstances, those under the age of 18 can obtain a license to use firearms for certain activities and under section 7 of the Firearms Act, minors must “complete the Canadian Firearms Safety Course and pass the test in order to attain their licence”²³. However, with the lack of restrictions on 3D printing, minors can construct operable firearms without a license nor having complete the Canadian Firearms Safety Course. The security concerns are that these minors, who have not yet matured, may cause incidences resulting from improper usage of these firearms. The end result would be that they harm themselves and quite possibly those around them inadvertently.

2. American Firearm Control Legislation

The National Firearms Act of 1934 (NFA) imposes taxes to regulate the transfer of firearms which pose a substantial crime issue, principally machine guns and short-barrel firearms.²⁴ The Congress determined that these firearms were significant because of their frequent usage in gang crimes and shootings. Hence, a \$200 tax was issued by the Bureau of Alcohol, Tobacco, Firearms and Explosives in 1934 (and has not yet changed) to discourage the possession of these firearms.²⁵ The NFA is outdated to the rise in 3D printed firearms; since users can easily bypass the government issued taxes by discreetly producing their own firearms. It is important to note that

²³ "Common Menu Bar Links." Firearm Users Younger than 18. N.p., n.d. Web. 26 Feb. 2015. <<http://www.rcmp-grc.gc.ca/cfp-pcaf/fs-fd/minor-mineur-eng.htm>>.

²⁴ "National Firearms Act." National Firearms Act. N.p., n.d. Web. 26 Feb. 2015. <<https://www.atf.gov/content/firearms/firearms-industry/national-firearms-act>>.

²⁵ McCutcheon, Caitlyn. "DEEPER THAN A PAPER CUT: IS IT POSSIBLE TO REGULATE THREEDIMENSIONALLY PRINTED WEAPONS OR WILL FEDERAL GUN LAWS BE OBSOLETE BEFORE THE INK HAS DRIED?" 110.

the contrary to its intentions, the \$200 tax will encourage the production of plastic printed guns, due to the regard for financial viability by avoiding this cost.

The Gun Control Act of 1968 is also pertinent to the analysis on the effects of 3D printed firearms. The GCA was enacted to prohibit “importing, manufacturing, or dealing in firearms, or in the course of such business to ship, transport, or receive any firearm in interstate or foreign commerce, except by a licensed importer or licensed manufacturer”²⁶. The GCA also mandated that all newly manufactured or imported firearms be affixed with a unique serial number.²⁷ The purpose of the GCA is to prohibit the interstate transfer of firearms in an attempt to reduce the number violent acts involving guns. Nonetheless, with respect to 3D printing, the transfer of “physical” firearms is no longer the issue. With the ability to self-manufacture them, 3D printing technology circumvents the regulations that restrict the transfer of physical firearms. Rather with 3D printing, the transfer of the CAD model for the firearm is more significant. Bypassing the Gun Control Act, users are able to self-manufacture firearms using data that is transferred through the internet. Although this remains illicit, it can be done inconspicuously without detection by the government, thereby rendering the GCA useless in deterring individuals from conducting such affairs.

F

✓ ²⁶ "The Gun Control Act of 1968, Public Law 90-618." The Gun Control Act of 1968, Public Law 90-618. N.p., n.d. Web. 26 Feb. 2015. <<http://www.keepandbeararms.com/laws/gca68.htm>>.

✓ ²⁷ "THE GUN CONTROL ACT OF 1968." THE GUN CONTROL ACT OF 1968. N.p., n.d. Web. 26 Feb. 2015. <<http://jpfo.org/articles-assd02/gca68-nra4.htm>>.

E. Approaches That Can Mitigate the Security Risk Imposed by 3D Printing

While it is apparent from the analysis in Part E that many of the current firearm regulations fail to keep pace with the expanding security concerns triggered by personal 3D printers, recently, there have been mentionable efforts by the American Congress to update the legislature, as shown by the Undetectable Firearms Modernization Act. The Undetectable Firearms Modernization Act, issued in 2013, directly targets plastic firearms by:

USA or
Canada?

*"Prohibits the manufacture, importation, sale, shipment, delivery, possession, transfer, or receipt of any receiver for a rifle or handgun, or of any ammunition magazine, that: (1) is manufactured by a person who is not a licensed manufacturer; (2) is not as detectable as the Receiver Security Exemplar or the Magazine Security Exemplar by walk-through metal detectors; or (3) does not generate an image that accurately depicts the shape of a receiver or a magazine when subjected to inspection by airport x-ray machines."*²⁸

This extension of Undetectable Firearms Act of 1988 attempts to obviate the self-production of 3D printed firearms by explicitly illegalizing the matter. Below, this paper will propose other approaches which may in fact help to mitigate the risk of 3D printed firearms.

1. Regulations on Ownership of Personal 3D Printers

The regulation or prohibition of personal 3D printers is a possible method that the government may take to hinder the ability for people to be able to manufacture their own plastic firearms. Although cities such as Philadelphia have already taken measures to ban the manufacture of the

²⁸ "H.R.1474 - Undetectable Firearms Modernization Act 113th Congress (2013-2014)." H.R.1474. N.p., n.d. Web. 26 Feb. 2015. <<https://www.congress.gov/bills/113th-congress/house-bill/1474>>.

printable firearms themselves²⁹, a better approach would be not to target the firearms, but rather the instrument used to manufacture them. It would be quite possible for governments to impose license certification in order for commercial companies to operate them, while civilians will be *opinion* unable to own personal 3D printers. Unlicensed individuals would be forced to utilize public 3D printing services (i.e. proto3000), with licensed surveillance officers.³⁰ Hence, the risk of individuals manufacturing dangerous firearms will be greatly mitigated. *feasibility?*

Conversely, there are many potential cons to the regulation on personal 3D printers. It is likely that groups would voice their argument that the ban on 3D printing is unjustified, since the potential of usage for this technology extends far beyond weapons manufacturing. In fact, legislature restricting the access of 3D printers may escalate the already imminent opinion that government policies and laws hinder technological advances.³¹ Furthermore, with additive manufacturing skyrocketing in economic value over the years³² and a forecast of \$6.5 billion by 2019, implementing a regulation on 3D printers could hinder the industry long-term. *F:*

2. Software Limitations and Internet Surveillance

A notable strategy which the government can take is by forcing manufactures to limiting the functionality of 3D printers to be recognize foreign CAD files and render them incompatible to *unclear* the printer. This solution is much less intrusive than the regulating the 3D printing hardware;

²⁹ "First Ban in the Country: 3D-printed Guns Now Illegal in Philadelphia." - RT USA. N.p., n.d. Web. 26 Feb. 2015. <<http://rt.com/usa/philly-gun-ban-johnson-280/>>.

³⁰ "3D Printing Services | 3D Printing Canada, 3D Print Service, 3D Printing Company." 3D Printing Services | 3D Printing Canada, 3D Print Service, 3D Printing Company. N.p., n.d. Web. 26 Feb. 2015. <<http://proto3000.com/3d-printing-services.php>>.

³¹ "Do Government Policies and Laws Hinder Tech Advances?" TechHive. N.p., n.d. Web. 26 Feb. 2015. <http://www.techhive.com/article/230384/laws_that_harm_or_curtail_internet_use.html?page=2>.

³² "The 3-D Printing Revolution Has Begun." The Globe and Mail. N.p., n.d. Web. 26 Feb. 2015. <<http://www.theglobeandmail.com/report-on-business/small-business/sb-digital/innovation/the-3-d-printing-revolution-has-begun/article8043259>>.

companies can create an embedded system which can detect unverified CAD models. Unfortunately, this solution is not unfaultable—it is possible for users to modify the program code for the printers to bypass the security software placed by the manufacturers. Despite the flaws, this strategy to mitigate the security risks of 3D printing does seem the most feasible.

speculative

Internet Surveillance is another approach that can be considered. CAD files can be routinely monitored for security purposes and files that correspond to firearms will be taken down by the government. Interestingly, this method of dealing with CAD files is currently being done under the DCMA for copyright infringement reasons.³³ To the advantage of the government, the policing efforts of CAD files can be combined to monitor both dangerous files along with those that infringe on copyrighted content. This seems tedious and inefficient, but it can act as a temporary “plug” to discourage firearm printing for the time being.

not clearly explained

not clear

not enough detail.

³³ Post, The Morningside. "Leave 3D Printing Alone." The Huffington Post. TheHuffingtonPost.com, n.d. Web. 26 Feb. 2015. <http://www.huffingtonpost.com/the-morningside-post/leave-3d-printing-alone_b_4666660.html>.

F. Conclusion

The modern technological advancements in three-dimensional printing has broadened the freedom for users to produce usable objects from CAD models. The 3D printing of firearms is particularly troublesome with respect to the security concerns which it may induce as a result of two factors. First, the global access of CAD files through the internet causes security risks since the files are available for so many people to download and use. Second, the anonymity of using personal 3D printers heightens the security risks of possessing self-manufactured firearms.

Owing to these factors, it becomes clear that the firearm regulations currently implemented in the Canadian and American Legislature are unsatisfactory at keeping up with the new age of 3D printing. The security risks of plastic firearms are too severe to be ignored and regulations in the software of 3D printers, internet surveillance and regulations on the ownership of personal 3D printers are possible starting points to combat illegal possession of these firearms.

(3809 Words)

4 = 2

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Well researched both secondary and primary research.

Logical approach

Analysis is good - shortcoming in primary research - not well aligned to ages in R0 similarly for some sec. research

C: IT Systems demonstrated some weaknesses

Other documentation within EE