

University of Turku
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Master Thesis

**Copyright Protection in 3D Printing Technology:
Does Copyright Protect 3D Printed Creations?**

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ABBREVIATIONS

IP	Intellectual Property
IPRs	Intellectual Property Rights
BC	Berne Convention
3DP	Three-Dimensional Printing
CC	Creative Commons
AM	Additive Manufacturing
CAD	Computer Aided Design
ECJ	European Court of Justice
STL	Stereo Lithography
WCT	WIPO Copyright Treaty
RCD	Registered Community Design
UDR	Unregistered Design Right
GUI	Graphic User Interface
FDM	Fused Deposition Modeling
InfoSoc	Information Society Directive
CDPA	Copyright, Designs and Patents Act
DMCA	Digital Millennium Copyright Act
TRIPS	Agreement on Trade Related Aspects of Intellectual Property
EUIPO	European Union Intellectual Property Office
U.S.	United States (of the America)

Introduction

The industrialized society of the current digital era is firmly influenced by the advancement of science. Since the beginning of civilization, the manufactured goods to serve communities for their daily need have played a significant role behind the creation of new social constructs. Certainly, mass-production and automation has liberated a great part of the population which consequently created a knowledge-based society and built the foundation of the welfare society. In respect to the production of products for the consumer in our societies, manufacturers are continuously pursuing new advanced methods for mass- production which can reduce the marginal costs, easy process and cheap labor. Considering these aspects of production, 3D printing technology can definitely satisfy modern manufactures to meet the escalating demand of consumers all around the globe.

Revolutionary technology like 3D-printing, also known as additive manufacturing, has provided an advanced platform to modern manufacturers to create exclusive complex designs, rapid prototypes, and parts of products in imaginative and distinctive ways. Consumers can easily get their desired product from the manufacturers as such exclusive products or spare parts can be manufactured without the need to build-up inventories and any additional cost by using this advanced technology. In 2015, the 3DP industry was calculated as USD 5.2 billion and by 2023, the market is expected to worth over USD 32 billion.¹ Micahel Weinber has rightly said that, “Just as computers have allowed is to become makers of movies, writers of articles, and creators of music, 3D printers will allow everyone to become creators of things”.²

Since the 3DP technology has emerged, reasonable expectation by manufacturer are that such technology will create a meaningful impact in regard to product manufacture and other activities related to it. There will be mass production by manufacturers to supply in the market for consumers., even though at present this particular technology is better for making modified objects rather than mass-produced, generic products. Nevertheless, it is expected to be an industry of billions of dollars, but it is still uncertain how this technology will develop and resulting impact after it is merged with our daily life.³ At this very moment, to meet the consumer demand in the market by the manufacturers

¹ Salgarkar, Optical Measurement Market Worth 5,14 Billion USD by 2023, Cision PR Newswire, <www.prnewswire.com/in/newsreleases >, last accessed May 24, 2019.

² Weinberg, M. (2013). What’s the Deal with Copyright and 3D Printing? *White paper from Public Knowledge’s Institute for Emerging Innovation*, page 1.

³ TJ McCue, *Significant 3D Printing Forecase Surges To \$35.6 Billion*, Forbes, <www.forbes.com/sites/tjmccue/2019/03/27/wohlers-report-2019-forecasts-35-6-billion-in-3d-printing-industry-growth-by-2024/#17390b267d8a> Last accessed May 24, 2019.

in 3D printing business, it can be perceived that manufactures may re-create products or spare parts with 3D-printer which may infringe copyright of the original creator of that particular product. In recent years, the extraordinary growth of the 3DP industry has created such complex situations and many questions in the area of intellectual property law. This thesis offers a detailed discussion regarding such implications in copyright context as it is considered to be one of the most important fields of intellectual property law.

Even though this particular topic regarding 3DP is extraordinarily new, it is one of the most discussed topics of revolutionary advancement of science which intrigued me to choose for master thesis. The methodology of qualitative research has been adopted for issues to be discussed in depth and detail as methods, results and conclusions of this research technique are context-dependent. The overall aim of this thesis is to critically focus on copyright issues and discuss such issues judiciously in the light of legislations, cases and law journals. These discourses may emerge from the use of 3DP technology as this technology is predicted by many to change the game in manufacturing industry and signified the technology as the harbinger of the “third industrial revolution”.⁴ Research will show that the 3DP technology can be expected to become a disruptive technology which may create sweeping implications for intellectual property (IP) owners, retailers, producers, and others.

The questions for this thesis are,

- a) Does copyright protect 3D printed creations? If yes, whether existing copyright regime is strong enough to deal with implications from 3DP technology? (discussion is mostly based on the U.S. law perspective)
- b) If no, what areas of IP law could be improved to implement strong regulatory framework for 3D printing technology?

Even though European copyright law provides a well-constructed framework for copyright protection and enforcement, in the context of 3D-printed objects, there are some potential unclear scopes which raise further copyright challenges that may raise concerns for content owners, online platform operators, and consumers in the industry.⁵ According to the Copyright law of the United States, *“copyright is granted as an unregistered and exclusive right given to creators of any original creative work which is fixed in a tangible medium including works that are written, drawn or designed even*

⁴ Ian Whadcock, “A third industrial revolution”, The Economist <www.economist.com/node/21551901> last accessed 20th May 2019.

⁵ Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, 3D Printing, Intellectual Property and Innovation, Insights from Law and Technology, Page 65. (2017)

though it does not protect the idea that it expresses".⁶ The country's legislation to advance the development of science and innovation can determine jurisdiction concerning copyright law. Nevertheless, universally the Berne Convention for the Protection of Literary and Artistic Works (Berne Convention) is accepted as international agreement governing copyright which proposes minimum standards of copyright protection that must be provided to creators.⁷ Art 2(1) of the Berne Convention states clearly that the copyright must be available for "*literary and artistic works*" and this also includes creative musical and dramatic works and additionally, 2D and 3D artistic works. Taking this definition into consideration strongly, the upcoming impact of 3D printing will certainly create challenges to this area of intellectual property law.

To serve the main purpose of this thesis, this paper will focus with an analytical view of the legal IP issues regarding 3DP industry along with a good evaluation of the potential infringements of intellectual property rights. To make this thesis as a part of the latest addition of 3DP technology research, recent case laws, legal journals, relative peer-reviewed scholarly articles from journals and online media coverage have been also considered.

This thesis proceeds as follows; first chapter provides a brief discussion on the overview of 3DP technology including the advancement of industries which have adapted this particular technique of producing objects. It also provides current perspectives on the 3DP innovation as it could become a disruptive innovation in global commerce and create massive impact on supply chain.

Chapter two focuses on the upcoming potential implications of 3DP on intellectual property and provides an overview of the IP law system including IP rights for 3D printers and scanner users in the context of 3DP industry. Considering the advancement of 3DP and its early stage in the mainstream society, legal and regulatory measures may not be enough to provide exclusive protection for inventive and creative efforts of individuals in the field this technology.⁸

The purpose of the third chapter with different sections is to provide an overview of Copyright law system in the context of 3DP technology from the U.S. and European perspective dealing with concerns for user's protection in the global market for 3DP. The growth of 3DP will raise questions that may challenge the copyright law to maintain a balance in terms of providing protection for

⁶ Copyright Law of the United States (Title 17), Chapter 1: Subject Matter and Scope of Copyright.

⁷ Article 2(1) of the Berne Convention for the Protection of Literary and Artistic Works (Paris Text 1971)

⁸ Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5, Page 63.

rightsholders. In addition, this chapter will also recognize exclusive rights of copyright holders and discuss most pressing matters regarding copyrightability of ‘work’ created by original authors including the concept of ‘originality’ related to the concept of ‘work’.⁹

The final chapter will discuss the copyrightability of Computer – Aided – Design (CAD) file which is considered to be one of the most significant elements and the core of 3DP.¹⁰ A CAD file can be considered as a digital representation of a physical item that consists of the exclusive information regarding its technical information, size, color, shape, dimensions or any other mechanical information that might be required to print out a physical object with a 3D printer.¹¹ In addition, this chapter will explore the legal nature of CAD file and IP related issues in the context of copyright law.

The outcome of this thesis will discover the effectiveness of the copyright framework established mainly in the USA and EU to protect the rights of copyright owners. The industry, without any doubt, is developing in a way which will require an update of the framework by legislators and existing regulations. Therefore, I strongly believe such examination of current rules and regulations will be really beneficial to understand the practical scenario of copyright law in the context of 3DP technology.

Chapter 1: Overview of 3D Printing Technology

1.1 What is 3D Printing technology?

In simple words, 3D printing technology is an additive technique which is a process of creating an object of three-dimensional from a digital model with the use of various raw materials.¹² This technology has been signified to as “additive manufacturing” since it has an “additive” process which includes constructing 2D shapes materials upon each other into 3D objects. A user of 3D printer can create a three-dimensional solid object of any shape by operating a 3D printer using a digital design. Creating a three-dimensional object requires a design model / blueprint saved on a digital file, scanning file of the original object to be used as a model or a file known as Computer-Aided-Design

⁹ Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5, Page 66.

¹⁰ Ballardini R.M., Lindman J. & Flores Ituarte I., “Co-creation, commercialization and intellectual property – challenges with 3D printing”, in European Journal of Law and Technology, Vol 7, No 3, 2016.

¹¹ Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5, Page 259.

¹² Tabrez Y. Ebrahim, 3D Printing: Digital Infringement & Digital Regulation, Page 41, 14 Nw.J. TECH. &INTELL. PROP.37. (2016). <www.scholarlycommons.law.northwestern.edu/njtip/vol14/iss1/2> last accessed 2 August 2019.

(CAD) which consists of written code to create that specific three-dimensional object. CAD files can be created by users, simply by designing from scratch or scanning a model object which can also be edited and shared with others on the internet.

Upon the completion of creating a CAD file on a computer, users or manufacturers can upload the file into 3D printer software where specifications of printing objects can be set according to the preference of the user including the speed and size of the print, type of the material and color.¹³ The ultimate usage of CAD file is to print 3D objects by slicing the digital article into more than thousands of 2D layers which are in electronic form.¹⁴ The modified electronic file is uploaded by the user into a 3D printer which is able to read decomposed those sliced 2D layers. After uploading the whole file into the 3D printer, objects are sequentially created layer by layer.¹⁵ The layers are blended in such a way that there cannot be any trace of those sliced 3D layers. It can be said that; printers of 3D objects are similar to consumer inkjet printers. The main difference is basically instead of putting a single layer of printed ink, 3D printers use preferred material of users to successively add layers to create the physical object. One of the most advantages of using 3D printer is that the printer can process various type of materials including bio-absorbable materials, resins, polymers, nanomaterials, and even human cells.

Since 3DP technology has been adopted by manufacturers, production of products for consumers have become convenient, speed of the production process has increased significantly and the price is cheaper than the products produced with conventional manufacturing technique.¹⁶ What is noteworthy is that this technology is definitely empowering users to make prototypes in a cost-effective manner and will also enable 3D printer users to create their desired objects of any shape at home when 3D printers will be available at home. Furthermore, modification and production of objects will be convenient for users based on their preferences of colors or styles. It is just a matter of time that consumer can create their own design, replicate and electronically customize scanned objects prior to printing an object or many copies of the same object at the same time whenever they desire.

¹³ Tabrez, *supra* note 12, Page 41.

¹⁴ *Ibid.*

¹⁵ Markforged, *3D Printing Process*, <<https://markforged.com/learn/3d-printing-process/>> last accessed 6 August 2019.

¹⁶ Ben Redwood, *The Advantages of 3D Printing*, <<https://www.3dhubs.com/knowledge-base/advantages-3d-printing>> last accessed 6 August 2019.

The advent of 3DP technology is influencing general public throughout the years and consequently reaching a widespread distribution among them. In addition, people are being more interested since interested people in this technology can easily access to online platforms which allow individuals to upload, modify, and download CAD files which is required for printing 3D objects.¹⁷ For instance, websites like GrabCad¹⁸, Onshape¹⁹, Thingiverse²⁰, Bricsys CAD (BricsCAD)²¹, Cult3D²², Pinshape²³, and Sculpteo²⁴ are one of top providers of CAD files to users to print 3D objects. Consequently, increasing accessibility on websites for designs to print or replicate objects as desired by consumers has prompted disruption of conventional manufacturing process and business based on rapid prototyping of complicated figures and materials.²⁵ The stance of Pirate Bay can be taken into consideration to prove this point as to encourage users of 3D printer users a new category of “Physibles” has been launched. According to the blog post of the Pirate Bay, “We believe that the next step in copying will be made from digital form into physical form. It will be physical objects. Or as we decided to call them: Physibles”.²⁶ So it can be impliedly said that practical scenario in terms of manufacturing or printing objects at home will be as easy as we print our lecture notes from printers at home.

In the late 1970s, 3D printing technology has been considered by manufacturer as a great technique of manufacturing technology even though this technology was not commercialized or widely diffused. In the mid-1980s, 3D printing technology has been used in various fields to advance the results including architecture, biotechnology, construction, fashion, food, footwear and industrial design. Manufactured objects are being used on daily basis all around the world by children to adults, for example shoes, toys, Lego pieces, lock and key, tea pot, phone cover and wallet, 3D printed carbon fiber bike frame etc. These 3D printed objects cost less than €100, and the ecosystem of this technology has extraordinarily extended up to the point where it is anticipated to build an industry of

¹⁷ Tabrez, *supra* note 12, page 41.

¹⁸ GrabCAD: Design Community, CAD Library, 3D Printing Software, <www.grabcad.com> last accessed 20 May 2019.

¹⁹ Onshape Product Design Platform, <www.onshape.com> last accessed 20 May 2019.

²⁰ Thingiverse – Digital Designs for Physical Objects, <www.thingiverse.com> Last accessed 20 May 2019.

²¹ BricsCAD: 2D & 3D CAD software with industry leading support – Bricsys <www.bricsys.com/en-intl/> last accessed 20 May 2019.

²² Cults: Download for free 3D models for 3D printers, <www.cults3d.com> last accessed 20 May 2019.

²³ Pinshape: Free 3D Printable Files and Designs, <www.pinshape.com> last accessed 20 May 2019.

²⁴ Sculpteo, Online 3D Printing Service for your 3D design, <www.sculpteo.com/en/> last accessed 20 May 2019.

²⁵ Tabrez Y. Ebrahim, 3D Printing: Digital Infringement & Digital Regulation, Page 42, 14 Nw.J. TECH. &INTELL. PROP.37. (2016)

²⁶ Sean Ludwig, The Pirate Bay launches crazy Physibles Category for printing 3D objects, 24th January 2012. <www.venturebeat.com/2012/01/24/pirate-bay-physibles-category-3d-printers/> last accessed 15th May 2019.

23 billion U.S. dollars by 2022.²⁷ It won't take long for us to have the 3D printer as just another home appliance and consequently, manufactured products which we buy from stores will not be required to be produced in bulk by manufacturers. The widespread use of 3D printing innovation will definitely advance the economic and environmental advantages compare to conventional methods of manufacturing and distributing goods, but there will also be concerns that such use of this technology could be fully constrained by the operation of intellectual property law.

However, individual with the special knowledge of intellectual property law or a lawyer specialized in copyright and trademark law can easily perceive that using 3D printer to create objects, or 2D printer to print birthday cards, may lead to infringe a number of IPRs, considering the source and the nature of the design model which is used to create the final object. In addition, if we can use 3D printer to create a toy of a well-known cartoon character or print a gift card with that cartoon character, the resulting toy or the card may even infringe the right of copyright holders.

Now the questions, which ought to be viewed in this paper, are basically whether it would be an infringement of copyright if any individual used a printer to make a mobile phone cover which has the picture of the cartoon character? Or producing distinctively styled wall artwork for bedroom? What if any one used 3D printer to make a tea pot as a gift with their favorite cartoon character? Would these actions lead to infringe IP rights? Nevertheless, this paper will have more discussion about the history of manufacturing and the beginning of the implementation of 3D printing technology as primary manufacturing idea. Furthermore, more discussion will be followed regarding intellectual property implications of the use of 3D printer for personal use with specific reference to copyright, as copyright may be related to every product or design that are being used to create an object or the replica of the unique original product.

1.2 3DP in Global Commerce, a Disruptive Technology?

1.2.1 Advancement of 3DP industry

3DP industry is growing rapidly as according to Wohlers report considering last three years a Compound Annual Growth Rate (CAGR) of 33.8% has been noted.²⁸ In 2015, the industry of AM

²⁷ Marianne Daquila, Michael Shirer, IDC Forecasts Worldwide Spending on 3D Printing to Reach 23 Billion Dollars in 2022, IC Media Center, 3rd August 2018, <www.idc.com/getdoc.jsp> last accessed 1st May 2019.

²⁸ Vincent Bonneau & Hao Yi, *The Disruptive Nature of 3D Printing, Digital Transformation Monitor*. January 2017. <www.ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files> last accessed 23 April 2019.

products and services reached to approximately 4.8 billion EUR with a CAGR of 25%.²⁹ Traditionally, prior to industrial revolution making products or goods by hand was the only way to manufacture and supply to market for consumers. “Revolution” always denotes rapid and radical change.³⁰ Throughout the history revolutions have occurred when we have adopted new technologies which has created a huge impact on economic systems and social structures. 3DP technology is considered to be a revolution which will be fundamentally transform our lifestyle, change the way we live and work. Therefore, to deal with upcoming possible challenges in the scenario of post-transformation of humankind, it is important and intense to understand how this revolution is going to shape our society.

Nowadays, even though this technology has not been adopted by mainstream yet, still a profound shift across industries regarding manufacturing can be observed as for instance, 3D printing technology is being used by Nasa to help in creating individual molds used in applying thermal protection.³¹ BMW has considered this innovation very seriously, focusing on automotive concepts on a large scale and announced 10 million Euros investment into a new Additive Manufacturing campus while Mercedes-Benz is allowing consumers to manufacture spare parts for freight trucks with the use of 3D printer.³² Giant industry like Siemens has been building modified train parts in small-parts and following this development as an example, Deutsche Bahn, the German national railroad has decided to manufacture modified train parts.³³

Even though this technology is expensive, despite their high costs manufacturing companies have adopted these 3D printers. For instance, in late 80s, 1990s, and early 2000s, 3DP technology advanced within the boundaries of the R&D departments of a small oligopoly of firms (e.g., Stratasys, zCorp, 3D systems and Object Geometrics) which ended up changing the total game of resolution, color complexion, and time management for printing. The cost of those 3D printers which are being used for production is around €300,000 and a normal mid-range printing machine might cost €40,000.³⁴

²⁹ Vincent Bonneau & Hao Yi, *supra* note 28.

³⁰ Klaus Schwab, *The Fourth Industrial Revolution*, World Economic Forum, <www.weforum.org> last accessed 28 April 2019.

³¹ Jack Coylar, *3D PRINTED MOLDS ARE HELPING NASA TO INSULATE ITS NEWEST DEEP SPACE ROCKET*, (April 2019) 3D Printing Industry, <www.3dprintingindustry.com/news/3d-printed-molds-are-helping-nasa-to-insulate-its-newest-deep-space-rocket-153780/> last accessed 28 April 2019.

³² Clare Scott, *BMW Group Invests in New Additive Manufacturing Campus*, (April 16, 2018), 3DPRINT.COM, <www.3dprint.com/210294/bmw-am-campus/> last accessed 28 April 2019.

³³ Larry Dignan, *Siemens Mobility's rail service center bets on 3D printing*, (September 19, 2018), ZDNet, <www.zdnet.com/article/siemens-mobilitys-rail-service-center-bets-on-3d-printing/> last accessed 28 April 2019.

³⁴ Simon Bradshaw, Adrian Bowyer and Patrick Haufe, *The Intellectual Property Implications of Low-Cost 3D Printing*, Volume 7, Issue 1, April 2010.

In 2004, Adrian Bowyer, a professor in the UK considered has worked on an open-source 3D printer project known as the RepRap considering 3DP as versatile technology which is a self-replicating rapid prototype. RepRap is short for Replicating Rapid-prototyper.³⁵ The process of fused-filament fabrication (FFF) has been adopted for printing various 3D objects and interestingly, this 3D printer could also be used to replicate significant fraction of its own parts.³⁶ After some years of RepRap launching, between 2009 and 2013, 3D printers can be bought less than USD 1,000 which was less than literally one tenth of the price of those 3D printers sold by the commercial oligarchy at the time.³⁷ Furthermore, open-source innovation is improving the area of 3D printing for users drastically. For instance, online platform like Thingiverse, consists of nearly a million free designs for users, is continuously providing newly created designs for complex objects that can be printed with 3D printer.³⁸

Continuing development of 3DP technology will affect some industries of manufacturing since it is diffusing at present and also in the future. Having said that, there are some industries which may not likely be as affected as other industries by the technology. For instance, objects which are manufactured of natural materials like solid wood, cork, leather, natural textiles, paper or tobacco products. In addition, another area that is not likely to be affected is manufacturing industrial raw material like petroleum products or basic metals. On the other hand, 3DP technology has the significant potential for affecting the area of simple products which are easy to be printed by a 3D printer as those products are small in size and do not require many materials. In addition, manufacturers of different industries have adopted this technology, such as jewelry, toys, sports goods, musical or even medical instrument. Repository like Thingiverse has own section advertising toys and games which are very popular for users to download. Since early 2000's, human tissues are being created to serve patients in the sector of 3D bio printing and the latest development in the sector is the 3D printed heart by scientists from Tel Aviv University by utilizing patient's blood cells and biological materials.³⁹ Manufacturing or wearing apparels is also another extension of 3DP technology even though the industry is currently limited to fashion products which are made of plastic.⁴⁰ Intricate patterned shoes and boots are already in the market which couldn't have come into

³⁵ Simon Bradshaw, Adrian Bowyer and Patrick Haufe, *supra* note 34. Page 9.

³⁶ *Ibid*, page 8.

³⁷ André Omer Laplume, Bent Petersen, *Global Value Chains From A 3D Printing Perspective*, Article in Journal of International Business Studies, January 2016. Page 6.

³⁸ Thingiverse, *supra* note 20.

³⁹ AJ Dellinger, *Scientists Print First 3D Heart Using A Patient's Own Cells*. Engadget, <www.engadget.com/2019/04/15/tel-aviv-university-3d-printed-heart/> last accessed 12 May 2019.

⁴⁰ André Omer Laplume, Bent Petersen, *supra* note 37, page 9

existence as such products would have been impossible to produce with traditional method.⁴¹ Based on this instances it is really obvious that replacements parts for machines can be easily produced by 3D printer users and our society will become a commonplace for reproduction.⁴²

1.2.2 A disruptive technology in supply chain

In the era of digital technology, novel technologies like Internet of Things, autonomous machines or high-end sensor technologies have created huge impact which led to frequent disruption in many sectors including global commerce.⁴³ 3DP technology can be considered as one of those new technologies which has given its impact on global industrial sector as well as modern commercial market because of its fast pace and its implementation in different areas of designs and manufacturing.⁴⁴ Consistent development of 3D printers in manufacturing product accurately, fast rapidity and quality, the potential impact on industries is certainly immense. In previous section, development of different sectors by 3DP technology gives the impression of significant change in industries but at the same time 3DP technology has the potential to disrupt the way products are designed, processed and manufactured.

As stated above, intricate objects can be printed with little additional costs, for instance, creating structures with hollowing, internal specifics, various cells of an object. The process is more flexible than conventional manufacturing as all the units are built independently. Therefore, it is of paramount importance that we explore what related phases of global commerce may have the potential to be disruptive and therefore administrators can take appropriate measures to adapt to a transformed environment. In this section, the perspective on the impact of 3DP technology has been taken as a possible disruptive technology after extensive consideration of research outcomes of related literature and latest development in industries. The following discussion will be based on the main areas where 3DP technology will create immense impact on global commerce considering resources of manufacturing products, customization by consumers from manufacturers, product design and prototyping and so on.

⁴¹ André Omer Laplume, Bent Petersen, *supra* note 37, page 9.

⁴² *Ibid.*

⁴³ Andre O. Laplume, Bent Petersen & Joshua M. Pearce, *Global value chains from a 3Dprinting perspective*, Article in Journal of International Business Studies, January 2016, <www.researchgate.net/publication/291375376> Last accessed 10 May 2019.

⁴⁴ Klaus Schwab, *supra* note 30.

The down-streaming sections like production and distribution of a manufacturing process have remarkable impact when 3DP technology is adopted by manufacturers. 3DP has the potential of blurring the line between buying and creating products for consumers as in future, design, manufacturing, and distribution could be merged by consumers. Consequently, consumer's involvement in manufacturing process could possibly bring a change in supply chain structure where the technology may also change management priorities.⁴⁵ In addition, in the area of resource efficiency, comparing to traditional manufacturing process, as an additive manufacturing technology it has way better efficiency in terms of using resources and produces less waste.⁴⁶ Therefore, 3DP technology could boost the circular economy, provide more positive society-wide benefits and bring a smooth transition towards using more renewable energy sources. Since there will be less waste from 3DP manufacturers, it can be considered as more environmentally sustainable technology.⁴⁷ Moreover, as a transportable manufacturing technology 3DP will bring production closer to consumers and market, as a consequence, significantly reducing the footprint of supply chain in global commerce and significant reduction in carbon emissions.

One of the most crucial impacts of 3DP technology will be decentralization of manufacturing as this technology will be adopted by manufacturers due to considerable benefits of production on-location and advantages of quicker responses to supply consumer demands.⁴⁸ This technology is really useful in the context of post-natural disaster scenarios as 3D printers can be considered as portable which could be very convenient for manufacturers to reach difficult locations. 3DP technology could be a game changer in the context of manufacturing products when movement of goods around the world will be transferred by sending designs of products over online and this practice can already be seen from many online platforms. This scenario also implies that 3DP has the capability for supplying products on demand and at the point of consumption which will create another impact on the area of inventory and logistics as manufacturers will be close to customers and there won't be any need for transporting physical goods. The ultimate impact on global business could be that the combined effects on various sections on transporting goods may decrease the demand of global transportation of goods.⁴⁹

⁴⁵ Nyman, H.J., & Sarlin, P. *From Bits to Atoms: 3D printing in the context of Supply Chain Strategies*. Paper presented at the 47th Hawaii International Conference on System Sciences, Waikoloa, HI, January 6-9, 2014. <www.doi.org/10.1109/HICSS.2014.518> last accessed 17 May 2019.

⁴⁶ *Ibid.*

⁴⁷ Robbert Janssen, Iris Blankers, Ewoud Moolenburgh, Bineke, TNO: The impact of 3-D printing on supply chain management, (April 2014).

⁴⁸ Andre O. Laplume, Bent Petersen & Joshua M. Pearce, *supra* note 37, page 20.

⁴⁹ Sebastian Mohr and Omera Khan, *3D Printing and Its Disruptive Impacts on Supply Chains of the Future*, Technology Innovation Management Review, November 2015 (Volume 5, Issue 11)

Additionally, conventional manufacturing requires more skills than 3DP technology and therefore, manufacturing of products could be re-shored to markets near to consumers which consequently will mitigate the risk of obsolescence. Besides, in terms of complexity reduction in manufacturing products, this technology is so powerful that shapes the whole process of manufacturing significantly shortened and simplified of the supply chain in global commerce. Most interestingly, the feature of 3DP is so versatile that manufacturing fundamentally different products with intricate shapes can be produced easily, quickly and cheaply.⁵⁰ Therefore, users of 3D printers who are enthusiastically involved in creating new designs and products will become “prosumers”.⁵¹ The concept of 3DP is basically additive nature and straight production from digital to physical objects. Adoption of this concept by 3DP designers can free themselves from conventional constraints given by manufacturers as designers are able to redesign an entire product by saving materials with enhanced functionality without decreasing the quality or losing any of the unique characteristics.⁵²

Since the technology is getting involved more and more mainstream due to the ease of its open source modelling software and 3D design files are being spread online, it will create a huge impact on legal matters in relation to 3DP and raise more security concerns. For instance, the law is not clear in terms of taking action against users who could use 3D printer to make harmful objects like knives or guns. Some scholars have already raised concerns that initiative by gun makers could easily make harmful objects which can be sold to consumers bypassing legal checks.⁵³ Moreover, another important question could be, who will be responsible if the printed product sold to customers and failed; would it be the designer or the printing machine manufacturer? the material supplier or the shop owner who is selling the product who is selling the 3D product? Moreover, another concern could be that scanning technology allows physical objects to be scanned to create digital files and physical objects can be created with 3D printers.⁵⁴ This rapid development of scanning technology will also require involvement of legislators in future to deal with legal complication or misconduct.

The above discussion of impacts on supply chain in global commerce clearly indicates that 3DP technology has massive potential to disrupt the existing paradigms of manufacturing industry or the

⁵⁰ Sebastian Mohr and Omera Khan, *supra* note 49.

⁵¹ *Ibid.*

⁵² Mohr, S. *The Impact of 3D Printing on Future Supply Chains*. Master’s Thesis, Technical University of Denmark, Copenhagen, (2015)

⁵³ Andre O. Laplume, Bent Petersen & Joshua M. Pearce, *supra* note 37, page 5.

⁵⁴ Nyman, H. J., & Sarlin, P. *From Bits to Atoms: 3D Printing in the Context of Supply and Strategies*, Paper presented at the 47th Hawaii international Conference on System Sciences, Waikoloa, HI, January 6-9, 2014, <www.dx.doi.org/10.1109/HICSS.2014.518> last accessed 20 May 2019.

status quo.⁵⁵ In addition, the current development without regulations in some particular 3DP industries will definitely raise legal and security concerns. Existing international 3DP manufacturing companies are making strong efforts to expand the use of 3DP technology and consequently, 3DP can be seen to make a strong move to global business industry and consumer market. Therefore, it is highly possible to see enormous changes and innovative ideas being created by fresh applications originating from this technology even though such developments in future will be uncertain. Having said that, this disruptive technology may have negative impact on commerce and it could be overwhelming but upcoming issues of such disruption worth discussion and research.

Chapter 2: IP rights in 3DP context

IP laws are implemented in our society to protect creations of mind as inventions, literary and artistic works, and symbols, names and images and so on. Promoting IP laws and protection of IP are required for advancing creative works and areas of technology on global scale. Certainly, legal protection for creation of an individual significantly encourages for further innovation. Consequently, such encouraging legal measures for creators can spur the economy of a society which ultimately creates additional jobs and build industries in the society. Furthermore, one of the ways to understand insights of the social impact of our reliance on technology is to IP law. Intellectual property industries have experienced technological developments over the decade and such advancement of industries; for instance, software, biotechnology or music industry, have led to IP reform which can be found in all types of IPRs.

In the context of 3DP, the advent of this technology should concern specifically four classes of IP rights which may be infringed by users or manufacturers. Most of the IP rights arise automatically which are known as unregistered rights, and there are registered rights which require registration of the creation or work. Four classes of specific rights are,

- a) Copyright, an unregistered right which provides strong protection for mainly artistic and creative works, generally referred to as “works”. It is one of the areas of IP law system which is perceived to be most affected by 3DP technology.

⁵⁵ Andre O. Laplume, Bent Petersen & Joshua M. Pearce, *supra* note 37, page 2.

- b) A patent is an exclusive right which requires registration, a right granted for invention. The aim of this right is to provide incentives to individuals by recognizing their creativity of novel and innovative products, for instance mechanisms or pharmaceutical products.
- c) Trademark, it ensures that the owners have the exclusive right of their symbol over their goods or services or have the power to transfer the ownership to let others use the symbol for a specific period of time.
- d) Design protection which exists in both registered and unregistered form, the protection serves the purpose for creators of their distinctive shape and appearance of products, specifically to those products which are mass produced.

Emerging technology like 3D printing is perceived to disrupt all of the above-mentioned areas of intellectual property law.⁵⁶ These areas of law have been implemented to provide astounding protection for creative and inventive efforts in all the territories of technology and art. Since 3DP is continuing to develop phenomenally, potential implications can bring a radical change in our society which will also include legal and regulatory implications.⁵⁷ Having said that, this technology is considered to be in very early stage and as said earlier that it has not been fully adopted by mainstream society, consequently, research and existing laws on 3DP aren't sufficient enough to regulate the potential disruption caused by this technology in the area of intellectual property rights (IPRs). To assess impacts of 3DP innovation in future on each part of intellectual property regime, it is essential to comprehend what is subject to protection and what is not subject to protection under each hypothesis. Therefore, the purpose of this chapter is to critically analyze the related aspects of 3DP technology which will give us the overview of IP law system in the context of this such revolutionary disruptive innovation.

Chapter 3: Copyright framework in 3D Printing context

Copyright protection is the ultimate defense to protect the original expression of an idea which is considered to be a type of intellectual property protection applicable to a 3D-printed object. Additionally, the concept of copyright has fluctuated with time, innovations, and based on the technological advancement of society. In the era of 3DP and impact of digitalization of things, copyright framework will eventually have massive changes in the context of regulations and

⁵⁶ Osborn, Lucas, 3D Printing and Intellectual Property (May 19, 2015). Research Handbook on Digital Transformations, edited by F. Xavier Olleros and Majlinda Zhegu. Edward Elgar, 2016. <www.ssrn.com/abstract=2533673> last accessed 20 May, 2019.

⁵⁷ *Ibid.*

protection for users. The following chapters will discuss how copyright applies to 3D printing context, considering the ownership of the copyright element, functionality doctrine and the basic originality requirement for copyright protection to be qualified. Moreover, it must be noted that models enjoy protection as derivative work when they are created from a preexisting copyrighted or public domain work.⁵⁸

To assess the potential infringements of intellectual property rights, it is crucial to consider involved actions in the process of making 3D printed replica objects using preexisting copyright file and CAD file. Since there is an increment of availability of 3D scanners and printers for consumers, such availability will highly likely to encourage individuals to practice making 3D CAD designs based on 3D objects. Therefore, a brief discussion of copyright implications of 3D scanning, copyrightability of user-generated content and detailed analyzation of U.S. and European laws governing copyright protection will be followed in the upcoming chapters.

3.1 Copyright and 3DP

Since the 3DP industry has attracted the consumers and manufacturers of 3D printers and 3D scanners, legal authors have raised serious concern regarding the protection of intellectual properties and in particular, protection for copyright owners. Before the revolution of 3DP technology, regulation and legislation were drafted to protect rights of owners which may not be able to protect rights of original creators in the present after 3D printers have emerged in the manufacturing society. The digitalization of things and 3DP have simplified the copyright of physibles and led to disputes in the field of 3DP. Consequently, designers are being discouraged to share their creative designs as they are not able to receive a sense of security for their IP. For instance, we can consider the action by the owner against Thingiverse, a hosting site for downloadable CAD designs, for distributing copyright digital model known as “Penrose Triangle” without permission of the owner.⁵⁹ Thingiverse was given a Digital Millennium Copyright Act (“DMCA”)⁶⁰ takedown notice and the hosting platform removed the design model from the site. This is considered to be the first time for a DMCA takedown notice issued in the case of a copyrighted object in the industry of 3DP.⁶¹ Even though in this occasion

⁵⁸ Haritha Dasari, Assessing Copyright Protection and Infringement Issues with 3D Printing and Scanning, 41 AIPLA Q. J. 279, Page 282, (2013).

⁵⁹ Duann, IP, 3D Printing & DMCA, SHAPEWAYS BLOG, February 20, 2011, <www.shapeways.com/blog/archives/747-IP,-3D-Printing-DMCA.html> last accessed 26 May 2019.

⁶⁰ Digital Millennium Copyright Act, 17 U.S. Code § 512 (d)(3) (2006). Limitations on liability relating to material online.

⁶¹ Duann, *supra* note 59.

the owner of “Penrose Triangle” has allowed the design to have remained on the platform after Thingiverse removed the item, other entities have pursued legal recourse as for instance, HBO’s notice against Fernando Sosa.⁶² Fernando Sosa created an iPhone dock based on the images of a well-known TV series Game of Thrones which is owned by HBO. Sosa initiated to sell the model along with other sculptures on his site, nuPROTO.com.⁶³ HBO found out about the initiation of Sosa and sent a cease-and-desist letter stating, Sosa’s creation of “iron throne dock will infringe on HBO’s copyright in the Iron Throne”⁶⁴

In the light of these instances, this note provides the idea of ownership of copyright element and it can be contended that copyright protection will not be available just because of using a 3D scanner to create a digital model based on a physical article as it absolutely lacks the necessary amount of originality. Besides, it can also be said that copyright provides the privilege to owners to enforce their existing rights against users of 3D printers or scanners through takedown notices.⁶⁵ These cases of takedown notice or warning by giant companies against 3D scanner or printer users will be more in upcoming days and subsequently, I strongly believe lawyers in the industry of IP should be prepared for all sorts of debates surrounding 3D printing and scanning.

As briefly discussed in previous chapters regarding 3D printing and scanning, without any doubt this technology has been the leader of innovative technologies.⁶⁶ Since the popularity of 3D printers and scanners are growing, it can be perceived that an increased number of users will use programs for using designs or CAD file to create objects. For instance, an online platform like Tinkercad,⁶⁷ has been encouraging and allowing amateur designers to make new 3D models. Vendors of 3D scanners and printers are also assisting their inexperienced consumers by offering similar easier programs.⁶⁸ Additionally, other merchants in the industry of 3DP are focusing on secondary schools and universities to expand their business by offering a particular software program alongside their offered hardware.⁶⁹ When students will turn out to be increasingly acquainted with such software and equipment, individuals will exceedingly like to be intrigued and utilize 3D printers and scanners for

⁶² Nathan Hurst, *HBO Blocks 3-D Printed Game of Thrones iPhone Dock*, *Wired* February 13, 2013. <www.wired.com/design/2013/02/got-hbo-cease-and-desist/> last accessed 25 May 2019.

⁶³ nuPROTO, *3D PRINTING AND PROTOTYPING*, <www.nuproto.com> last accessed 25 May 2019.

⁶⁴ *Ibid.*

⁶⁵ Haritha Dasari, *supra* note 58, Page 284.

⁶⁶ Priya Ganapati, *3-D Printers Make Manufacturing Accessible*, *Wired*, August 11, 2009. <www.wired.com/gadgetlab/2009/08/makerbot/> Last accessed 27 May 2019.

⁶⁷ TINKERCAD, *Mind to Design in Minutes*, <www.tinkercad.com> last accessed 27 May 2019.

⁶⁸ Replicator G, *Lowering the barrier to 3D printing*, <www.replicat.org> last accessed 27 May 2019

⁶⁹ Haritha Dasari, *supra* note 58, Page 285.

utilitarian and creative purposes.⁷⁰ This technology will allow the masses to have access and use the tools to copy works of others along with customizing the same work. Complications will arise when individuals would use a 3D printer to make an object which they copied from another person's original work. Since 3D printers are becoming available to ordinary people, anyone could become a creator and consequently due to the advancement of 3DP technology millions of people ultimately become creators. Therefore, the upcoming scenario of the possible claims of authorship by individuals will be complex and may create a situation which may never have been experienced in digital manufacturing industry or in the area of 3DP.

In addition, Individuals can use such software to create advanced digital models manually by design software or a 3D scanner can be used to make a digital model automatically.⁷¹ Most of the occasions, users of such hardware are following a flexible way to create a digital model by using a combination of a manual and automatic process. The level of mechanization may likely to affect the copyright analysis of those created models and therefore, to discuss issues in relation to copyright, this chapter addresses different 3D scanners which are commercially accessible.⁷²

3.1.1 Eligibility for copyright protection: functionality limitation, creativity

The most important criteria for a work to be copyright protected, the work has to be an original work of authorship fixed in a tangible medium of expression.⁷³ In the context of 3DP, other aspects of copyright law will affect protection for users and manufacturers in addition to the above-mentioned requirements which additionally include the functionality doctrine and originality requirement.⁷⁴

3.1.1.1 Fixed Expression

Applying the concept of fixed expression, when individuals create original digital models and physical objects they can be considered as works of "fixed" expression. Under copyright law, such works are able to receive protection as these works are represented ideas in a tangible form which are

⁷⁰ Robert L. Mitchell, 3D Printers: Almost Mainstream, COMPUTERWORLD, December 21, 2011, <www.computerworld.com/s/article/9222839/3D_printers_Almost_mainstream> last accessed 27 May 2019.

⁷¹ *Ibid.*

⁷² *Ibid.*

⁷³ 17 U.S.C § 102(a) (2006)

⁷⁴ Haritha Dasari, *supra* note 58, Page 289.

sufficiently permanent, reproduced or can even be modified with permission of the creator.⁷⁵ When digital models are created, they can be considered as an expression of ideas rather than ideas themselves since such models are produced in perceivable format. When an artist re-creates models in digital format, the artist's idea behind creating digital models can be perceived as a graphical representation or as stereolithography (STL) file which stores lines of code. Such digital models can be qualified as an "expression" under 17 U.S.C § 102(1) which states that "works of authorship fixed...from which they can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device".⁷⁶ Furthermore, physical objects are representations of "fixed" ideas and also tangible which are sufficient to receive protection under copyright law.⁷⁷

3.1.1.2 Works of authorship

According to the Copyright act, physical objects, digital models, and the source code should be considered as works of authorship as per the definition provided by 17 U.S.C. § 102(a) as "pictorial, graphics and sculptural works" ("PGS" works) or "literary works".⁷⁸ Moreover, without any doubt, physical objects are qualified for protection when they are created specifically for non-utilitarian purposes as part of PGS works due to the fact that they are considered as sculptural artworks.⁷⁹ Likewise, digital models can also be considered as PGS works of authorship within the statute.⁸⁰ Any designer can create a 3D digital model by altering the graphics and this instance by the designer can be perceived as expressing his or her ideas using the CAD software, consequently, the representation would be able to receive protection as a pictorial or graphic work.

The designer can take action against anyone who could copy the fundamental elements of his or her original work. The case of *Meshwerks, Inc.*⁸¹ is very relatable in this context. In this case, Toyota

⁷⁵ Michael Weinberg, *What's The Deal With Copyright And 3D Printing*, 1st January 2013. Public Knowledge, <https://www.publicknowledge.org/files/What%27s%20the%20Deal%20with%20Copyright_%20Final%20version2.pdf> last accessed May 28, 2019.

⁷⁶ 17 U.S.C. § 102(a).

⁷⁷ *Ibid.*

⁷⁸ According to Section 101 of the 1976 the U.S. Copyright Act, "Pictorial, graphics, and sculptural works" include two-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". <<https://www.copyright.gov/title17/92chap1.html>> last accessed 6 August 2019.

⁷⁹ Michael Weinberg, *supra* note 75.

⁸⁰ Haritha Dasari, *supra* note 58, Page 290.

⁸¹ *Meshwerks, Inc. v. Toyota Motor Sales U.S.A.* 528 F.3d 1258 (10th Cir. 2008), LexisNexis, <www.lexisnexis.com> last accessed 29 May 2019.

Motor Sales U.S.A (Toyota) contacted Grace & Wild, Inc. (G&W) to create a campaign for Toyota's new upcoming cars. Later G&W had given the contract to Meshwerks, Inc. to develop the advertising campaign. Meshwerks is a company specialized in creating 3D digital content by using state of the art technology and provides highly creative 3D solutions for film, commercial, broadcast television, and game companies.⁸² Then Meshwerks collected all the related information of Toyota's new car models, processed all the data onto a computerized program and used software to create design models for the campaign. Upon completion of making design models, Meshwerks obtained copyrights for all those designs from the U.S. Copyrights Office and sued Toyota, its advertising agency Saatchi & Saatchi (Saatchi), and G&W for copyright infringement. Meshwerks alleged against all the parties that defendants have used those design models without the permission of Meshwerks as it is the owner of all those designs. The issue, in this case, was whether Meshwerks had the copyright over those digital models that it created. The decision of the Court of Appeal is remarkable as it found that Meshwerks could not receive valid protection since those models were originally created by Toyota. Therefore, there were not considered to be the "original works" of Meshwerks and no valid copyright could have been granted. This case note suggests that creators or manufacturers in the 3DP industry must not re-create any product or design without the permission of the owner and be prepared to produce evidence of their originality in their work.

3.1.2 The Functionality Doctrine's Limits on Physical Objects and Digital Models

3.1.2.1 Physical Objects

Copyright protection for exclusively functional digital models and physical items would not be provided due to the functional limitation. Numerous physical objects are subject to functional limitation and hence, copyrightable works will not receive copyright protection. Under existing copyright law when a useful article is made with "an intrinsic function", creators will not receive copyright protection for the shape of that useful article.⁸³ The instance of *Baker* provides that, copyright protection is not reached out up to absolutely useful articles.⁸⁴ For instance, articles can be created with pure aesthetic purposes like clay sculptures or objects with a solely utilitarian reason like pencil sharpeners. In both cases, under current copyright law, the functional components of both objects may not receive copyright protection.⁸⁵

⁸² MESHWERKS, *About Us*, <www.meshwerks.com> Last accessed 1 June 2019.

⁸³ 17 U.S.C § 101 (2006)

⁸⁴ *Baker v Selden*, 101 U.S. 99, 105 (1880)

⁸⁵ 17 U.S.C. § 101

Besides, when an article is created with artistic features and useful capacities, for instance, a pencil sharpener with a designed eraser or top, that particular article may be qualified for partial copyright protection. In this particular scenario, the ultimate issue can be whether a copyrightable segment of the article is physically or conceptually divisible from the utility section. The case of *Kieselstein-Cord v. Accessories by Pearl, Inc.*⁸⁶ can illustrate this point as in this case the plaintiff, Barry Kieselstein-Cord filed suit for copyright and trademark infringement against Accessories By Pearl (Pearl). In the 1970s, Kieselstein manufactured fashion accessories for consumers and on 3rd March 1980, the company registered the Vaquero and Winchester buckles with the Copyright Office as “jewelry” even though the designer’s contribution was considered on the list as “original sculpture and design”. The Vaquero, and Winchester buckle has had great success within the market and Pearl had copied, advertised, manufactured and sold for commercial purposes. Having said that, Pearl admitted that the company had copied and sold copies of Vaquero, and Winchester but it filed for judgment on the grounds that Kieselstein-Cords copyrights weren’t valid. United States District Court found for Pearl considering the Copyright Act and stated, the works with utilitarian features can be copyright protected when their features are “separately identifiable and capable of existing independently as a work of art.”⁸⁷

The court also noted that it does not find those buckles in question are “pictorial, graphic, or sculptural features that can be identified separately from, and are capable of existing independently of, that utilitarian aspects”⁸⁸ Kieselstein-Cord appealed the decision to United States Court of Appeals for the Second Circuit which reversed the decision finding that Kieselstein-Cord’s buckles were copyrightable as the court noted that involved belt buckles can be considered as utilitarian objects which aren’t copyrightable but they are not ordinary buckles since sculptured designs created by the plaintiff which are cast in exclusive metals-decorative in nature and used principally for ornamentation.⁸⁹

⁸⁶ *Kieselstein-Cord v. Accessories By Pearl, Inc.*, U.S. District Court, S.D.N.Y – Case No. 80 Civ. 1029 (GLG); U.S. Court of Appeals, Second Circuit – Case No. 1351 (1980). *The Fashion Law* <www.thefashionlaw.com/learn/kieselstein-cord-v-accessories-by-pearl-inc> last accessed 30 May 2019.

⁸⁷ *Ibid.*

⁸⁸ Casetext, *Kieselstein-Cord v. Accessories by Pearl, Inc.* 632 F.2d 989 (2d Cir. 1980). <*Kieselstein-Cord v. Accessories by Pearl, Inc.*, 632 F.2d 989 (2d Cir. 1980)> last accessed 30 May 2019.

⁸⁹ *Ibid.*

This case has been considered as the case “on a razor’s edge of copyright law”.⁹⁰ The court has considered the physical and conceptual separability of copyright law into consideration. It found conceptually separable components in plaintiff’s belt buckles which impliedly created an essential test for deciding conceptual separability. The standard that has been established from this case which could be applicable to the scenario of the 3DP industry is that design elements or accessories manufactured by 3D printers might be copyrightable if those particular items are physically or conceptually separable from the utilitarian aspects. Moreover, most importantly only those elements of the object may be qualified for copyright protection which aren’t dedicated to the object’s functionality and meet the originality requirement.

3.1.2.2 Digital Models

According to 17 U.S.C §101 of the Copyright Act, CAD files or digital models should be considered as PSG works which include two-dimensional (2D) and 3D “diagrams, models, and technical drawings.”⁹¹ Furthermore, as per 113(b) of the Copyright Act⁹², models of useful articles receive not less or greater protection. Consequently, a model of an object with utilitarian aspects might be able to obtain if it fulfills the requirements of copyrightability. But the important note is the physical counterpart of the same object may not be able to have protection due to the functionality doctrine. This means that it doesn’t matter whether a digital model obtains copyright protection, such protection would not extend up to the manufacturing of that item. In the case of *Niemi v. American Axle Mfg. & Holding Inc.*, it was found by the court that the copyright protection did not extend to a copyrighted scale model of an automobile, used to manufacture automobiles of that design.⁹³

3.2 Originality Requirement in 3DP Context: The U.S Approach

One of the most challenging in the industry of 3DP will be whether outputs of 3D printers and scanners separately constitute “original” works. One of the fundamental elements of copyright is the ‘originality’ which is a significant requirement for copyright protection. This particular term lacks a precise statutory definition and there was no initiative to provide explicit definition from any major

⁹⁰ See Kieselstein-Cord, *supra* note 86.

⁹¹ 17 U.S.C. § 101 (2006)

⁹² 17 U.S.C. § 113(b) (2006)

⁹³ *Niemi v. American Axle Mfg. & Holding Inc.*, 2006 WL 2077590, copyright protection wouldn’t extend to a copyrighted technical drawing showing the construction of a machine used to manufacture the machine.

international copyright treaties.⁹⁴ In the US, Congress did not provide any definition of “originality” under section 102 of the Copyright Act, courts have translated the condition in such a way where creators will require to demonstrate some sort of creativity as opposed to novelty.⁹⁵ Interestingly, the concept of originality varies in common law and civil law systems around the world.

In the European Union (EU), The most pertinent convention could be the Berne Convention for the Protection of Artistic and Literary Works (1886) impliedly and verifiably suggests a general requirement of originality with Article 2(1) of the convention. Article 2(1) establishes “the literary and artistic works” and it also provides a broad list of examples of “protected works”, such as books and other writings, lectures, drawings, sculpture, photographic works, architectures, painting, engraving, musical compositions with or without words, illustrations, works of applied arts, cinematographic works, choreographic works, maps, and plans. These similar examples of protected works have been incorporated in most national Copyright Acts.⁹⁶

In the case of *Feist Publications, Inc. v. Rural Telephone Service Co*⁹⁷., the United States Supreme Court adopted a two-step test to determine the “originality” for copyright. As per the *Feist* two-step test, the first step of the test requires that the contribution towards the work must be created independently. The second step recognizes that the element of creativity or the work must exhibit a modicum of creativity.⁹⁸ In this particular case, the court interpreted the subjected element of originality as a modicum of creativity. Later, Justice Ginsburg defined the “modicum of creativity” in the case of *Atari Games Corporation v Oman* as that for a work to be original there must be an element of material variation.⁹⁹ Even though *Feist* is considered to be a landmark case, it worth to note that incorporating “creativity” without any specific limitations is not of the best interests to copyrights.¹⁰⁰

⁹⁴ Thomas Margoni, *The harmonization of EU Copyright Law: The Originality Standard*, Article in SSRN Electronic Journal, January 2016. <www.researchgate.net/publication/315440050> last accessed 30 May 2019.

⁹⁵ Haritha Dasari, *supra* note 58, Page 292.

⁹⁶ Thomas Margoni, *supra* note 94, Page 3.

⁹⁷ *Feist Publ'n Inc. V. Rural Tel. Serv. Co., Inc*, 499 U.S. 340, 362 (1991).

⁹⁸ *Ibid.*

⁹⁹ *Atari Games Corp. v. Oman*, 979 F.2d 242 (D.C. Cir. 1992)

¹⁰⁰ Manoj Isuru Kotigala, *Rethinking Originality in Copyright Law and Exploring the Potential for a Global Threshold*, Research Gate, <www.researchgate.net/publication/311377345> Last accessed 1 June 2019.

Furthermore, the established threshold is considered to be low which makes most of the works to be qualified to be original implying that the requirement for the work to be original is really easy.¹⁰¹ After critically analyzing this test, Edward Lee has suggested that this two-step test will likely to create confusion for the courts as the test raise various concerns.¹⁰² There will be more issues as digital technologies are growing fast and in the context of 3DP, it will be complicated for courts to determine as 3DP technology is enabling users to copy way easier than it used to be twenty years ago. Since the digital age has been constantly changing with new creations, legal concepts of applying tests in cases should be revised. In my opinion, I strongly agree with Edward lee as at the inception of the twenty-first century, information technologies are constantly shaping our society and have become gradually fundamental to world economy.

3.2.1 Edward Lee test

Therefore, Edward Lee has proposed a three-step test which would provide a better understanding of originality and its constituent components to the courts to evaluate the work. His proposed three-step test is believed to be an effective measure for courts to determine the potential originality of creations by 3D printers. The three-part test seems that it could be really effective for the courts as the test would review the independence of the work, consider the creation process and finally, evaluate the requirement of the modicum of creativity.¹⁰³ The independent requirement of the three-step test means that, according to *Feist* case, a person cannot obtain a copyright for his work by simply copying another person's work.¹⁰⁴

For example, if someone prints a picture of Van Gogh from internet, that picture will not receive copyright protection because the picture was not created "independently". Conversely, when someone reproduces a work of another author's original work, the author has the right to have a defense to copyright infringement. Having said that, it is important to note that the independence requirement does not stop someone to copy but only from "others works"¹⁰⁵ which may constitute copyright infringement. In the context of 3DP, when someone creates an object using a 3D printer can fulfill the independence requirement if the designs are not copied from someone else's work. For

¹⁰¹ Lee, Edward, Digital Originality (August 13, 2012). Vanderbilt Journal of Entertainment & Technology Law, Vol. 14, No. 4, p. 919, 2012; Chicago-Kent College of Law Research Paper No. 2012-11. Available at <SSRN: <https://ssrn.com/abstract=2128799>> Last accessed 1 June 2019.

¹⁰² *Ibid.*

¹⁰³ Lee, *supra* note 101, Page 936

¹⁰⁴ *Feist*, 499 U.S. 340, 362 (1991).

¹⁰⁵ *Ibid.*

instance, if someone creates a CAD file of a dinosaur from the scratch independently and did not copy another person's work, the design and the produced toy of dinosaur would be eligible for copyright protection when they also fulfill other two requirements of the originality test.

Furthermore, complex issues may be created when copyright protection may be sought after someone creates an object based on the design of the work or CAD file downloaded from the public domain.¹⁰⁶ So to say, if someone creates an object with the 3D printer by obtaining a CAD file from an online platform like GrabCAD, which is an original work of someone else, then the work will not receive copyright protection as the CAD file and the output would not fulfill the requirement of independent work.¹⁰⁷ These kinds of works are considered as “derivative works”¹⁰⁸ which are subject to additional requirements and required a different standard of originality. Derivative work is copyrightable when the work has incorporated some or all of existing work and also possess new copyrightable elements to that specific work.¹⁰⁹ In order to claim copyright protection for derivative work, the author must provide all the information of the work including previous registrations of preexisting material, exclusive information regarding new materials added to the existing work, description of the material excluded and limitations of the claim. Courts will look for “more than merely trivial” variation in derivative works where CAD or design files were obtained from the public domain.¹¹⁰ However, a true advantage for 3D scanner users is basically creating a CAD model from an existing physical object. But in that case, the court will strongly consider the resulting CAD model and check whether such work constituted enough creativity and originality in order to grant copyright protection.

The famous case *Batlin*¹¹¹ is very relevant to this context as in this case. In this case, the new addition of the Uncle Sam bank which was already existed in public domain was found to not have originality in their work due to the fact that the plastic bank was very much similar to the cast iron bank with some minor differences. As discussed above, the hypothetical dinosaur may create similar complexities. If users of 3D printers create dinosaur obtaining a CAD from the public domain and modify with color and size, according to existing copyright law such modifications would be considered as merely trivial variations and consequently, the toy would be considered as just a copy

¹⁰⁶ *Brown v. Latin Am. Music Co.*, 498 F.3d 18, 23 (1st Cir. 2007) (Provides the definition of public domain)

¹⁰⁷ *Lee*, *supra* note 101, Page 948.

¹⁰⁸ 17 U.S.C § 101 (2006)

¹⁰⁹ Copyright, United States Copyright Office, Circular 14, < www.copyright.gov/circs/circ14> last accessed 1 June 2019.

¹¹⁰ *United States v. Hamilton*, 583 F. 2d 448, 450 (9th Cir. 1978).

¹¹¹ *L. Batlin & Son, Inc. v. Snyder*, 536 F.2d 486, 489 (2d Cir. 1976)

from public domain design.¹¹² If the same user can add noteworthy addition of features which are “more than merely trivial” to the design the toy dinosaur, it is highly likely that the user would be able to reach the level of independence.¹¹³

The second step of Lee’s test is the requirement of creating a work and it can be said that by using the 3D printer when someone creates an object based on their own CAD made from scratch, such creativity would easily satisfy the “create” requirement.¹¹⁴ When users are able to prove that their design was created from scratch, the design can demonstrate their intellectual conception, thoughts behind the design and nature of the product with the design. As said in the case of *Feist* that such elements are “founded in the creative powers of the mind”¹¹⁵. Hypothetically, if someone merely prints out dinosaur toy by obtaining a CAD file from online, that person will not be able to satisfy this second requirement as the element of mental creation is absent.

Furthermore, 3D printer users will struggle to obtain copyright protection if they used CAD or design files which enable users to customize up to a limited degree, for instance, color, size or shape. The resulting product, toy dinosaur will have only trivial variations from the designs acquired from the public domain by 3D printer users and consequently, the second requirement will not be satisfied. It is interesting to note that the first two requirements of the three-step test will likely to follow each other as the element of independence must be required in all creations.

The third requirement which is the modicum of creativity will not be difficult to be fulfilled for users if resulting object possesses “creative spark” and is not so mechanical to “be expected as a matter of the course”¹¹⁶. Consequently, if a toy dinosaur is created by using a CAD file built from scratch and printed with a 3D printer, the creator would likely to satisfy at least the creativity. But again, the threshold of creativity would not likely to be fulfilled if the design or used CAD file is downloaded from the public domain which is a work of someone else.¹¹⁷

Creators make 3D models based on existing articles by using 3D scanners which can be compared to photographic works as precisely to say, such work that exemplifies photographing of copyrighted

¹¹² L. Batlin & Son, Inc, *supra* note 111.

¹¹³ Lee, *supra* note 101, Page 948

¹¹⁴ *Ibid.* Page 949.

¹¹⁵ Feist, 499 U.S. 340, 362 (1991)

¹¹⁶ Lee, *supra* note 101, Page 950.

¹¹⁷ *Ibid.*

items. The U.S. courts have interpreted the originality criteria for photographs and the view is that a photograph must possess “creative spark” to be copyright protected. A photograph can be considered as an original work if the resulting photograph is comprised of creative decisions including the subject, background, lighting and all-important aspects which makes the photographer works unique and protectable worthy.¹¹⁸

Considering the applicability of the Lee test, public benefit from this test can be perceived. In my view, Lee test provides a better understanding of the elements required for originality. Despite the fact that Lee test is not a mathematical technique to perceive whether a work is original, this test appears to add noteworthy precision to the examination. Since new technologies are creating more complexities in legal area, Lee test should help to recognize the proper questions that would require courts to answer under the respective parts of the test. However, this test may attract criticism as some critics may contend that Lee test is complicating the doctrine of originality unnecessarily. Additionally, criticism may also include that Lee test yields very little additional insight beyond the Feist test that exists already. A test which is applicable only to digital creations may create inconsequential confusion for courts. For instance, should digitally printed photographs now be analyzed under Lee test?

Hypothetically, the criticism of complexity about applying Lee test has some validity as the test requires an additional step than the current two-part test. In my opinion, the added complexity will ultimately provide more reasoned and informed outcome in complex cases and therefore such complexity is justified. According to Edward Lee the formulation of the proposed test (Lee test) is derived directly from Feist case and therefore, there shouldn't be any concern about creating two different tests of originality.¹¹⁹ I appreciate this particular test due to its application towards newly digital creations with 3D printers and this proposal certainly gives courts guidance to address the increasing issues of digital creations in the digital age.

As discussed in many instances above, when 3D printers are mass produced and sold to consumers, it is highly likely that ordinary people will become creator. Consequently, there will be situations where newly creators will implicate copyright with their creations. For instance, if a user creates a toy phone with 3D printer from a design that was obtained from public domain but additionally add

¹¹⁸ Haritha Dasari, *supra* note 58, Page 297.

¹¹⁹ Edward Lee, *Digital Originality*, 14 Vand. J. Ent. & Tech. L. 919 (2012), <http://scholarship.kentlaw.iit.edu/fac_schol/352> last accessed 5th July 2019.

some artistic elements to the design, the user will have an arguable claim for added artistic components.

By applying Lee test in this context, courts will be able to easily find whether there has been an infringement by user or whether the copyright for added elements can be granted. In terms of any cases of digital creations with 3D printers, courts should highly consider Lee test and apply by analyzing whether the work in question (a) was independently created, (b) used a process that required the creative element of mind and resulted in a creation which is within the subject matter of copyright, and finally, (c) possesses a modicum of creativity. Lee test will positively provide a more accurate way to examine whether originality exists in creations by 3D printer users.

3.3. 3D Printer and Replicating Copyrighted Digital Objects and Models

3.3.1 Infringement of Copyrighted Digital Models by Printed Objects

Based on the discussion above, it can be clearly said that if users produce an object based on copyright protected digital object or model and do not obtain permission from the original owner, the user would likely to infringe original owner's copyright. An author of original work has every exclusive right to reproduce and disseminate the work, create derivative works based on his or her own copyrighted work and sell those works in the market.¹²⁰ An infringement suit can be brought against by the copyright owner against the user of the 3D printer who produces a copy of the owner's digital object or model provided that the owner can show the ownership of the copyright.¹²¹ The owner will also be required to demonstrate that the user's copied object or model has original elements of the owner's preexisting copyrighted work.¹²²

The case of *Bernal* establishes that a plaintiff must be able to demonstrate that the defendant was able to access the plaintiff's original work and the defendant's work substantially possess similarities with the original work.¹²³ Most of the recent cases related to 3DP involve copyright owners are large established companies which brought actions against 3D printers users as for instance *Meshwerks*¹²⁴ case. Thus, it would be convenient for those giant companies to establish access for infringers since

¹²⁰ 17 U.S.C § 106 (2006)

¹²¹ Haritha Dasari, *supra* note 58, Page 305.

¹²² Feist, 499 U.S. 361 (1991).

¹²³ *Bernal v. Paradigm Talent & Literary Agency*, 788 F. Supp. 2d 1043, 1052 (C.D. Cal. 2010)

¹²⁴ *Meshwerks, Inc. v. Toyota Motor Sales U.S.A.* 528 F.3d 1258 (10th Cir. 2008).

the nature of their copyright-protected works is well disseminated including over public domain.¹²⁵ The access is proven by the plaintiff based on the circumstantial shreds of evidence provided that there's a chain of events where the defendant had the full access to original work or plaintiff's work is widely available.¹²⁶ However, a most important issue in front of the court will be to determine whether both works in question have substantial similarity and such analyzation of finding similarity can vary based on the amount of creativity that could be found in the original work.¹²⁷

In order to determine “substantial similarity” between two works in any cases of works produced with a 3D printer, the court is likely to adopt a test which involves an “extrinsic” and “intrinsic” test, and both have to be satisfied.¹²⁸ The extrinsic test is an objective test which recognizes all the important aspects of the events including the plot, settings, characters and dialogues, theme of that event in question, etc. On the other hand, the intrinsic test specifically focuses on whether an ordinary reasonable person would find substantial similarity between two works which can be defined as a test of “total concept and feel”.¹²⁹ This test was applied by the court as in the well-known case of *CBS Broadcasting, Inc. v. American Broadcasting Companies, Inc. et al.*¹³⁰ In this case, CBS Broadcasting, Inc. (“CBS”) brought a claim against American Broadcasting Companies, Inc. (“ABC”) and ABC's other institutional members of infringing their copyright in Big Brother television program by airing similar show on television as called Glass House. Defendants opposed the claim on the ground that CBS was not able to produce evidence of similarity and the Court found that by applying “substantial similarity test”, CBS is not able to prove that the show Glass House has copied protected elements of Big Brother television program.¹³¹ As stated earlier, in order to prove copyright infringement, a plaintiff must possess ownership of a valid copyright and also required to provide the evidence that copied elements of the work are original.¹³² If the intrinsic test is applied in the context of 3DP, the Court may likely to consider whether the resulting objects of 3D printers can be perceived by an ordinary person to have a substantial similarity.

¹²⁵ *Meshwerks, Inc. v. Toyota Motor Sales U.S.A.* 528 F.3d 1258 (10th Cir. 2008).

¹²⁶ *Boys Music Corp. v. Bolton*, 212 F.3d 477, 482 (9th Cir. 2000)

¹²⁷ Haritha Dasari, *supra* note 58, Page 306.

¹²⁸ *Rice v. Fox Broadcasting Co.*, 330 F.3d 1170, 1174 (9th Cir. 2003)

¹²⁹ Haritha Dasari, *supra* note 58, Page 306. Also see *Sid & Marty Krofft Television Prod., Inc. v. McDonald's Corp.*, 562 F.2d 1157, 1164 (9th Cir. 1977).

¹³⁰ *CBS Broadcasting, Inc. v. American Broadcasting Companies, Inc. et al.* CV 12-04073 GAF (JEMx) (2012)

¹³¹ *Ibid.*

¹³² *L.A. Printex Industries, Inc v. Aeropostale, Inc.*, 676 F. 3d 841, 836 (9th Cir. 2012)

Additionally, in the case of *Rogers*,¹³³ the court found that creating a physical object based on a 2D image without authorization of the original owner can constitute copyright infringement. Another example of copyright infringement in this sense would be the case of *King Features Syndicate*,¹³⁴ where the plaintiff had exclusive rights over his works as a series of cartoons which were published in books and magazines. Defendants were accused of producing toys based on the plaintiff's cartoon characters known as "spark plug" or "sparky". According to the Court, defendants infringed the plaintiff's copyright by producing toys based on the cartoons as those toys are resulting object of the artist's creativity and concept of humor which was expressed in copyrightable form. Likewise, if 3D printer users or manufacturers create toy versions of 2D cartoon characters which were created by another person, those toys would be considered as infringing products as such work embodies original creator's creative sensibilities.¹³⁵ Therefore, under the total concept of feel test, users will be liable for copyright infringement if they print a 3D version of the copyrighted digital model or object.¹³⁶

3.3.2 Technical limitations and Mass Infringement

Depending on the model of 3D printers, users can use different features to create physical objects. Most of the existing 3D printers in the market require ink or an assortment of material to create the resulting article, For instance, Makerbot industries produce and sells spools of plastic with different shading which is known as filament. This material can be used coordinated into its corresponding 3D printer, the Replicator which is a desktop 3D printer for fast and reliable way of producing 3D objects.¹³⁷ The Replicator requires the filaments and when materials are entered into the machine, the printer uses heat, melt the material and process melted plastic by layering to build the object.¹³⁸ There are smaller versions of the Replicator for the enthusiast who would like to create 3D objects and such Replicators have been introduced for home use. For instance, the Replicator has a processing space of 300 cubic inches to print a 3D object. Theoretically, it can be perceived that 3D printers could be used for mass production, but these kinds of technical deficiencies would preclude mass infringement by single users. In this sense, when objects are printed with the 3D printer they can be considered as to a printing a word report. However, depending on the circumstance an author may not be able to

¹³³ *Rogers v. Koons*, 751 F. Supp. 474, 477 (S.D.N.Y. 1990)

¹³⁴ *King Features Syndicate v. Fleischer*, 299 Fed. 533, 534 (C.C.A.2. 1924).

¹³⁵ Haritha Dasari, *supra* note 58, Page 307.

¹³⁶ *Ibid.*

¹³⁷ MAKERBOT INDUSTRIES, *The MakerBot Replicator*, <www.makebot.com/support/replicator/> last accessed 2nd June 2019.

¹³⁸ MAKERBOT INDUSTRIES, *MakerBot Replicator+ User Manual*, <www.makebot.com/wp-content/uploads/2018/09/Replicator_User_Manual.pdf> last accessed 2nd June 2019.

use a printer to deliver the story onto paper yet author's initiative to place his or her contemplations and thoughts into the record might be adequate to be copyrightable.¹³⁹

It goes without saying that an individual would be infringing the copyright of the original author if he or she prints out the file without the permission of the author.¹⁴⁰ For instance, there are authors who are sharing their work with publishing companies to print out their original work, sell and distribute for commercial purposes. In a scenario, where other publishing companies get hold of the author's original copyrighted work and sold in the market, the act of selling and distributing of those publication companies would be considered as an infringement of the author's copyright.¹⁴¹

Moreover, users will most likely be unable to create an accurate replica due to technical constraints and henceforth, replicating a copyrighted item would not sufficiently substitute for the original work.¹⁴² Considering photography and 2D artwork, for instance, usually desktop printers will not be able to print with same exclusive effect as acquiring a bigger print or canvas painting. In like manner, 3D printers with mechanical limits can print a limited number of complex articles and such reproductions would not be an artistic substitute for an intricate work of statue or sculpture.¹⁴³ It is important to note that, regardless of whether replicas of structures produced by 3D printers would be an artistic substitute, the demonstration of replicating may constitute copyright infringement in the light of *Meshwerks*.¹⁴⁴ Consequently, the original owner of that particular structure can bring a claim and uphold their rights against alleged infringers.¹⁴⁵ Since the digital design or CAD files are easily accessible on the internet, the nature of such files is transferable in one's convenience. Therefore, to prevent such cases of infringements copyright holders ought to emphatically concentrate on taking appropriate measures against illicit dissemination of their copyrighted models while 3DP technology is still in its commencement.

3.3.3 Innocent infringer in 3DP industry

Upcoming days in the industry of 3DP, it can be perceived that there will be many innocent infringers who may not be aware of the infringing content on the internet. Infringement occurs as soon as a

¹³⁹ Haritha Dasari, *supra* note 58, Page 308.

¹⁴⁰ 17 U.S.C. § 106 (2006)

¹⁴¹ 17 U.S.C. § 106 (2006)

¹⁴² Haritha Dasari, *supra* note 58, Page 308.

¹⁴³ *Ibid.*

¹⁴⁴ *Meshwerks, Inc. v. Toyota Motor Sales U.S.A. Inc.*, 528 F.3d 1258, 1270 (10th Cir.2008)

¹⁴⁵ 15 U.S.C. §501 (2006)

digital file of a book or novel is printed with an inkjet printer.¹⁴⁶ In the same manner, an infringement by sharing digital design or CAD files can easily extend to 3D digital models. As previously noted, an individual may not have the capacity to mass produce, but it can be foreseeable that as the technology becomes less expensive, the number of individuals with 3D printers will ultimately increase. Consequently, it's just a matter of time when a digital model of 3D articles could be shared with a plethora of 3D printer users to create the item.¹⁴⁷

At present, copyright holders know about infringing content on websites like Thingiverse which requires a takedown notice under DMCA to remove the infringing content. In this process, the copyright owner is required to provide the notice of the infringing item.¹⁴⁸ Consequently, the website should take the measure of removing the content and upon removing, a notice of removal must be sent to the work's creator.¹⁴⁹ Furthermore, the alleged infringer does not have the right to provide a counter-notice to the website regardless of his or her belief that the disputed work is not infringing.¹⁵⁰ If the creator of the copyrighted work files a lawsuit within a specific period of time, that particular material in question can be reuploaded on the website. This note implies that, when enforcement rights are given to copyright holders to take action accordingly and online platforms are encouraged to comply with requirements of the Digital Millennium Copyright Act, claims of copyright infringements will be a lot convenient to resolve in future.

When individuals download music from online are aware of the facts that those downloads are protected works. Likewise, in the picture of 3DP, there will be individuals who would make 3D digital models or download them believing that they have obtained the models from an authorized source but later the work found to be an infringed work, those individuals will be considered as innocent infringers. The case of *Lipton*¹⁵¹ provides the definitions of innocent infringers which involves obtaining copyrighted material from a third party without the knowledge of existing copyright.¹⁵² Applying the precedent in the case of 3D printing, if individual downloads copyright protected 3D digital model regardless of his or her knowledge of the copyright-protected material, he or she is not immune from copyright infringement. The case of *Towle*¹⁵³ illustrates that if an individual with good

¹⁴⁶ 15 U.S.C. §501 (2006)

¹⁴⁷ Ashlee Vance, *3D Printers: Make Whatever You Want*, BLOOMBERGBUSINESSWEEK, April 26, 2012.

<www.businessweek.com/articles/2012-04026/3d-printers-make-whatever-you-want> last accessed 2nd June 2019.

¹⁴⁸ 15 U.S.C §512(c)(3) (2006)

¹⁴⁹ *Ibid.*

¹⁵⁰ 15 U.S.C §512(g)(3) (2006)

¹⁵¹ *Lipton v. Nature Co.*, 71 F.3d 464, 471 (2d Cir. 1995)

¹⁵² *Ibid.*

¹⁵³ *Towle v. Ross*, 32 F. Supp. 125, 127 (D. Or. 1940)

faith produces a 3D model based on a copyright-protected object, the individual's action would still constitute an infringement and he or she would be liable.¹⁵⁴ It can be perceived that cases involving innocent infringers will be more as discussed previously regarding HBO's instance against designer Fernando Sosa who created a 3D printed object of iPhone dock in good faith.¹⁵⁵ Even though HBO obviously owned the copyright of the Iron Throne and did not express its plan to sell a duplicate version of iPhone dock, the company did not allow a license to the designer for selling the object regardless of his intention.¹⁵⁶

In contrast, if the copyright owner doesn't have the knowledge prior to the distribution of his or her copyright protected 3D model or failed to provide takedown notice to the online platform and many individuals have already shared and produced replica based on the 3D model, they would be liable as innocent infringers.¹⁵⁷ Considering the aforementioned instance, if individuals have downloaded that particular design for iPhone dock of Iron Throne and printed the object before the designer received the notice from HBO, a large number of individuals have infringed HBO's copyright on Iron Throne. In this type of scenarios, Courts are reluctant to accept the defense of the defendant's good faith. In addition, if all infringers begin to use good faith as a defense then such defense could substantially undermine the protections given to copyright holders. The advancement of the internet in our society has created possibilities for users to share rapidly of protected files on the public domain which can consequently give rise to many innocent infringers. This implies that if 3D printer users are under constant fear of infringing someone's work, that could impede the growth of the 3DP industry. Therefore, to avoid liability the defense of fair use can be obtained by innocent infringers provided by Section 17 of the Copyright Act.¹⁵⁸ If the Court found the substantial elements of original work in infringer's work and actual copying is established, theoretically a fair use defense can be used by the defendant which has been very rare in courts due to its high degree of ambiguity.¹⁵⁹

3.3.4 'Fair Use' defense

According to the section 17 of the Copyright Act, the court will assess four surrounding factors to consider fair use defense. Firstly, the Court will evaluate the purpose and the character of the use of that particular copyright protected work meaning that whether such use of work was used for

¹⁵⁴ *Towle v. Ross*, 32 F. Supp. 125, 127 (D. Or. 1940).

¹⁵⁵ Hurst, *supra* note 62.

¹⁵⁶ *Ibid.*

¹⁵⁷ *Lipton v. Nature Co.*, 71 F. 3d 464, 471 (2d Cir. 1995)

¹⁵⁸ 17 U.S.C. § 107 (1992)

¹⁵⁹ *Campbell v. Acuff-Rose Music, Inc.*, 510 U.S. 569, 577-78 (1994)

commercial gain or for a permissible use, for instance, educational or parody purposes. In the case of *American Geophysical Union*¹⁶⁰ and *Campbell*,¹⁶¹ the fair use defense was provided by both defendants. The *Campbell* case is noteworthy since the United States Supreme Court ruled that a commercial parody can qualify as fair use.¹⁶²

However, it will be difficult for an alleged infringer to apply fair use defense if works were created for commercial purposes with a 3D printer. Based on the precedent from the case of *Sony Corp. v. Universal Studios, Inc.*,¹⁶³ the court will find any work that is used for commercial purposes as unfair.¹⁶⁴ In contrast, if any copyrighted objects are 3D printed and used for educational or parody purposes and constitute infringement, the law would likely to consider such defense and allow the infringer's fair use defense.¹⁶⁵ For educational and research purposes, 3D printers are being used widely and therefore, it can be perceived that students or teachers can create objects with 3D printers for educational or make parodies of existing articles.¹⁶⁶ In order to resolve cases of infringements of this kind, courts are ought to apply their own intuition and consider whether any 3D printed objects for educational or parody undermine the creativity of original creators.

Secondly, the nature of the protected work will be considered and thirdly, the court will critically analyze the amount and the substantial similarity between those two works in question.¹⁶⁷ Assessing the nature of the copyrighted work will recognize the work's originality.¹⁶⁸ In terms of evaluating the amount and substantiality incorporated to the copyrighted work as a whole, the court will analyze the infringing work and evaluate whether it has incorporated noteworthy amount and possess substantial similarity of the original work.¹⁶⁹ 3D printer or scanner users will certainly be interested in creating replicas of the entire digital model or objects and therefore, such attempt will reduce the infringer's fair use defense due to the fact that the attempt was intended to copy the whole work. Consequently, the original creator of copyright-protected work can enforce his or her right against the infringer for using the work provided that the work is used for commercial gain but not educational or parody purposes.

¹⁶⁰ *American Geophysical Union v. Texaco Inc.*, 60 F.3d 913, 918 (2d Cir. 1994)

¹⁶¹ *Campbell v. Acuff-Rose Music, Inc.*, 510 U.S. 569 (1994)

¹⁶² *Ibid.*

¹⁶³ *Sony Corp. v. Universal Studios, Inc.*, 464 U.S. 417, 451 (1984)

¹⁶⁴ *Ibid.*

¹⁶⁵ *Campbell v. Acuff-Rose Music, Inc.*, 510 U.S. 569 (1994)

¹⁶⁶ 3DPRINTINGNUTS, *Stephen Colbert 3D Printed Bust*, <www.3dprintingnuts.com/stephen-colbert-3d-printed-bust/> last accessed

¹⁶⁷ 17 U.S.C. § 107 (1992)

¹⁶⁸ *Feist*, 499 U.S. 361 (1991)

¹⁶⁹ *Campbell v. Acuff-Rose Music, Inc.*, 510 U.S. 569, 586-87 (1994)

Finally, the fourth factor is the market estimation of the copyrighted work and its present value will be assessed.¹⁷⁰ This factor requires a subjective analysis than other factors because the court will be required to have the current value of the work in the market. In the event that an individual creates a product without the knowledge of the 3D digital file as copyright protected work and sells it on the market, there is a chance of having an impact on the cost of original products. Nonetheless, generally replicas are cheaper than original products and consequently, there may not be a noticeable change in the market value of the original product. Based on the discussion it appears that the defense of fair use has less potential to become a triumph since it relies mostly on the precise features of the original work and the way wherein copyright was infringed. Taking into consideration of all the four statutory factors, a court may also use its discretion and take the initiative of a fact-focused initiative for innocent infringers after finding infringement.

3. 4 Cross-border digital commerce and 3DP industry

Human has engaged in international business for over thousands of years and that's how our society has advanced. Technologies are consistently shaping the way we have been traditionally trading. 3DP innovation will certainly create implications in terms of manufacturing products since the elite feature of 3D printing is fundamentally that products can be manufactured anywhere in the world or the digital design file or CAD files can be transferred with just a click on a computer by the internet.¹⁷¹ For instance, an individual in China can easily obtain a CAD file from GrabCAD, create a product without the permission of the original owner and sell those products in the market for own financial benefit. Therefore, if regulations are implemented throughout the U.S. and the EU, the implementations of rules and regulations governing 3DP industry will have a limited effect since they will be confined to those geographical borders and consequently, those measures will not address the global and cross-border flow of digital information in the context of 3DP.¹⁷² For example, legislators in the EU or Congress in the US can implement a notice-and-takedown rule or an improved repair-and-reconstruction doctrine and its effect will be limited within a certain geographical area and effect can be perceived as limited in the world of 3D printing. Therefore, to protect the rights of users in the 3DP industry it is important that digital regulation regarding cross-border digital commerce must be addressed.

¹⁷⁰ 17 U.S.C. § 107 (1992)

¹⁷¹ Tabrez, *supra* note 12, Page 70.

¹⁷² *Ibid.*

Another challenge in the context of 3DP for implementation of digital regulation in the industry of 3DP. For instance, when a CAD file is created in the EU, however the assembling of the product with that specific CAD file is done in another country, such digital exchanged may be challenged along with the result of that procedure.¹⁷³ It might occur because the process of creating objects with 3D printer consists of separate steps as digital creation or alteration of a physical item and printing the product based on the digital design file or CAD file. These steps can be performed by various actors from different parts of the world and their works or any files in digital form of the 3D printing value chain can be disseminated conveniently across borders.¹⁷⁴ Because of this specific reason, the cross-border dispersion of 3D printing makes greater intricacy concerning IP rights as each segment of the 3D printing value chain can be executed in different countries or by different actors.

Considering the advancement of the music industry, copyright law responded to most of the challenges created with the issues emerged from digital music files.¹⁷⁵ Additionally, to protect the creativity of authors means as open software development and creative commons licenses have been provided to authors which enable them to distribute their copyrighted work.¹⁷⁶ Many scholars expressed their opinion regarding personalized 3DP technology as they perceive the beginning of such technology as an open-source development and believe that this technology should allow users to engage through open source licensing.¹⁷⁷ Even though the implementation of open source has been established for a while in other industries, it can be said that in the 3DP platform it would be a relatively new phenomenon. There are many terms which are included in open source license terms and the most common term can be mentioned here as “*copy and distribute the product, use the product for any purpose, and modify, repurpose, and create derivative works of the products*” and this type of terms are intended for the uses of software and digital files.¹⁷⁸ Even though open source license terms are designed to promote users collaboration for new creations and valid throughout jurisdictions with different laws, these terms do not address printed objects in physical form and tangible goods.¹⁷⁹ The 3DP industry requires to protect owners who possess exclusive rights to

¹⁷³ Tabrez, *supra* note 12, Page 70.

¹⁷⁴ *Ibid.*

¹⁷⁵ *Ibid.*

¹⁷⁶ “*What are Creative Commons Licenses?*”, Wageningen University & Research, <www.wur.nl/en/article/What-are-Creative-Commons-licenses.htm> last accessed 7 June 2019.

¹⁷⁷ Hjalte Worm Frandsen, A commercial Perspective on Open Source Hardware: An interdisciplinary Law and Management Investigation of the Personal 3D Printing Industry (Nov. 2012) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2285055> last accessed 8 June 2019.

¹⁷⁸ Circulate 14, *Copyright in Derivative Works and Compilations*, United States Copyright Office, <<https://www.copyright.gov/circs/circ14.pdf>> last accessed 8 June 2019.

¹⁷⁹ Hjalte Worm Frandsen, *supra* note 177. Page 71.

physical goods and therefore, legislation is very much needed to address physically printed objects and tangible goods in open source licensing terms.

However, there were some legislative proposals which concerned digital technology and geared towards regulating the copyright-protected digital works through electronic transmission from any part of the globe.¹⁸⁰ For instance, in the U.S. the Stop Online Piracy Act (SOPA) was an initiative to deal with internet sites which were dedicated to the theft of goods by the U.S., and designed to increase the power of U.S. enforcement officials to secure copyright protection.¹⁸¹

Further, the Attorney General in the U.S. was given the power by the Preventing Real Online Threats to Economic Creativity and Theft of Intellectual Property Act of 2011 (PROTECT IP Act or PIPA) to sue an author or online platform operator whose conduct may infringe any original or derivative works which had an authentic purpose except for facilitating copyright infringement.¹⁸² Such legislative proposals brought a considerable web objection from the online communities against them because the language of those proposed acts were not clear and vague in nature. Consequently, SOPA and PIPA were not executed. Learning from these preceding, Copyright law has been amended to meticulously consider digital data which can be suspected to be infringing rights of creators, particularly, when transmitted to another country in any possible digital form. Applying this very principal, dissemination of any copyright-protected works in the 3DP industry; the subject matter will be CAD files or design files which are used to create 3D printed objects.

The recent case based on 3DP technology has involved infringement of digital files and created debate over the issue of infringements from cross-border data transfer. Even though the technology used in this case was to create physical goods like plastic dental appliances such as invisible braces, however, the claims by the plaintiff did not concern produced objects but the process.¹⁸³ This case engages patent that concerns the manufacturing process of producing objects by Align Technology, Inc.'s Invisalign.¹⁸⁴ Align Technology (Align) had designed a process that was patented to create custom-made aligners for patient's teeth which includes scanning patients teeth. After obtaining scans of

¹⁸⁰ *Ibid.*

¹⁸¹ Michael A. Carrier, *SOPA, PIPA, ACTA, TPP: An Alphabet Soup of Innovation-Stifling Copyright Legislation and Agreements*, 11 NW. J. TECH. INTELL. PROP. 21,21-22 (2013)

<<https://scholarlycommons.law.northwestern.edu/njtip/vol11/iss2/1>> last accessed 9 June 2019.

¹⁸² *Ibid.*

¹⁸³ Sapna Kumar, *Regulating Digital Trade*, 67 FLA. L. REV. 1909, Page 15, (2016)

<<http://scholarship.law.ufl.edu/flr/vol67/iss6/2>> last accessed 9 June 2019.

¹⁸⁴ *Align Technology, Inc. v Clearcorrect Operating, LLC*, 17-2106 (Fed. Cir. 2018)

patient's teeth, those scans were transformed into digital files. The plaintiff's claims concerned the process which includes producing dental appliances, digital information sets, and treatment plans in digital forms and producing the aligners by 3D printing.¹⁸⁵ Therefore, if anyone used the process without the consent of Align or produced such digital data sets, the acts would constitute an infringement of Align's patents regardless whether the elements of the aligner were printed with 3D printer or created with any other medium.

The dispute began in 2006, Align filed a complaint against the OrthoClear¹⁸⁶ companies in the ITC stating that the act of OrthoClear's importation of dental apparatuses from Pakistan violated Align's two patents.¹⁸⁷ It is noteworthy that, Align's claim was based on the violation of Section 337 of the Tariff Act by ClearCorrect, which states that the patent holders shall enjoy exclusive rights of their patented articles and their rights must be protected by the U.S. government from the importation of patented articles.¹⁸⁸ Both parties came to an agreement to a consent order in which OrthoClear decided to agree not to commit any acts, for instance importing such appliances, that were considered to be violating Align's exclusive rights granted by patents and trade secrets.¹⁸⁹ Align brought claims to International Trade Commission (ITC) by arguing that OrthoClear violated the consent decree in 2012. They complained the digital files were downloaded by OrthoClear which were customized by ClearConnect in Pakistan, from a server which was based in Houston to print models for aligners with 3DP technology.¹⁹⁰ For the first time in 2012, Align claimed regarding the importation of digital information, in the *Certain Digital Models* ITC proceeding.¹⁹¹ Further, the original teeth scans were produced by ClearConnect in the U.S. and subsequently, those digital scans were sent to Pakistan where those digital files were transformed to 3D models in CAD files.¹⁹² These CAD files were then received by ClearConnect in the U.S. which printed by 3D printer.

From the above discussion it can be concluded that the relevant sections of this case are- whether the imported digital data sets amount to patent infringement and most importantly, whether digital representations of physical objects can receive patent protection. The dispute between both parties

¹⁸⁵ Sapna Kumar, *supra* note 183. Page 16.

¹⁸⁶ *Ibid*, "Orthoclear" refers to three companies which are OrthoClear, Inc. of San Fransisco, OrthoClear Holdings, Inc. of Tortola (British Virgin Islands); and OthoClear Pakistan Pvt, Ltd. Of Lahore (Pakistan) and that ClearConnect is an agent of OrthoClear.

¹⁸⁷ Sapna Kumar, *supra* note 183. Page 16.

¹⁸⁸ Tabrez, *supra* note 12, Page 72.

¹⁸⁹ Sapna Kumar, *supra* note 183. Page 16.

¹⁹⁰ Debra Thimmesch, *3D Printing at the Center of Controversial Intellectual Property Debate*, 3DPRINT.COM (2015) <<http://3dprint.com/34255/itc-intellectual-property/>> last accessed 4th July 2019.

¹⁹¹ Sapna Kumar, *supra* note 183. Page 16

¹⁹² Debra Thimmesch, *supra* note 190.

was centered on whether the transfer of digital data sets should be considered as ‘importation of articles’ within the scope of the meaning provided by the section 337 of the Tariff Act.¹⁹³ However, eventually, the ITC decided that the digital data sets which were transmitted with the patented method between companies in two different countries were articles. It was held by ITC that the statutory phrase of ‘importation of articles’ should be interpreted to acknowledge the electronic transmission of digital data and recognized that there was importation of digital data which fell under Section 337 of the Tariff Act.¹⁹⁴ The case then went to Federal Circuit which did not deal with any issues of whether digital information constitutes an article which is transmitted in electric form. However, based on the latest news from online, ClearCorrect and Align Technology have agreed for an out of court settlement.¹⁹⁵ ClearCorrect has agreed to pay USD 35 million to bring an end to the dispute with Align and in return, Align has expressed that the company will withdraw all infringement litigation against the company.¹⁹⁶

The ultimate objective to discuss the case of Align and its facts in this paper is to provide the gravity of the complex situation regarding upcoming infringements in the industry of 3DP that will emerge from cross-border data transfer. While this case was strongly concerned with patent infringement, the outcome of this particular case applies to an intellectual property infringement claims which will include copyrights, designs, and trademarks. It can be perceived that the 3D printing ecosystem will have an effect due to the rapid distribution of digital importation of digital files or CAD files from one country to another as till now it is simply not possible for an individual to protect their interest against infringement when a person is able to download a file from website.

Despite the fact that SOPA and PIPA did not come into effect, another attempt was made to provide strong intellectual property rights to innovators and creators. The Online Protection and Enforcement of Digital Trade Act (OPEN) were designed to regulate digital commerce and intended to extend the Tariff Act to allow the ITC to have jurisdiction over any importation that may come in digital form. OPEN would have allowed enforcers to take actions against entities which intentionally promoted infringed materials.¹⁹⁷ Even though the initiative of implementing OPEN failed, the incentive for

¹⁹³ Tabrez, *supra* note 12, Page 72.

¹⁹⁴ Aarti Shah, *ITC on Digital Imports: Takeaways for Softwares, Media Cos.*, LAW360 (April 23, 2014) <<https://www.law360.com/articles/529861>> last accessed 4th July 2019.

¹⁹⁵ Bloomberg, *Clearcorrect and Align Technology agree to settle long-standing patent dispute out of court*, March 28, 2019. <<https://www.bloomberg.com/press-releases/2019-03-28/clearcorrect-and-align-technology-agree-to-settle-long-standing-patent-dispute-out-of-court>> Last accessed 4th July 2019.

¹⁹⁶ *Ibid.*

¹⁹⁷ Sapna Kumar, *supra* note 183.

OPEN was to deter unfair infringements by imports penetrating in the U.S. market and the target was to provide creators the maximum benefit of their creations while maintaining an open internet. I believe this principle can be applied to regulate digital copyright infringement in 3DP industry. Online platforms which promote infringed work or allow users to have benefits that consequently infringers creators work should be excluded or banned from performing any sort of activities online even though surely there will be repercussions. One can argue that, if there are digital border created, this can lead to provide too much jurisdiction to the internet service provider or the government but also at the same time it can be said that the interests of creators or for the advancement of technology may override the interests against infringers from a different country. As stated in many instances, 3D printing technology is a new means for manufacturing products for consumers or creating copied objects, at the same time this technology can be an instrument to make a copy of copyright-protected works and therefore, convenient to infringe copyright. Provided that the laws or regulations are not updated to deal with new technologies like complications emerging from 3DP industry, new robust set of regulations are needed. In the context of the U.S. law, even though OPEN was intended at copyright but failed, the underlying principle of OPEN can be considered to regulate cross-border data transfer and infringements in the 3DP industry.

Chapter 4: 3DP technology and the CAD file

Based on the brief discussion in prior chapters regarding CAD file, it can be perceived that CAD file is the most significant part in the 3D Printing context. It can be a representative of a copyright-protected work, a registered design or a patented invention, or even include a trademark.¹⁹⁸ This infers, utilizing a CAD file to produce objects by individuals or manufacturers will require the permission of the owner of that specific CAD file considering its standard or originality. Utilization of CAD file has been used in different industries for a long time, for example, virtual games, animation, car manufacturing industry,¹⁹⁹ textile design²⁰⁰ or architecture sector. Digital manufacturing existed before 3D printing technology emerged in the world.²⁰¹ Therefore, as a result, the legal characterization has economic relevance in the 3DP industry as well as in other industry.²⁰²

¹⁹⁸ Simon Bradshaw, Adrian Bowyer & Patrick Haufe, *The Intellectual property Implications of Low-Cost 3D Printing*, 7 ScriptEd 5 (2010); Daniel Harris Brean, *Asserting Patents to Combat Infringement via 3D Printing: It's No 'Use'*, 23 Forham Intell. Prop. Media & Ent.

¹⁹⁹ Joseph B. White, *One thing isn't new in Car design: Clay Prototypes*, The Wall Street Journal, <www.wsj.com/articles/one-thing-isnt-new-in-car-design-clay-prototypes-1401473645> last accessed 5th July 2019.

²⁰⁰ Mikko Antikainen & Daniël Jongsma, *The Art of CAD: Copyrightability of Digital Design Files*, Chapter 12, Page 258.

²⁰¹ *Ibid.*

²⁰² *Ibid.*

Due to the proliferation of 3D printing technology and considering the legal nature of CAD files, there has not been any specific discussion about the copyrightability of CAD file even though at the core of 3DP is the CAD file.²⁰³ CAD files can be found on all key branches of intellectual property laws as a CAD file can represent a copyright-protected work, a registered design, a patented invention or a trademark.²⁰⁴ There has also not been any specific response from legislator or courts regarding CAD files as to whether such files should be protected by copyright (e.g. as ‘works of art’, ‘software’, or ‘databases’), patents, trademarks or designs.²⁰⁵ This is a question that needs to be focused and addressed considering the potential repercussions from the perspective of intellectual property laws and policies. This chapter will fundamentally analyze to answer whether CAD files and works produced using CAD files can receive copyright protection and how CAD files should be portrayed under copyright law. In contrast, it is important to note that along with examining the legal status of a CAD file under copyright law, this chapter will discuss issues from the perspective of copyright framework in the European Union law and the U.S. law.

4.1 Creating CAD file

If someone is willing to create a CAD file to print an object, for instance, a toy of a tiger or digital representation of a drinking glass, two specific ways can be obtained. The first option is to create the CAD file from the scratch by using CAD modeling software or the second option will be to make the CAD file by scanning the object by a 3D scanner.²⁰⁶ Building a CAD file is basically creating a digital design file which is to provide a digital representation of the physical object (e.g. toy of tiger) that will contain all the related information of that particular structure including its shape and dimensions, color, exclusive geometric data, structural strength, object properties, the mass, and all other technical information of the object.²⁰⁷ For a CAD file to be printed, the file has to be transformed into a digital file format like ‘*Stereo Lithography*’ (STL) file which is intended to be used by a 3D printer.²⁰⁸ As all the information are incorporated into STL file, user can print an object by using a 3D printer and its printing software.²⁰⁹

²⁰³ Ballardini R.M., *supra* note 10. Page 11.

²⁰⁴ Mikko Antikainen & Daniël Jongsma, *Supra* note 200, Page 258

²⁰⁵ Ballardini R.M., *supra* note 10. Page 11.

²⁰⁶ Mikko Antikainen & Daniël Jongsma, *Supra* note 200, Page 259.

²⁰⁷ *Ibid.*

²⁰⁸ *Ibid.*

²⁰⁹ *Ibid.*

The first option requires appropriate design software to create a CAD file from scratch. From the creator's point of view, the design software for creating CAD file can be considered as a virtual working space where objects can be made and modified with the tools provided by the software.²¹⁰ The creator may make various types objects of different shapes, update the mesh and texture of the object as he wishes. Additionally, the object's background can be manipulated, and the creator can control the shading and lighting of the object.²¹¹ The total setting of creating a CAD file from the scratch can be perceived from a professional skilled painting artist who uses pencil, paint and paper or canvas to produce art.

Therefore, a skilled creator could create a digital design file of a toy tiger that may look realistic by adding realistic texture, shape, shadows and detail information to the file. Furthermore, it is noteworthy that creating a CAD model does not always require visual design software as a CAD file can be created with coding by a skilled creator. This process would require the creator to add a series of specific virtual coordinates or geometrical information manually to be read by the 3D printer.²¹² A computer program like OpenSCAD can be one of the possible ways to create a CAD file by creators.²¹³

The second option to create a CAD file is to use the technology of 3D scanner and there are various versions of such technology available for consumer ranging from expensive industrial scanners to highly advanced mobile phone camera software. For instance, iPad application 'itSeez3D' is an application which can be used to extract color and structure information of an object and process captured information to realistic 3D models for 3D printing.²¹⁴ The ultimate objective for the scan is to create an accurate digital copy of an existing physical object by producing its information about shape and dimension into 3D coordinates. When all extracted scanned information by 3D scanner forms into a CAD file which can be manipulated by the creator to its all aspects as any other CAD file.²¹⁵ Even though the scanning technology has been improved over the years, to produce an accurate scan of an existing physical object, the process is still complicated and labor-intensive. However, more discussion on the implications of producing CAD files by 3D scanners and relevant complexities will be followed in the next sections.

²¹⁰ Mikko Antikainen & Daniël Jongsma, *supra* note 200, Page 259.

²¹¹ *Ibid*, Page 260.

²¹² *Ibid*.

²¹³ OpenSCAD, About OpenSCAD, <www.openscad.org/about/html> last accessed 7th July 2019.

²¹⁴ itSeez3D, *Turn your mobile device into a powerful 3D scanner*, <<https://itseez3d.com>> last accessed 7th July 2019.

²¹⁵ Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5, Page 261.

4.2 Copyrightability of CAD file

4.2.1 The European perspective

The discussion regarding the copyrightability of CAD file requires to focus on the main issue which can be expressed as to how should CAD files be recognized based on its characteristics under copyright law? The fundamental question is basically whether CAD files should be considered as literary or artistic works which are subject to receive exclusive protection provided by copyright law? Or CAD files should apply to laws applicable to computer programs?.²¹⁶ The question has been raised regarding the legal status of a CAD file by an emerging body of literature. Some scholars are in the view that the definition of computer programs perfectly fit with the characteristics of CAD files and see them as literary works and most significantly computer programs.²¹⁷ Other opinions that CAD files are just like a drawing or a sculpture which fall under artistic works.²¹⁸ To make it simple, I will investigate how copyright will deal with CAD files if it is prescribed as a work or computer program. The answer will ultimately depend on the process by which the CAD file is created, and whether there were substantial skill and judgment exercised by the creator during production or manipulation of that particular work.

In my view, it is very crucial to determine the category of CAD file between computer program or just a 'work' that receives protection by the 'ordinary' law of copyright. Because if CAD files are considered to be computer programs, they will receive the protection provided by Directive 2009/24/EC of the European Parliament and of the Council of 23 April 2009 on the legal protection of computer programs (Software Directive). Additionally, exclusive rights will be given to the author of that CAD file and those rights are also subject to a set of exceptions. Consequently, exceptions will not apply to the general private copying of CAD files as provided by the InfoSoc Directive.²¹⁹ Likewise, the applicability of exhaustion doctrine and ownership of the copyright in employment relationships will also depend on the legal qualification of CAD files. In the case of *Usedsoft GmbH*

²¹⁶ Directive 2009/24/EC of the European Parliament and of the Council of 23 April 2009 on the legal protection of computer programs, OJ L 111, 5 May 2009, p. 16. Henceforth referred to as '*Software Directive*'.

²¹⁷ Simon Bradshaw, Adrian Bowyer and Patrick Haufe, *supra* note 34, page 24.

²¹⁸ Jeanette Cuzella, *Fast Fashion: A proposal for Copyright Protection of 3D-Printed Apparel*, 13 *Colo. Tech. L.J.* 369, 384-385 (2015); Haritha Dasari, *supra* note 58, Page 279 and 2911 .

²¹⁹ Directive 2001/29/EC of the European Parliament and of the Council of 22nd May 2001 on the harmonization of certain aspects of copyright and related rights in the information society, OJ L 167, 22nd May 2001, Page 10. Henceforth referred to as '*InfoSoc Directive*'.

v. *Oracle International Corp*, The CJEU has held that exhaustion will occur if there are the dissemination of intangible copies of computer programs.²²⁰

To understand the legal status of a CAD file, we can differentiate between two scenarios which are close to the discussion regarding two different ways of creating CAD files that have been discussed above. In the first scenario, a user of a 3D printer creates a new object like a toy tiger by using a CAD program. In the second scenario, an individual uses a 3D scanner to scan an existing item or recreate that existing item by using the CAD file. As shall become clear, in both scenarios the created CAD file can be covered by copyright.²²¹ Now to receive copyright protection for a CAD file, it is required to meet the standard of originality and this requirement has been harmonized for computer programs,²²² databases,²²³ and photographs²²⁴ in the EU. Concerning other subject matter, it can be stated that this requirement has been harmonized by the *InfoSoc* Directive less explicitly. The Court of Justice of the European Union (CJEU)²²⁵ has dealt with many cases and consequently, a uniform concept of originality has been implemented in the EU based on the interpretation of this Directive.²²⁶

The CJEU's decision in the case of *Infopaq*²²⁷ provides an EU-wide understanding of the threshold of originality for the subsistence of copyright. Further rulings provide more clarification on this threshold by the CJEU in subsequent cases, *BSA*,²²⁸ *FAPL*,²²⁹ *Painer*,²³⁰ and *Football Dataco*.²³¹ Before to *Infopaq*, there not any specific understanding within the EU Member States of the threshold of originality and in terms of determining this criterion to provide copyright protect, the EU Member

²²⁰ *Usedsoft GmbH v. Oracle International Corp*, Court of Justice of the European Union (Grand Chamber), Case C-128/11. (2012)

²²¹ Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5, Page 261.

²²² Software Directive, *supra* note 211. 193Art. 1(3)

²²³ Directive 96/9/EC of the European Parliament and of the Council of 11 March 1996 on the legal protection of databases, OJ L 77, 11 March 1996, Page 20, Art. 3(1); henceforth referred to as '*Database Directive*'.

²²⁴ Directive 2006/116/EC of the European Parliament and of the Council of 12 December 2006 on the term of protection of copyright and certain legal rights, OJ L 372, 12 December 2006, Page 12, Art 6.

²²⁵ Common referred as 'ECJ', referred to throughout this chapter as CJEU.

²²⁶ Annette Kur & Thomas Dreier, *European Intellectual Property Law: Text, Cases & Materials*, Page 291 – 293, (Edward Elgar 2013).

²²⁷ Case C-5/08, *Infopaq International A/A v Danske Dagblades Forening*, E.C.R. I-06569, (2009); henceforth referred to as '*Infopaq*'

²²⁸ Case C-393/009, *Bezpečnostní softwarová asociace - Svaz softwarové ochrany v Ministerstvo kultury*. E.C.R. I-13971, (2010); henceforth referred to as '*BSA*'.

²²⁹ Cases C-403/08 and C-429/08, *Football Association Premier League Ltd nad Karen Murphy*, E.C.R. I-09083, *FAPL* (2011); henceforth referred to as '*FAPL*'.

²³⁰ Case C-45/10, *Eva-Maria Painer v Standard Verlags GmbH and others*, E.C.R. I-12533, (2011); henceforth referred to as '*Painer*'.

²³¹ Case C-604/10, *Football Dataco v Yahoo! UK Ltd and others*, 2 C.M.L.R. 24 (2012); henceforth referred to as '*Football Dataco*'.

States took different approaches.²³² Many continental European countries decided to consider a higher standard of originality while the UK took the approach of ‘sweat of the brow’.²³³ In the EU, the existing originality requirement under copyright law is that a work has to be an author’s intellectual creation.²³⁴ The definition of this requirement is adopted widely to include all kinds of works under the Berne Convention into European Copyright law.²³⁵ Based on the five cases mentioned earlier in this section, *Infopaq*, *BSA*, *FAPL*, *Painer*, and *Football Dataco*, decisions from the CJEU can demonstrate that,

1. In order to be considered as original, a work has to be the author’s own intellectual creation which is applicable to all subject matter protected by EU copyright directives.²³⁶
2. The work can be considered as original if the author could add creative elements and free selections which would ultimately mirror his personality,²³⁷ and
3. The work will not be considered as original if the expression is constrained by narrow rules and consequently leave no space for making creative choices, or if there’s only one way to express an idea.²³⁸

Based on the precedents from these cases, my understanding is that, if we apply the originality of CAD files under the EU law, the feature of the CAD file to be assessed which were formed based on just scanning or capturing a picture of a copyright-protected object. Since the author created the CAD file by scanning the object or capturing a picture, such type of CAD file can be perceived as an author’s intellectual creation.²³⁹

Additionally, it must be noted that the work must reflect the author’s personality by demonstrating his creative and free choices. Having said that, I think it would be quite complex to conclude whether a CAD file showing an object which is scanned or whose picture is taken establishes creative and free

²³² Enrico Bonadio, & Nicola Lucchi, *Non-Conventional Copyright: Do New and Atypical Works Deserve Protection?* Page 364, (2018).

²³³ Estelle Derclaye, *Assessing the Impact and Reception of the Court of Justice of the European Union Case Law on UK Copyright Law: What Does the Future Hold?*, *Revue Internationale du Droit d’auteur* 5-117 (2014), <http://eprints.nottingham.ac.uk/3613/2/RIDA_article_derclaye_April_2014_eprints.pdf> Last accessed 12 July 2019.

²³⁴ *Infopaq*, *supra* note 227.

²³⁵ *Ibid.*

²³⁶ Thomas Margoni, *The Digitization of Cultural Heritage: Originality, Derivative Works and (Non) original Photographs*, *IVIR*, 14, <<http://www.ivir.nl/publicaties/download/1507>> last accessed 12 July 2019.

²³⁷ *Ibid.*, note 12; *Infopaq*, *supra* note 204.

²³⁸ *FAPL*, *supra* note 206.

²³⁹ Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5, Page 365.

choices. Up to the extent to which the CAD file precisely depicts the scanned object on the attributes and complexity of the 3D scanner and not on the interference of the creator.²⁴⁰

The implication is that when a CAD file is created or influenced by an object which is copyright protected, the protection for that object will override the CAD file. On the other hand, if an individual creates such CAD file, the file is not eligible to receive copyright protection since there has not been any added creative elements and free choices that would make the CAD file different from its underlying object. However, if there are author's creative and free choices which are demonstrated by the CAD file, such modified CAD file may receive copyright protection as its right. Furthermore, a CAD file can also be perceived as original if the file has been produced from scratch by utilizing design software. This implies that the design is based on a theory from the creator's imagination which is an independent creation.²⁴¹ It is noteworthy that, under EU law, if CAD files are created from scratch, by a creator with CAD software, that file may be adequately creative to deserve copyright protection.²⁴²

4.2.2 The U.S. perspective

In the U.S., the decision of Supreme Court in the case of *Feist*²⁴³ has set the precedent that copyright protection applies only to the original selection and arrangement of the facts, precisely to the expression aspect of databases. As discussed in many instances throughout this paper, it can be said that the case ultimately set up a creativity standard for originality to protect in American law requiring a modicum of creativity, or creative spark. Having said that, low that threshold may be translated fundamentally for the originality evaluation. Therefore, in the U.S., upon application of such a threshold test for originality, courts couldn't find copyright in digital designs. This also points out that there is less probability in providing copyright for the majority of CAD files in that authority.²⁴⁴ To summarize simply, if a 3D design file just demonstrates features of an existing physical object, then the file may not be able to be considered as protectable subject matter.²⁴⁵

²⁴⁰ Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5, Page 365.

²⁴¹ *Ibid.*

²⁴² *Ibid.*

²⁴³ *Feist*, *supra* note 97.

²⁴⁴ Matt Simon, *When Copyright Can Kill: How 3D Printers Are Breaking the Barriers Between 'Intellectual' Property and the Physical World*, 3 Pace IP Sports & Ent Law Forum, Page 74 (2013).

²⁴⁵ *Ibid.*

Moreover, if we consider the case of *Meshworks*,²⁴⁶ the decision of U.S State Court provides that 3D design files of Toyota's vehicles were not copyrightable as those designs considered to be original. The facts of the case were discussed in the earlier section, but it is noteworthy that, the Court considered Meshworks's work as just copy of the original work since they collected information based on existing copyrighted object provided by Toyota and then rendered into a digital file. Eventually, there wasn't any element of originality in using the software to create the replication based on Toyota's products. Most interestingly, the Court noted added that if there were some additional changes with the original version through the software by plaintiffs, for instance, lighting, shading or background, those added elements could have been enough to warrant protection. It can be perceived that the U.S. expects a greater degree of creativity from the author on the process and result in creating an object or digital design.

In my view, if creators are creating CAD files which are based on existing copyrighted objects and creator manipulated most of the features of that particular object with a new idea of the design file, that particular file should be granted copyright protection. This will ultimately encourage innovation from upcoming creators and innovation influenced by existing creations. This initiative is specifically to provide a sense of security to the designer's new creations as due to the requirement of higher creativity. For instance, we can again consider the instance of HBO's notice against Fernando Sosa.²⁴⁷ Even though in this particular case, designer Fernando Sosa had one of the most interesting innovative ideas which was to sell 'iron throne' designed iPhone dock based on HBO's copyrighted object, he was not able to do so since HBO possess the copyright ownership of 'iron throne'. However, although Fernando Sosa came up with the specific idea of marketing such popular product which could create immense opportunities for Fernando Sosa as a designer in a business sense, HBO's instance restricted him to have such opportunity.

Furthermore, till now there has not been any iPhone dock of 'iron throne' being sold for consumers by HBO on the market which implies that if copyright protection for innovations for designers who are willing to modify features of existing copyright-protected designs, designers will ultimately be discouraged and the platform for bringing innovations in the society will be shrunk. Furthermore, HBO's action against Fernando Sosa has also been perceived as a precedent against designers with creative minds. To overcome these giant companies against enthusiastic designers, I strongly believe

²⁴⁶ *Meshwerks*, *supra* note 80.

²⁴⁷ Nathan Hurst, *HBO Blocks 3-D Printed Game of Thrones iPhone Dock*, *Wired* February 13, 2013. <www.wired.com/design/2013/02/got-hbo-cease-and-desist/> last accessed 25 May 2019.

that there should be a collaborative platform where new designers like Fernando Sosa can share their innovative thoughts which will ultimately contribute to the user-generated platform in 3DP industry.

However, Fernando Sosa's work on creating 'iron throne' iPhone dock can be considered a derivative work since it is a user-rendered CAD file based on a preexisting copyrightable work. Hence, the case of *Meshworks* provides that to receive copyright protection for a derivative work, the work must fulfill the same requirement of originality standard as an independently created work. Therefore, in the U.S. the copyrightability of CAD file will depend on whether and to what extent the file passes the test of originality.

According to section 102 of the Copyright Act, "*the subject matter of copyright as specified by section 102 includes...derivative works, but protection for a work employing preexisting material in which copyright subsists does not extend to any part of the work in which such material has been used unlawfully*".²⁴⁸ This makes sense as if materials are added unlawfully to the derivative work by the manipulator of a preexisting work, the extended version of that work will not receive copyright protection. Additionally, it is important to note that a 3D-scanned file which may not be considered as original to receive independent protection as a derivative work for its design drawing element may still gain independent protection for its copyrightable code and this can be perceived as an advantage for CAD file designers.²⁴⁹ This note means that all of the features of a CAD file should be judged based on authors creative contribution and independent process of creating the CAD file.²⁵⁰ Also, designers of CAD files may rely on the decision of the Court from the case of *Théberge*²⁵¹, where it was held that changing an object into a digital medium was considered to be an infringement even though no new copies were created.²⁵² Consequently, the action of digitalizing of an object into a 3D file may receive consideration to be a secondary item and therefore, the CAD file would become a new work that may receive copyright protection on its own as new work is covered under protection as an attribute of the primary object.²⁵³

Without any doubt, the industry of 3D printing is having an extremely fast pace and continuously developing daily basis with user's contribution in building intricate designs for own and consumers

²⁴⁸ 17 U.S.C. § 103(a) (2012)

²⁴⁹ Kyle Dolinsky, *CAD'S Cradle: Untangling Copyrightability, Derivative Works, and Fair Use in 3D Printing*, 71 Wash. & Lee L. Rev. 591 (2014), Page 660, <<https://scholarlycommons.law.wlu.edu/wlulr/vol71/iss1/14>>

²⁵⁰ Kyle Dolinsky, *supra* note 226. Page 660.

²⁵¹ *Théberge v Galerie d'Art du Petit Champlain Inc* [2002] 2 S.C.R. 336.

²⁵² Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5, Page 363.

²⁵³ Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5, Page 363.

in the area of technology. As the technology becomes more common within the community and accessible, there will be more many questions and legal challenges. Considering the digital nature of CAD files, copyright protection is certainly a significant issue as these files can be disseminated around the globe with just a click of a button on the internet. To receive protection, it can be said that users of this technology seeking protection for their creative endeavors will be required to show the substantive amount of originality in their work to share it over the public domain.

Based on the discussion above, users can demonstrate their creativity in their work by making exclusive evidence of their degree of creativity. Mere modification of existing file or work should not receive protection in my opinion but having said that when significant additions to original work can be perceived and the work can be considered as independent creation based on those newly added elements, courts should take a flexible approach in granting protection for creators. Considering the case of Thingiverse regarding ‘Penrose Triangle’, as a platform which received DMCA takedown notice for making CAD files available for downloading, it’s just a matter of time that a copyright holder will accuse a CAD designer, an online platform, or hobbyist for infringement. Understandably, copyright law will highly likely to battle against claims involving such new issues emerging from CAD files as happened in the music industry or peer-to-peer file sharing industry. Now the courts are expected to establish a copyright framework where it should maintain a balance to protect the rights of copyright owners and consider strongly the advancement of new technology rather than restraining it.

4.3 Copyright implications of 3D scanning

The advent of 3DP technology will raise several implications concerning 3D scanning as it is obvious that when the 3D printer will be available as home appliances, the question of whether existing copyright law is sufficient to regulate this new technology must be answered. This particular section concerns about 3D scanning of objects by users or manufacturers of 3D printers to print or manufacture objects, and copyright implications of 3D scanning. Creating a digital scan of physical things would require a skilled individual a significant amount of time, hard work and creativity that comes into matter.²⁵⁴ Moreover, the crucial part in the context of 3D scanning is that the ownership of the scan may be different from the ownership of the object which is being printed by manufacturers or users using 3DP technology.²⁵⁵ Commercial contracts can be enforced and dictate

²⁵⁴ Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5, Page 220. (2017)

²⁵⁵ *Ibid.*

the ownership of 3D scans which is bound between parties to that specific contract, although, copyright law creates better protection even for third parties.²⁵⁶ As discussed above, it's clear that the concept of copyright- protection has been implemented to encourage creativity, hard work or reward but to enjoy copyright for 3D scans by individuals, the originality requirement of copyright must be fulfilled.²⁵⁷

To understand the copyright implications of 3D scanning, the connection between copyright and 3D scanning, I will consider the question of whether copying a scan should be considered an infringement in a right held by the person who created the scan. However, copyright does not automatically protect everything that is created by individuals or organizations around the world. As like any other works, to receive copyright protection, 3D scans must fulfill the requirements provided by the law to enforce rights against infringers.²⁵⁸

Scanning technology for 3DP can be partitioned into two categories, such forms can be described as contact and non-contact. Contact 3D scanners are required to contact the subject physically for the outcome and on the other hand, non-contact scanners operate by delivering radiation or light to review the subject. In any case, regardless of the process that a 3D scanner obtains to produce the digital model, a tangible object can be created depending on the on-screen image.²⁵⁹ This specific process has been mentioned earlier in the first chapter which is known as rapid prototyping²⁶⁰ or additive manufacturing. Since the innovation for 3D printers is becoming available and less expensive, giant international companies and entrepreneurs have invested in the 3DP industry which has resulted in decreasing the cost of 3D printers and scanners worldwide.²⁶¹ At this very moment, 3D printers can be bought from vendors by casual customers for just only \$1,500.²⁶²

Regarding 3D scans, we need to consider whether 3D scans meet those criteria and fall in the scope of copyright protection. This must be noted that original and creative works are protected by copyright but not because of the hard work and special skills. However, the 3D scanning process

²⁵⁶ Aliza Rana, *Scan, Copy, Print: How to Minimize Copyright Infringement During the 3D technology revolution*, <https://cblr.columbia.edu/wp-content/uploads/2018/07/6_2018.2_Rana_Final.pdf> Last accessed 10th July 2019.

²⁵⁷ *Ibid.*

²⁵⁸ Aliza Rana, *supra* note 256.

²⁵⁹ Lilli Manolis Sherman, *3D Printers Lead Growth of Rapid Prototyping*, *Plastics Technology*, 1st August 2004, <www.plotonline.com/articles/3d-printers-lead-growth-of-rapid-prototyping> last accessed 28 May 2019.

²⁶⁰ *Ibid.*

²⁶¹ Lilli Manolis Sherman, *supra* note 259.

²⁶² Mitchell, *supra* note 49. Such 3D printers cost less because of their size and functionality and since they are sold to the general public. Compare to manufacturers, casual customers tend to produce fewer products. This implies that since manufacturers are likely to produce more copies, there will be a higher risk of copyright infringement.

consists of three phases which can be pointed out as, (a) preparing the scan, (b) making the scan, and (c) processing the data generated by scan.²⁶³ Each of these phases should require originality to be copyright protected. The first phase which is preparing the scan, the person who is responsible for scanning must arrange the lighting, backgrounds, and position of the object so that the scanning can be done properly.²⁶⁴ Making the scan is simple as it may require the person to operate the scanning machine and finally, processing the data phase is meant to present the data as a useful source for manufacturers.²⁶⁵ Now the issue is basically that, when it comes to discussing regarding photographs and scanning, the courts have been vague regarding assigning creativity of the creation of an image in the steps of this process, and whether copyright should be attached to first, the second or third part of the whole process.²⁶⁶ A creative person may argue that any phase of this process is sufficient for obtaining copyright but ultimately if the scanner is creating a digital file based on an object which is copyright protected, it may be considered as an infringement of copyright.

The easier way to determine the originality of 3D scans and whether it should enjoy copyright protection would be to consider the intent of the scanner which can be categorized in two ways, representational scans and expressive scans.²⁶⁷ Representational scans can be considered as those which are transferred from physical objects to digital medium which is not eligible for copyright protection for being not creative even though those scans can serve as the foundation for creative work.²⁶⁸ In contrast, expressive scans are those designed explicitly to interpret the scanned object differently and to modify the outcome with an expressive purpose that varies from the original. Therefore, expressive scans are eligible for copyright protection.²⁶⁹ Today most of the scans are representational scans and consequently, such scans do not qualify to receive copyright protection.²⁷⁰

One of the key differences between representational scans and expressive scans is the goal of representational scan is to create a scan as accurately as possible based on the object. Which means that representational scans are constructed to eliminate any differences that may occur while creating the resulting file. Furthermore, two skilled scanners may try to create a scan based on one physical object where one of the skilled scanners may produce a better result than others. Despite creating the

²⁶³ Scan in a Box, *Guide to the Ideal 3D Scan*, <www.scaninabox.com/guide-to-ideal-3d-scanning-part-2-scanning-procedure.html> Last accessed 10th July 2019.

²⁶⁴ Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5, Page 227.

²⁶⁵ *Ibid.*

²⁶⁶ *Ibid.*

²⁶⁷ *Ibid.* Page 220.

²⁶⁸ *Ibid.*

²⁶⁹ Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5. Page 220.

²⁷⁰ *Ibid.* Page 228.

better results, none of those results possess creative decisions or original element in their creativity and therefore such representation scans are not considered to be eligible for copyright protection. The Court's decision in the case of *Batlin* is related in this context as the precedent provides that the mere reproduction of a work of art transformed in a different medium may not constitute the required originality which implies that the result of representational scans is not to be considered as original.²⁷¹ Additionally, for instance, if one produces a medical image by using the 3D scanner with the decision to create the best diagnostic image possible, the process certainly lacks the creative expression of a scanner and therefore, medical scans cannot receive copyright protection.²⁷²

In contrast, expressive scans are eligible for copyright protection because produced scans have the creative impressions of the scanner. Expressive scanners goal can be distinguished by the goal as the objective is to produce a creative impact or to provide an expressive signature, reproducibility and verifiability ultimately become less priority.²⁷³ When a new scan is produced with creative features, that scan is not considered to be a mere reference but a creative work which is justifiably considered to be protected by copyright.²⁷⁴ However, it is important to note that the act of scanning a copyright protected object or the act of creating a copy of it, to the same medium or another, can be perceived as an infringement. If the person who created the scan based on the copyright protected object doesn't get the protection of copyright, the owner of that copyright-protected object can bring an action against the person who created the scan and anyone who reproduces the file.²⁷⁵ It is also important to note that, there are some exceptions which are applicable to scanning. In some situations, copying work to another medium can be protected by fair use and consequently, such an act will not be considered as copyright infringement.²⁷⁶ For instance, one can make copies of a CD that he bought from the market and those copies for own use will not constitute infringe on the original or a student can but a picture from the market and can make copies of that particular picture to share between students for research or educational purposes.

However, the ultimate goal of scanning is to transform an object accurately from one medium to another, so to say from a physical object to a digital file. Therefore, it is very much possible that digital files of scans which are created by follow-on scanners based on physical files have substantial similarity between those scanners who came before them. If such scans are considered to be

²⁷¹ *L. Batlin & Son V. Snyder*, 536 F. 2d 486, 491 (2nd Cir. 1976)

²⁷² Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5, Page 231.

²⁷³ *Ibid.*

²⁷⁴ *Ibid.*

²⁷⁵ Weinberg, M., *supra* note 2.

²⁷⁶ *RIAA V. Diamond Multimedia Systems*, 180 F. 3d 1072 (9th Cir. 1999)

eligible for copyright protection, similarities between those scan files may lead to copyright infringement between the first scanners and the follow-on scanners even though those files were created independently.

Furthermore, if an object is copyright protected, the act of creating a copy or scanning the same object in another medium can be considered infringement. Subsequently, even if the person who is not granted copyright for creating the file, the copyright holder for the original object may object to the person for the scan or reproducing the file. 3D scanning can also be discouraging for creativity as such right can be a tool for nuisance in the hand of mischievous copiers in the 3DP industry.²⁷⁷ This implies that if copyright holders cannot impose their rights on the person who is a representational scanner, creators will be discouraged to even designing a product for consumers.

Having said that, since the industry of 3DP is advancing the area of 3D scanning must not be excluded without consideration from the world of copyright. Based on the discussion above, it can be perceived that files which are being created with 3D scanners have got potential to fall within the umbrella of copyright protection. Since 3D scanners are becoming a program for manufacturers and private users as such scanners are becoming smaller, cheaper and universal, there should be more clarity in terms of rules and regulations governing this area of 3DP industry.

4.4 3DP and user generated content complications

In 3D printing online platforms, most of the content are generated by users and therefore, these platforms have a direct responsibility towards their users to protect their intellectual property right like copyright. For users to share their creative work on these user generated content (UGC) platforms, users need to license their copyright.²⁷⁸ The definition of 3DP online platform can be provided as ‘the online platform where service to its users include giving supports and facilitates creation, distribution, sharing and trading of CAD files including printing any CAD files that users may desire’.²⁷⁹ There are more than twenty online platforms which are conducting their business over the internet and providing services to consumer based on their need.²⁸⁰

²⁷⁷ Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5, Page 234.

²⁷⁸ *Ibid*, Page 239.

²⁷⁹ *Ibid*, Page 240.

²⁸⁰ For instance, 123D, 3D Burrito, 3D Hubs, Thingiverse, Myminifactory, GrabCAD, 3DCreationLab, 3DPrintUK, Cuboyo, iMaterialize, Sculpteo, Trinkle, Leopoly, Kraftwurx, 3Dagogo, Cgtrader, Fastprotos, Materialise Onsite, Ponoko, Youimagine, The 3DPrinter Experience etc.

Online platforms require their users to accept their terms and conditions for using their service and upon accepting those terms and conditions, users are bound by the agreement with the platform.²⁸¹ This agreement between online platforms and their users allow to license each other's intellectual property but having said that, users may also be required to allow their license to be used by a 3rd party on the platform by accepting that agreement.²⁸²

In the context of 'user generated content', it is important to define what each term means as copyright protection to each one of them. A 'user' can be defined as the person who uses the services being offered by the platform and who would also be able to create, modify, upload and download CAD files. Most of the contents are generated by the users on the online platforms except for those platforms where platforms operators provide contents to function and run the operation of the platform.²⁸³ This means that the ultimate playground for users is provided by the online platform operators.

Moreover, the term 'generated' can be defined based on the definition provided by the Oxford dictionary which states that 'to produce and create'.²⁸⁴ In the context of 3DP, this would mean that creation of contents, modification of contents by users and platform operators, or simply a reproduction of pre-existing contents from the platforms. Every action of mentioned instance concern copyright law, as the law provides exclusive rights for those actions exploiting the subject matter.²⁸⁵ A creator who creates an original work and uploads the content on the platform is considered to be the author of that particular content and possess all exclusive rights over that content.²⁸⁶ Now a days most of the contents are being created by ordinary people around us which are constantly being uploaded on websites.

A user who uses the content and modifies that content will be considered as the author of that derivative content and consequently requires the consent of the original owner of that content. If the author of derivative content fails to obtain permission from the original owner, then the author of derivative work infringes the right of the original author. In this scenario, online operators are playing a crucial role for creators, and those who are willing to use the content. Consequently, in my view,

²⁸¹ Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5, Page 240.

²⁸² *Ibid.*

²⁸³ *Ibid.*, Page 241.

²⁸⁴ *Ibid.*, Page 242.

²⁸⁵ *Ibid.*

²⁸⁶ *Ibid.*

there is a chance that the operator may become jointly liable for not providing copyright protection to the original author.²⁸⁷

Furthermore, within the context of 3DP UGC, the ‘content’ includes CAD files, object design files, features of the CAD file, features of the object which are demonstrated by CAD file and pictures that depict the original printed-out products. All the included elements in ‘content’ are in digital forms, which are capable of being considered as work and therefore, they are capable of receiving copyright protection by copyright law. Based on the stance of CJEU since *Infopaq*²⁸⁸ ruling, it can be perceived that a common standard has been laid down for copyright protection of a ‘work’ in EU law which precedent followed by domestic courts. The precedent from this case provides that the criteria require the work to demonstrate the author’s independent intellectual creation. Based on this understanding, I believe that EU copyright law has included all kinds of regardless the form of the work, whether the work is in digital form or physical form both entitled to receive protection if the work demonstrates authors creative abilities to make free and creative choices.²⁸⁹ Moreover, there are some EU copyright Directives which are providing rules and regulations for a specific type of work and some Directives are intended to provide rules for a computer program which can be the Computer Program Directive.²⁹⁰

Since all the contents of the online platform are in digital form and can be considered as a computer program, this particular Directive is significantly applicable in the context of UGC. A CAD file can be considered as the blueprint to create an object by a 3D printer, the file is created by utilizing CAD software and therefore it can be seen as a computer program. According to the article 1 of the Computer Program Directive, all member states of the EU are required to provide copyright protection to computer programs as literary works even though there has not been any explicit definition of a computer program. In my view, such an arrangement by legislators was intentional because providing a fixed definition for the computer program may become outdated considering the advancement of technologies. However, Recital 7 of the Directive states that the term ‘computer program’ can also include any other programs which are merged into hardware. This implies that the definition of the computer program in the eyes of EU legislators are very broad and consequently,

²⁸⁷ Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5, Page 240.

²⁸⁸ *Infopaq International A/A v Danske Dagblades Forening*, E.C.R. I-06569, (2009)

²⁸⁹ Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5, Page 243.

²⁹⁰ DIRECTIVE 2009/24/EC of the European Parliament and of the Council of 23 April 2009 on the Legal Protection of Computer Programs, OJ L 111, 23 April 2009, Page 16.

in this stage of 3DP if there isn't clarity regarding the definition computer program, I think in upcoming days there will be more complications in the area of 3DP industry.

4.4.1 Terms and Conditions in the context of UGC

Further, terms and conditions are designed to protect the rights of users and interests of online platform operators. However, it can be perceived that online platforms are pushing their interest proportionally way higher than users' interest.²⁹¹ Since these online platforms are acting as an intermediary between their users and 3rd parties, concerns should be whether these terms and conditions need to be regulated to license copyright within the legal framework as online platforms may end up hijacking users' interests by enforcing their unfair terms and conditions.²⁹²

As stated earlier, 3DP UGC platforms include clauses in their terms and conditions to protect interests for all users using their platform and such clauses concern copyright. These clauses can be considered as the foundations of protecting copyrights of platform users. From the perspective of platform operators, for examples like Thingiverse²⁹³, MyMiniFactory²⁹⁴ or GrabCAD²⁹⁵ have taken every possible measure to protect their interest against the user, additionally, at the same time, they allow their users to use their works in a very explicit way. Which means that use any of works beyond that explicit agreement will be infringing copyright of online platform operators as they are the right holders of their copyrighted works on their websites. Furthermore, operators of online platforms restrict their users to use UGC on their website for commercial purposes by adding clauses as '*for personal and non-commercial uses*' only.²⁹⁶ This term seems to be effective in a sense that users cannot use those sites and services for personal financial gain or commercial purposes and therefore there won't be any infringement of copyrights. In contrast, it should be also noted that, UGC platform operators are restricting their users from some uses which may be still within the scope of 'personal' or 'non-commercial use' and I realize this prohibition as a threat against creative users. For example, clauses like 'users shall not modify, make derivative works of, disassemble, reverse compile, or reverse engineer any part of the Sites or Services'.²⁹⁷

²⁹¹ Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *supra* note 5, Page 244.

²⁹² *Ibid.*

²⁹³ Thingiverse, *supra* note 20.

²⁹⁴ MyMiniFactory, *ON THE ROAD TO DECENTRALIZATION*, <www.myminifactory.com> last accessed 18 July 2019.

²⁹⁵ GrabCAD, *supra* note 18.

²⁹⁶ Makerbot, *Terms of Use*, <<https://www.makerbot.com/legal/terms/>> Last accessed 18 July 2019.; GrabCAD *Website Terms of Use*, <<https://grabcad.com/terms>> last accessed 18 July 2019.

²⁹⁷ Makerbot, *supra* note 296.

These platforms have also included the word ‘by any means’, which implies that users are not able to use their creative mind for new creations because of such restrictions which will eventually discourage them to participate in engaging with 3DP industry. On the other hand, I also believe that these steps by online platform operators can be perceived as extreme measures to secure new authors creations and to avoid legal risks of copyright infringements.

In contrast, users have a contractual relationship for the protection of their intellectual property as soon as they agree to accept the terms and conditions provided by the UGC platforms.²⁹⁸ However, those clauses in that agreement are structured by the online platform operators which raise a concern for copyright protection of users. In my view, since users have to agree with those terms and conditions which is basically created by those online platform operators there may be a potential threat as they lose partial control of their copyright.

Another issue that concerns users is that users are required to waive their moral rights.²⁹⁹ In this sense, I strongly feel that users are allowing UGC platforms a broader scope of uses compared to those granted by them. Therefore, it can impliedly be said that users are losing their IP rights in the bigger picture even though they enjoy the sense of their rights being protected by these online platforms. Moreover, online platform like MyMiniFactory³⁰⁰ requires a warranty from users where they have to warrant that ‘any material uploaded or posted is (the original creation of the user) or (the user has) the necessary rights, licenses, and permissions to submit such content and can lawfully grant (the service providers) the rights required in such content. This condition can be perceived as a strong requirement from the users and also can be a clause model for upcoming UGC sharing online platforms. Because complications of copyright will not arise if uploaded design or works on the website did not infringe any other copyright holders.

To provide maximum copyright protection to users and to achieve maximum certainty in the use of UGC by online platform operators, it seems that users are required to give broad authorization which ultimately becomes an obstacle for users to license their works to others in a business context.³⁰¹ For example, when users are required to grant an irrevocable right, this can imply that the license is going to last forever even if the user terminates their contract. Therefore, it may not be convenient for users to transfer their existing rights to an assignee or licensee to accept copyright

²⁹⁸ Makerbot, *supra* note 296.

²⁹⁹ *Ibid.*

³⁰⁰ Myminifactory, <<https://www.myminifactory.com/pages/terms-and-conditions>> Last accessed 18 July 2019

³⁰¹ Makerbot, *supra* note 296.

since there is a restriction. Even though this situation isn't leading to a copyright infringement, but it is highly questionable whether such a condition is necessary and proportional to the interest served by the agreement.

It goes without saying that without contributions of users on these platforms, the existence of online platforms will be in question and therefore users require more friendly attention of operators. On the other hand, operators seem to be taking advantages of such situation to protect their interest by creating some unfair conditions for users. Having said that, since the 3DP UGC platform is a new business model, a collaboration between users and platform operators can lead to a better user-friendly platform for this innovation and protect their respective rights.

Conclusion

Copyright law continually struggles to keep up with technological advances and without any doubt, 3DP is one of the most advanced technologies that challenge IP law.³⁰² It has been considered as the next disruptive technology to conflict with copyright law.³⁰³ 3DP technology or additive manufacturing is allowing people to produce any 3D object in their own home and therefore, such technology promises to democratize creation.³⁰⁴ Manufacturers around the globe produce products based on consumer demand in their factories and those products are being distributed to focused markets domestically and internationally for sale. Consumers buy their desired products either from online or brand's outlet, which implies that manufacturers have extensive control over their manufactured products while such products may have already distributed in another country or being sold to consumers. The enjoyment of extensive control to owners over their product is given by IP laws and since 3DP came into existence, manufacturers may not enjoy as much as control over their intellectual properties. Therefore, it can be perceived that the technology has huge potential to change industrial production and legal complications will arise regarding the production of goods and replications of proprietary intellectual creations.

There are many issues which will emerge from the 3DP industry and most importantly, some issues are noteworthy which will make the IP issues more complicated and these key issues required to be

³⁰² Ben DEpoorter, Technology and uncertainty: The Shaping Effect on Copyright, 157 U. PA. Rev. 1831, 1835-36 (2009) (Because innovation is rapid and unpredictable, the adaptation of copyright law lags far behind the introduction of new technological advancements)

³⁰³ Peter Hanna, The next Napster? Copyright questions as 3D Printing Comes of Age, ARS TECHNICA (APR. 6, 2011) <<http://arstechnica.com/tech-policy/2011/04/the-next-napster-copyright-questions-as-3d-printing-comes-of-age/>> last accessed 18 July 2019.

³⁰⁴ *Ibid.*

resolved as soon as possible. The first issue can be the current copyright law framework where it has many loopholes and legislators are required to take measures as soon as possible to deal with concerns regarding potential infringement. Secondly, the issue of considering CAD file as a computer program or just to be considered to be a database needs to be resolved. The CAD file is the core of 3D printing of an object which is a digital representation of the produced 3D object. The process can be stated as the first phase requires the 3D printer to utilize the CAD file to print out a 3D object by interpreting the data included in the CAD file. Second phase's ultimate objective is to print the object by 3D printer by the layer-by-layer process. In creating an object, the IP rights in these phases can be different and consequently, it could be really difficult for copyright law to comprehend the whole printing method by 3D printer. There are many other issues in the contest of CAD files which need to be clarified. For instance, it needs to be argued that whether the law is limiting or enhancing freedom of designers of CAD models or creators are making new products using CAD files. Furthermore, is current legal framework being ready to deal with the upcoming market if it becomes overcrowded by individuals who created their own CAD models for objects, share them online and seek protection? What will happen to subsequent CAD models which were already available online? This industry of 3D printing will certainly empower the individuals in their creativity and that's why we will need clear cut laws for third parties to avoid potential infringement and more importantly, balance the interests of third party in new creations.

Finally, since the development of the industry is driving with a really fast pace, courts should adopt a new threshold for determining originality in work as proposed by Edward Lee. The originality requirement is a key element for a work to receive copyright protection. The traditional two-step test derived from the *Feist* case may not be sufficient to determine the originality of works created digitally or creations in the industry of 3DP. Proposed test by Edward Lee additionally improve the test by adding another step considering the "creation process" of work along with analyzing independency of the creator and modicum of creativity. This would mean that in the 3DP industry, the creation process based on CAD file will be analyzed which can be created by an author from scratch, modifying a preexisting design file, or by scanning existing physical object. The final step of Edward Lee test will certainly help courts to determine originality in digital creations although whether the proposed test will be adopted by the courts. The test has been discussed in the third chapter in detail as in my view, there will be many more cases which would require courts to analyze the originality of each work and applying traditional test may not be enough If more complex cases emerge.

Throughout this thesis, the topic of protection of creations under copyright law has been extensively discussed with U.S. copyright legislation and case laws. Even though that there have been legal researchers who have discussed issues in detail regarding copyright protection for creators, still there is no clear comment that would bring an end to the question which this thesis paper intends to answer. Opinions of legal scholars are divided into two or more regarding digital design files or CAD files, and 3D printed objects. Many believe that protecting CAD files would be as hard as protecting creations of authors whereas others are in the opinion that, CAD files may have fewer chances to receive copyright protection than 3D printed objects. In my personal view, since the technology of 3D printing has not been adopted by mainstream society yet and it is still in its very early stage, a contradiction in scholars' opinions have occurred due to not enough legal researches and cases in this particular field. Therefore, researchers, lawyers, scholars, and law librarians should collaborate and produce effective research paper and proposals for legislators as a tool to create a strong framework to protect the interests of creators in our society.

In contrast, dealing intellectual property law issues with new technology by legislators is not a new situation as for instance, new regulations had been implemented to deal with IP law issues emerged from photocopying machines, recording devices like cassettes, video, CDs, MP3s, etc. Such technological advancements created issues before in different intellectual property rights as 3DP technology is creating impact and enforceability issues across the IPRs. To regulate 3DP industry, intervention of legislators in terms of implementing robust set of rules and regulations are must but at the same time in my opinion, intellectual property policies should intensely concern right holders that include creators, manufacturers, and operators of user generated content platforms online.

Based on the analyzation in this this thesis paper it can be said that because of the fast development of the 3D printing industry, legislators are not familiar to many aspects to this technology and therefore, any step for policy-making should include scholars and those who know the industry. Also, it is significant for the technology advanced community to stay abreast of 3D printed objects to avoid any IP infringements since tools for creating 3D printed products are going to more common in upcoming future. 3D printed products are literally being produced and sold around the globe every day and therefore, this field is no longer in its infancy,³⁰⁵ but neither this industry is matured. New technology brings new disruption and 3D printed products will not be different. For instance, 3D printed gun will also bring disruption to existing legal system and resolutions are much required to

³⁰⁵ Jasper Tran, The Law and 3D Printing, 31 J. Marshall J. Info. Tech. & Privacy L. 505 (2015) <<http://repository.jmls.edu/jitpl/vol31/iss4/2>> last accessed 20 July 2019.

deal with such complex legal issues. Again, legal scholars and users are definitely required to work through and manage these concerns regarding laws emerging from 3DP industry.

Economic right of copyright owners can be vindicated by themselves engaging in the marketplace and get profit from their potentially infringing pieces or rightsholders can grant licenses to others who are interested in their work. Refusing to allow someone else to use these 3D works can alienate enthusiasts and threaten the industry creating a limited negative impact. Creators and manufacturers with copyright protected are highly likely to be concerned if 3D printers become widespread as computer and create such impact which would impinge on commercial exploitation of their IP rights.³⁰⁶ The future reactions of copyright holders against infringers can be perceived from the history of copyright infringement in music industry by internet users. Legal and technical responses from copyright owners against infringers have been considered led to a strong set of copyright law and now the percentage of infringements have declined over the years significantly. For instance, if an infringed material is uploaded on a user generated platform like YouTube³⁰⁷, the copyright owner can submit a copyright takedown notice and the right holder is required to consider fair use.³⁰⁸ Applying this principle in the context of 3DP, there will be always ordinary protection for copyright owners but what if the rightsholders aren't aware about the infringement of their work?

Therefore, operators of user generated platforms have to play a strong role to protect interests of their users and provide proposals to strengthen legislative measures. However, fair defense would need to demonstrate that alleged infringer did not use the work for commercial benefit. The ultimate challenge for the court would be to protect the rights of alleged infringer if he acted on good faith and at the same time, the courts would have to consider in a way that if fair defense is used by someone, it must not undermine the creativity of copyright holders or original creators.

Based on the study it can be said that in some segments of 3DP industry, clarity in copyright law is much required to provide substantial profits to the community which will lead companies to engage in the market increasingly. The study also revealed that there are many loopholes concerning rightsholders when it comes to cross-border data transfer. In the context of international trade in the 3DP industry, the biggest challenges for the EU and the U.S. would be to develop sustainable and effective intellectual property rights strategies to protect 3D printed creations. Realistically, it is just

³⁰⁶ Simon Bradshaw, Adrian Bowyer and Patrick Haufe, *supra* note 34. Page 30.

³⁰⁷ YouTube, <www.youtube.com>, last accessed 20 July 2019.

³⁰⁸ *Ibid.* Submit a copyright takedown notice, <<https://support.google.com/youtube/answer/2807622?hl=en>> Last accessed 20 July 2019.

a matter of time that copyright holders bringing actions against online platforms that make or allow users to download CAD files, a CAD designer or hobbyist, for instance, giant company like HBO's action against Fernando Sosa can prove this opinion. At present, existing copyright law will highly likely to manage all these claims and even though it may protect creations, on the other hand, it may become an obstacle for the advancement of 3DP industry. The ultimate expectation from the courts by 3D printing industry would be an establishment of a copyright jurisprudence which will provide protection to copyright owners and allow the development of 3DP industry by adopting modern doctrines to create a community of democratizing creation.

BIBLIOGRAPHY

Books

1. Marcus Norrgård, Rosa Maria Ballardini & Jouni Partanen, *3D Printing, Intellectual Property and Innovation: Insights from Law and Technology*, (2017)
2. Annette Kur & Thomas Dreier, *European Intellectual Property Law: Text, Cases & Materials*, (2013).
3. Enrico Bonadio, & Nicola Lucchi, *Non-Conventional Copyright: Do New and Atypical Works Deserve Protection?* (2018).
4. Lucie Guibault, *Relationship Between Copyright and Contract law in Research Handbook on the Future of EU Copyright*. (Estelle Derclaye, ed., Edward Elgar, 2009).

International Legislative treaties

1. Berne Convention for the protection of Literary and Artistic Works of 9 September 1886. Paris Act of 24 July 1971, as amended on 28 September 1979. WIPO, Geneva.
2. The Agreement on Trade Related Aspects of Intellectual Property Rights. 15 April 1994, WTO, Marrakesh.
3. WIPO Copyright Treaty. 20 December 1996. WIPO, Geneva.

European Union legislative materials

1. Directive 96/9/EC of the European Parliament and of the Council of 11 March 1996 on the legal protection of databases OJ L 077, 27.03.1996
2. Directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the harmonization of certain aspects of copyright and related rights in the information society. OJ L 167/10, 22.06.2001
3. Directive 2006/11/EC of the European Parliament and of the Council of 12 December 2006 on the term of protection of copyright and related rights. OJ L 372/12, 27.12.2006.
4. Directive 2009/24/EC of the European Parliament and of the Council of 23 April 2009 on the legal protection of computer programs. OJ L 111/16, 5.5.2009.

US Legislative materials

1. Copyright Act, Title 17 United States Code.
2. The Digital Millennium Copyright Act of 1998.

Peer-reviewed sources and other sources

1. Salgarkar, Optical Measurement Market Worth 5,14 Billion USD by 2023, Cision PR Newswire, www.prnewswire.com/in/newsreleases >, last accessed May 24, 2019.
2. Weinberg, M. (2013). What's the Deal with Copyright and 3D Printing? *White paper from Public Knowledge's Institute for Emerging Innovation*.
3. Ballardini R.M., Lindman J. & Flores Ituarte I., "Co-creation, commercialization and intellectual property – challenges with 3D printing", in *European Journal of Law and Technology*, Vol 7, No 3, 2016.
4. Tabrez Y. Ebrahim, 3D Printing: Digital Infringement & Digital Regulation, Page 41, 14 *Nw.J. TECH. &INTELL. PROP.*37. (2016).
www.scholarlycommons.law.northwestern.edu/njtip/vol14/iss1/2>
5. GrabCAD: Design Community, CAD Library, 3D Printing Software, www.grabcad.com> last accessed 20 May 2019.
6. Onshape Product Design Platform, www.onshape.com> last accessed 20 May 2019.
7. Thingiverse – Digital Designs for Physical Objects, www.thingiverse.com> Last accessed 20 May 2019.
8. Circulate 14, Copyright in Derivative Works and Compilations, United States Copyright Office, <https://www.copyright.gov/circs/circ14.pdf> > last accessed 8 June 2019.
9. BricsCAD: 2D & 3D CAD software with industry leading support – Bricsys www.bricsys.com/en-intl/> last accessed 20 May 2019.
10. Cults: Download for free 3D models for 3D printers, www.cults3D.com> last accessed 20 May 2019.
11. Pinshape: Free 3D Printable Files and Designs, www.pinshape.com> last accessed 20 May 2019.
12. Sculpteo, Online 3D Printing Service for your 3D design, www.sculpteo.com/en/> last accessed 20 May 2019.
13. Tabrez Y. Ebrahim, 3D Printing: Digital Infringement & Digital Regulation, Page 42, 14 *Nw.J. TECH. &INTELL. PROP.*37. (2016)
14. Sean Ludwig, The Pirate Bay launches crazy Physibles Category for printing 3D objects, 24th January 2012. www.venturebeat.com/2012/01/24/pirate-bay-physibles-category-3d-printers> last accessed 15th May 2019.
15. Marianne Daquila, Michael Shirer, IDC Forecasts Worldwide Spending on 3D Printing to Reach 23 Billion Dollars in 2022, IC Media Center, 3rd August 2018, www.idc.com/getdoc.jsp> last accessed 1st May 2019.

16. Vincent Bonneau & Hao Yi, *The Disruptive Nature of 3D Printing, Digital Transformation Monitor*. January 2017. www.ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/ last accessed 23 April 2019.
17. Klaus Schwab, *The Fourth Industrial Revolution*, World Economic Forum, www.weforum.org/ last accessed 28 April 2019.
18. Aarti Shah, *ITC on Digital Imports: Takeaways for Softwares, Media Cos.*, LAW360 (April 23, 2014) < <https://www.law360.com/articles/529861>> last accessed 4th July 2019.
19. Jack Coylar, *3D PRINTED MOLDS ARE HELPING NASA TO INSULATE ITS NEWEST DEEP SPACE ROCKET*, (April 2019) 3D Printing Industry, www.3dprintingindustry.com/news/3d-printed-molds-are-helping-nasa-to-insulate-its-newest-deep-space-rocket-153780/> last accessed 28 April 2019.
20. Clare Scott, *BMW Group Invests in New Additive Manufacturing Campus*, (April 16, 2018), 3DPRINT.COM, www.3dprint.com/210294/bmw-am-campus/> last accessed 28 April 2019.
21. Larry Dignan, *Siemens Mobility's rail service center bets on 3D printing*, (September 19, 2018), ZDNet, www.zdnet.com/article/siemens-mobilitys-rail-service-center-bets-on-3d-printing/> last accessed 28 April 2019.
22. Simon Bradshaw, Adrian Bowyer and Patrick Haufe, *The Intellectual Property Implications of Low-Cost 3D Printing*, Volume 7, Issue 1, April 2010.
23. André Omer Laplume, Bent Petersen, *Global Value Chains From A 3D Printing Perspective*, Article in Journal of International Business Studies, January 2016.
24. AJ Dellinger, *Scientists Print First 3D Heart Using A Patient's Own Cells*. Engadget, www.engadget.com/2019/04/15/tel-aviv-university-3d-printed-heart/> last accessed 12 May 2019.
25. Andre O. Laplume, Bent Petersen & Joshua M. Pearce, *Global value chains from a 3Dprinting perspective*, Article in Journal of International Business Studies, January 2016, www.researchgate.net/publication/291375376> Last accessed 10 May 2019.
26. Nyman, H.J., & Sarlin, P. *From Bits to Atoms: 3D printing in the context of Supply Chain Strategies*. Paper presented at the 47th Hawaii International Conference on System Sciences, Waikoloa, HI, January 6-9, 2014. www.dx.doi.org/10.1109/HICSS.2014.518> last accessed 17 May 2019.
27. Robbert Janssen, Iris Blankers, Ewoud Moolenburgh, Bineke, TNO: *The impact of 3-D printing on supply chain management*, (April 2014).

28. Sebastian Mohr and Omera Khan, *3D Printing and Its Disruptive Impacts on Supply Chains of the Future*, Technology Innovation Management Review, November 2015 (Volume 5, Issue 11)
29. Mohr, S. *The Impact of 3D Printing on Future Supply Chains*. Master's Thesis, Technical University of Denmark, Copenhagen, (2015)
30. Nyman, H. J., & Sarlin, P. *From Bits to Atoms: 3D Printing in the Context of Supply and Strategies*, Paper presented at the 47th Hawaii international Conference on System Sciences, Waikoloa, HI, January 6-9, 2014, www.dx.doi.org/10.1109/HICSS.2014.518 last accessed 20 May 2019.
31. Lucas Osborn, *Intellectual Property Law's Digital Future*, in RESEARCH HANDBOOK ON DIGITAL TRANSFORMATIONS (F. Xavier & Majlinda Zhegu eds., forthcoming 2016) (Manuscript at 1), www.ssrn.com/abstract=2533673 last accessed 20 May, 2019.
32. Haritha Dasari, Assessing Copyright Protection and Infringement Issues with 3D Printing and Scanning, 41 AIPLA Q. J. 279, Page 282, (2013).
33. Duann, IP, 3D Printing & DMCA, SHAPEWAYS BLOG, February 20, 2011, www.shapeways.com/blog/archives/747-IP,-3D-Printing-DMCA.html last accessed 26 May 2019.
34. Nathan Hurst, *HBO Blocks 3-D Printed Game of Thrones iPhone Dock*, *Wired* February 13, 2013. www.wired.com/design/2013/02/got-hbo-cease-and-desist/ last accessed 25 May 2019.
35. nuPROTO, *3D PRINTING AND PROTOTYPING*, www.nuproto.com last accessed 25 May 2019.
36. Priya Ganapati, *3-D Printers Make Manufacturing Accessible*, *Wired*, August 11, 2009. www.wired.com/gadgetlab/2009/08/makerbot/ Last accessed 27 May 2019.
37. TINKERCAD, *Mind to Design in Minutes*, www.tinkercad.com last accessed 27 May 2019.
38. Replicator G, *Lowering the barrier to 3D printing*, www.replicat.org last accessed 27 May 2019
39. Robert L. Mitchell, *3D Printers: Almost Mainstream*, *COMPUTERWORLD*, December 21, 2011, www.computerworld.com/s/article/9222839/3D_printers_Almost_mainstream last accessed 27 May 2019.
40. Michael Weinberg, *What's The Deal With Copyright And 3D Printing*, 1st January 2013. Public Knowledge,

- <https://www.publicknowledge.org/files/What%27s%20the%20Deal%20with%20Copyright%20Final%20version2.pdf> last accessed May 28, 2019.
41. Thomas Margoni, *The harmonization of EU Copyright Law: The Originality Standard*, Article in SSRN Electronic Journal, January 2016.
www.researchgate.net/publication/315440050 last accessed 30 May 2019.
 42. Manoj Isuru Kotigala, *Rethinking Originality in Copyright Law and Exploring the Potential for a Global Threshold*, Research Gate, www.researchgate.net/publication/311377345
Last accessed 1 June 2019
 43. Hjalte Worm Frandsen, *A commercial Perspective on Open Source Hardware: An interdisciplinary Law and Management Investigation of the Personal 3D Printing Industry* (Nov. 2012) < https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2285055> last accessed 8 June 2019.
 44. Michael A. Carrier, *SOPA, PIPA, ACTA, TPP: An Alphabet Soup of Innovation-Stifling Copyright Legislation and Agreements*, 11 NW. J. TECH. INTELL. PROP. 21,21-22 (2013) <<https://scholarlycommons.law.northwestern.edu/njtip/vol11/iss2/1>> last accessed 9 June 2019.
 45. Lee, Edward, *Digital Originality* (August 13, 2012). *Vanderbilt Journal of Entertainment & Technology Law*, Vol. 14, No. 4, p. 919, 2012; Chicago-Kent College of Law Research Paper No. 2012-11. Available at <SSRN: <https://ssrn.com/abstract=2128799>> Last accessed 1 June 2019.
 46. Sapna Kumar, *Regulating Digital Trade*, 67 FLA. L. REV. 1909 (2016) <<http://scholarship.law.ufl.edu/flr/vol67/iss6/2>> last accessed 9 June 2019.
 47. Edward Lee, *Digital Originality*, 14 Vand. J. Ent. & Tech. L. 919 (2012), <http://scholarship.kentlaw.iit.edu/fac_schol/352> last accessed 5th July 2019.
 48. MAKERBOT INDUSTRIES, *The MakerBot Replicator*, <www.makebot.com/support/replicator/> last accessed 2nd June 2019.
 49. Ashlee Vance, *3D Printers: Make Whatever You Want*, BLOOMBERGBUSINESSWEEK, April 26, 2012. <www.businessweek.com/articles/2012-04026/3d-printers-make-whatever-you-want> last accessed 2nd June 2019.
 50. 3DPRINTINGNUTS, *Stephen Colbert 3D Printed Bust*, <www.3dprintingnuts.com/stephen-colbert-3d-printed-bust/> last accessed 2nd June 2019.
 51. “*What are Creative Commons Licenses?*”, Wageningen University & Research, <www.wur.nl/en/article/What-are-Creative-Commons-licenses.htm> last accessed 7 June 2019.

52. Simon Bradshaw, Adrian Bowyer & Patrick Haufe, *The Intellectual property Implications of Law-Cost 3D Printing*, 7 ScriptEd 5 (2010); Daniel Harris Brean, *Asserting Patents to Combat Infringement via 3D Printing: It's No 'Use'*, 23 Forham Intell. Prop. Media & Ent.
53. Joseph B. White, *One thing isn't new in Car design: Clay Prototypes*, The Wall Street Journal, <www.wsj.com/articles/one-thing-isnt-new-in-car-design-clay-prototypes-1401473645> last accessed 5th July 2019.
54. OpenSCAD, About OpenSCAD, <www.openscad.org/about/html> last accessed 7th July 2019.
55. itSeez3D, *Turn your mobile device into a powerful 3D scanner*, <<https://itseez3d.com>> last accessed 7th July 2019.
56. Jeanette Cuzella, *Fast Fashion: A proposal for Copyright Protection of 3D-Printed Apparel*, 13 Colo. Tech. L.J. 369, 384-385 (2015)
57. Enrico Bonadio, & Nicola Lucchi, *Non-Conventional Copyright: Do New and Atypical Works Deserve Protection?* Page 364, (2018).
58. Estelle DERclaye, *Assessing the Impact and Reception of the Court of Justice of the European Union Case Law on UK Copyright Law: What Does the Future Hold?*, *Revue Internationale du Droit d'auteur* 5-117 (2014), <http://eprints.nottingham.ac.uk/3613/2/RIDA_article_derclaye_April_2014_eprints.pdf> Last accessed 12 July 2019.
59. Thomas Margoni, *The Digitization of Cultural Heritage: Originality, Derivative Works and (Non) original Photographs*, *IVIR*, 14, <<http://www.ivir.nl/publicaties/download/1507>> last accessed 12 July 2019.
60. Matt Simon, *When Copyright Can Kill: How 3D Printers Are Breaking the Barriers Between 'Intellectual' Property and the Physical World*, 3 Pace IP Sports & Ent Law Forum? (2013)
61. Nathan Hurst, *HBO Blocks 3-D Printed Game of Thrones iPhone Dock*, *Wired* February 13, 2013. <www.wired.com/design/2013/02/got-hbo-cease-and-desist/> last accessed 25 May 2019.
62. Kyle Dolinsky, *CAD'S Cradle: Untangling Copyrightability, Derivative Works, and Fair Use in 3D Printing*, 71 Wash. & Lee L. Rev. 591 (2014), Page 660, <<https://scholarlycommons.law.wlu.edu/wlulr/vol71/iss1/14>>
63. Aliza Rana, *Scan, Copy, Print: How to Minimize Copyright Infringement During the 3D technology revolution*, <https://cblr.columbia.edu/wp-content/uploads/2018/07/6_2018.2_Rana_Final.pdf> Last accessed 10th July 2019.

64. Lilli Manolis Sherman, *3D Printers Lead Growth of Rapid Prototyping*, *Plastics Technology*, 1st August 2004, <www.plotonline.com/articles/3d-printers-lead-growth-of-rapid-prototyping> last accessed 28 May 2019.
65. Scan in a Box, *Guide to the Ideal 3D Scan*, <www.scaninbox.com/guide-to-ideal-3d-scanning-part-2-scanning-procedure.html> Last accessed 10th July 2019.
66. MyMiniFactory, *ON THE ROAD TO DECENTRALIZATION*, <www.myminifactory.com> last accessed 18 July 2019.
67. Ben DEpoorter, *Technology and uncertainty: The Shaping Effect on Copyright*, 157 U. PA. Rev. 1831, 1835-36 (2009)
68. Peter Hanna, *The next Napster? Copyright questions as 3D Printing Comes of Age*, *ARS TECHNICA* (APR. 6, 2011) <<http://arstechnica.com/tech-policy/2011/04/the-next-napster-copyright-questions-as-3d-printing-comes-of-age/>> last accessed 18 July 2019.
69. Jasper Tran, *The Law and 3D Printing*, 31 J. Marshall J. Info. Tech. & Privacy L. 505 (2015) <<http://repository.jmls.edu/jitpl/vol31/iss4/2>> last accessed 20 July 2019.
70. Markforged, *3D Printing Process*, <<https://markforged.com/learn/3d-printing-process/>> last accessed 6 August 2019.
71. Ben Redwood, *The Advantages of 3D Printing*, <<https://www.3dhubs.com/knowledge-base/advantages-3d-printing>> last accessed 6 August 2019.

CASES: The U.S. and European Case Laws

1. Meshwerks, Inc. v. Toyota Motor Sales U.S.A. 528 F.3d 1258 (10th Cir. 2008)
2. Kieselstein-Cord v. Accessories By Pearl, Inc., U.S. District Court, S.D.N.Y – Case No. 80 CiV. 1029 (GLG); U.S. Court of Appeals, Second Circuit – Case No. 1351 (1980).
3. Niemi v. American Axle Mfg. & Holding Inc. WL 2077590 (2006)
4. Feist Publ'n Inc. v. Rural Tel. Serv. Co., Inc, 499 U.S. 340, 362 (1991).
5. Atari Games Corp. v. Oman, 979 F.2d 242 (D.C. Cir. 1992)
6. Baker v. Selden, 101 U.S. 99, 105 (1880)
7. Brown v. Latin Am. Music Co., 498 F.3d 18, 23 (1st Cir. 2007)
8. United States v. Hamilton, 583 F. 2d 448, 450 (9th Cir. 1978).
9. L. Batlin & Son, Inc. v. Snyder, 536 F.2d 486, 489 (2d Cir. 1976)
10. Bernal v. Paradigm Talent & Literary Agency, 788 F. Supp. 2d 1043, 1052 (C.D. Cal. 2010)
11. Boys Music Corp. v. Bolton, 212 F.3d 477, 482, 9th Cir. (2000)
12. Rice v. Fox Broadcasting Co., 330 F.3d 1170, 1174 (9th Cir. 2003)

13. CBS Broadcasting, Inc. v. American Broadcasting Companies, Inc. et al. CV 12-04073 GAF (JEMx) (2012)
14. Align Technology, Inc. v Clearcorrect Operating, LLC, 17-2106 (Fed. Cir. 2018)
15. L.A. Printex Industries, Inc v. Aeropostale, Inc., 676 F. 3d 841, 836 (9th Cir. 2012)
16. Rogers v. Koons, 751 F. Supp. 474, 477 (S.D.N.Y. 1990)
17. King Features Syndicate v. Fleischer, 299 Fed. 533, 534 (C.C.A.2. 1924).
18. Meshwerks, Inc. v. Toyota Motor Sales U.S.A. Inc., 528 F.3d 1258, 1270 (10th Cir.2008)
19. Lipton v. Nature Co., 71 F.3d 464, 471 (2d Cir. 1995)
20. Towle v. Ross, 32 F. Supp. 125, 127 D. Or. (1940)
21. American Geophysical Union v. Texaco Inc., 60 F.3d 913, 918 (2d Cir. 1994)
22. Sony Corp. v. Universal Studios, Inc, 464 U.S. 417, 451 (1984)
23. Campbell v. Acuff-Rose Music, Inc., 510 U.S. 569 (1994)
24. Usedsoft GmBH v. Oracle International Corp, Court of Justice of the European Union (Grand Chamber), Case C-128/11. (2012)
25. Infopaq International A/A v Danske Dagblades Forening, E.C.R. I-06569, (2009)
26. Bezpečnostní softwarová asociace - Svaz softwarové ochrany v Ministerstvo kultury.E.C.R. I-13971, (2010)
27. Football Association Premier League Ltd nad Karen Murphy, E.C.R. I-09083, FAPL (2011)
28. Eva-Maria Painer v Standard Verlags GmbH and others, E.C.R. I-12533, (2011)
29. Football Dataco v Yahoo! UK Ltd and others, 2 C.M.L.R. 24 (2012)
30. Théberge v Galerie d'Art du Petit Champlain Inc [2002] 2 S.C.R. 336.
31. *L. Batlin & Son V. Snyder*, 536 F. 2d 486, 491 (2nd Cir. 1976)
32. *RIAA V. Diamond Multimedia Systems*, 180 F. 3d 1072 (9th Cir. 1999)

Online Newspaper

1. Ian Whadcock, "A third industrial revolution", The Economist
<www.economist.com/node/21551901> last accessed 20th May 2019.
2. TJ McCue, *Significant 3D Printing Forecase Surges To \$35.6 Billion*, Forbes,
<www.forbes.com/sites/tjmccue/2019/03/27/wohlers-report-2019-forecasts-35-6-billion-in-3d-printing-industry-growth-by-2024/#17390b267d8a> Last accessed May 24, 2019.
3. Bloomberg, *Clearcorrect and Align Technology agree to settle long-standing patent dispute out of court*, March 28, 2019. <<https://www.bloomberg.com/press-releases/2019-03-28/clearcorrect-and-align-technology-agree-to-settle-long-standing-patent-dispute-out-of-court>> Last accessed 4th July 2019.