3D Printing: A new round in the battle between Technology and Intellectual Property Rights

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SCHOOL OF ECONOMICS, BUSINESS ADMINISTRATION & LEGAL STUDIES
A thesis submitted for the degree of
MA in Art, Law and Economy

January 2016
Thessaloniki – Greece
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January 2016
Thessaloniki - Greece
Abstract

This dissertation was written as part of the MA in Art, Law and Economy at the International Hellenic University.

3D printing nowadays bears a resemblance to the personal computer revolution, mainly due to its quite affordable home versions compared to the technology used. That encompasses the link between copyright and digital rights, which began concerning the legal community initially as regards movies, music and photos. The ongoing development of 3D printing technologies and services radically affects intellectual property rights worldwide, regardless of local legal regimes.

3D printing is a hot topic, especially considering that the recent developments in the related technology have enabled the printing of physical objects by consumers, which may easily lead to mass-production. Of course, such hypothetic developments do also involve infringements in almost all types of IPRs.

This paper explores the most interesting parts of the Intellectual Property frameworks in the EU, UK and US as regards the use of 3D printing technology; it further examines various issues that concern such use and finally concludes with some recommendations, such as for instance the need for introducing different business models.

Keywords: 3D printing/scanning, IPRs, infringement, business models.

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31/01/2016
Preface

I wish to thank my supervisor, Dr. Irini Stamatoudi, for the continuous advice, pertinent recommendations and the enthusiasm she shared with me.

This study takes into account literature and documents available until January 2016.
Contents

ABSTRACT .................................................................................................................. I
PREFACE..................................................................................................................... II
CONTENTS................................................................................................................. III
INTRODUCTION............................................................................................................ 1
CHAPTER I: THE 3D PRINTING REVOLUTION............................................................ 2
   A. THE TECHNOLOGY .................................................................................................. 2
   B. CAD FILES AND 3D SCANNER ............................................................................. 4
CHAPTER II: INTELLECTUAL PROPERTY AND 3D PRINTING WITH REFERENCES TO UK, US AND EU LEGAL FRAMEWORKS .................................................................................. 6
   A. COPYRIGHT ........................................................................................................... 7
      i. UK ....................................................................................................................... 8
      ii. US .................................................................................................................... 10
      iii. EU .................................................................................................................. 12
   B. INDUSTRIAL DESIGN............................................................................................ 13
      i. UK ...................................................................................................................... 13
         1. UK REGISTERED DESIGN ............................................................................ 13
         2. UK UNREGISTERED DESIGN ........................................................................ 15
      ii. US .................................................................................................................... 16
      iii. EU .................................................................................................................. 18
   C. TRADEMARKS ...................................................................................................... 19
D. PATENTS .................................................................................................................. 20

CHAPTER III: ISSUES CONCERNING INTELLECTUAL PROPERTY AND 3D PRINTING ..... 22

A. REPRODUCTION THROUGH THE WEB .................................................................... 22

B. ENFORCEMENT ....................................................................................................... 25

C. CAD FILES AND THEIR PROTECTION UNDER COPYRIGHT ............................. 26

D. THE PRIVATE USE EXCEPTION .............................................................................. 28
   i. EU ...................................................................................................................... 28
   ii. UK ................................................................................................................. 30

CHAPTER IV: RECOMMENDATIONS ........................................................................ 31

A. USE OF TECHNICAL PROTECTION MEASURES – INVOLVEMENT OF INTERNET
   SERVICE PROVIDERS ......................................................................................... 31

B. THE NECESSARY PROMOTION OF NEW BUSINESS MODELS ......................... 32

CONCLUSION .............................................................................................................. 35

BIBLIOGRAPHY ......................................................................................................... 36
Introduction

Three-Dimensional Printing (3D printing) allows the manufacturing of physical objects layer-by-layer from digital files. It refers to objects designed on a computer that take flesh and blood with a simple click. Although three-dimensional printers could still be considered a futurist idea, 3D printing is not actually a new technology; it was a US patent invented more than 40 years ago - actually the application for the first patent was filed on 23 July 1971 and published on 09 August 1977 under no. 4,041,476. The patents have recently expired leading to cost reductions that allowed the arrival of low-cost domestic 3D printers and the subsequent development of the corresponding services.

Some experts believe that 3D printing could spark a third industrial revolution making everyone a manufacturer\(^1\). The mass development of this technology gives rise to complex legal issues. Among various legal fields, Intellectual Property Rights (IPRs) run a high risk of being infringed at a global level. The truth is that 3D printing impacts other legal fields as well, such as the environmental and contract law. However, these will not be examined here.

The present thesis will discuss the implications of 3D printing, especially in relation to consumers in the EU, UK and US jurisdictions.

The paper consists of four chapters. It starts with the examination of 3D printing technology and its revolution; the examination of specific aspects of Intellectual Property law, namely copyright, industrial design, trademarks and patents under the aforementioned jurisdictions, follows; afterwards, the issues that are prone to occur from the interaction between IPRs and 3D printing are reviewed; last but not least, recommendations are made concerning the need for the reform of the law and current business models; lastly, conclusions are drawn.

Chapter I: The evolution of 3D printing

The present Chapter will give a brief analysis of the technology behind the 3D printing technology and the particularities of the CAD files and 3D scanners.

A. The Technology

It is true that 3D printing is the latest in a long line of disruptive technologies – including photocopiersons, cassette recorders, MP3 players, personal computers, peer-to-peer networks and wikis – which have challenged intellectual property laws, policies, practices and norms.² Its particularities will be discussed in greater detail below.

The Computer Numerical Control (CNC) technology comes in two forms: one is the subtractive manufacturing and the other is the additive manufacturing. The former cuts and extracts the final product from a block, such as laser cutters. The latter constitutes the key aspect of 3D printing technology. 3D printing briefly describes what constitutes the procedure of “additive manufacturing”, which is defined as ‘the process of joining materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies’.³

3D printing is a production process that “builds” a three-dimensional object based on a digital model. More specifically, a 3D printer is a machine that can turn a blueprint into a physical object.⁴ Objects are printed using a broad range of materials such as plastics, metals, plaster, ceramics or synthetic resins.⁵ Other 3D printing devices use cheese, chocolate⁶ or sugar⁷ and researchers have been even experimenting on

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³ Li P. and others, ‘Intellectual Property and 3D printing: a case study on 3D chocolate printing’ 1 JIPLP 322, quoting the definition included in the ASTM F2792 – 12 a standard.
printing meat\textsuperscript{8} and human organs\textsuperscript{9}. It is obvious that the ever increasing variety of potential materials is leading to tailor-made objects used in every sector, such as medicine (surgery, dentistry, etc.), the military, electronics, industrial machines, aerospace etc.

Apart from the materials to be potentially used, there is also a variety in the processes that are used by the 3D printers’ models, the most common out of which are the Selective Laser Sintering (SLS) and the Fused Deposit Modeling (FDM). Both have advantages and disadvantages but such an analysis does not fall within the scope of this dissertation.

3D printers nowadays look like classic inject printers that everyone uses in their daily activities. The main difference is that a regular inject printer prints pixel from the screen onto a piece of paper using ink on a two-axial basis (XY-axis) whereas a 3D printer prints on a three-axial basis (XYZ-axis), therefore it prints on 3D. Most desktop versions of 3D-printers use a filament of ABS-plastic\textsuperscript{10}, which gets fed into the device, heated and pressed through a tiny hole in the printhead. Three-axial movements of the printhead (or the base plate where the object is created) allow the application of single layers of the material.\textsuperscript{11}

\textsuperscript{8} Farina, La stampante 3D che produce bistecche, Corriere Della Sera \url{http://www.corriere.it/scienze/12_agosto_18/bistecca-stampata-3d_cdd39a00-e906-11e1-b806-99ce9fc5f07d.shtml} (2012).
\textsuperscript{9} This is done by applying a solution with stem-cells onto agars or a pedestal. Anderson C., op cit (1), at 97,101 (2013); Zukunft der Medizin: Organe aus dem 3D-Drucker, derStandard.at \url{http://derstandard.at/1363707533751/Zukunft-der-Medizin-Organe-aus-dem-3D-Drucker} (2013).
\textsuperscript{10} Acrylnitril-Butadien-Styrol-Copolymerisate is a matte shining and especially hard plastic. As it is scratch- and bite-resistant and entirely non-toxic, it is used amongst other things for production of the well-known LEGO-bricks \url{http://www.lego.com/de-de/aboutus/news-room/2013/january/55-jahre-lego-stein}.
\textsuperscript{11} Anderson C. op cit (1), at 25 (2012).
B. CAD files and 3D scanners

Everything starts from a computer program that allows 3D design, i.e. the use of Computer Aided Design (CAD) files from the designer-creator.

CAD programs have been a commonplace for architects and other designers, who use them to visualise physical objects (buildings, furniture etc.) before their actual creation.

By using a CAD program a digital model is created that is then being saved in a file. This digital model is “cut” in very thin segmentations, the so-called layers. Every single layer is then sent to a 3D printer that prints layer-by-layer until the final development of the physical object.

To give a brief example of the above it can be said that if someone sends a CAD file with a design of a shoe to a 3D printer, the latter will actually ‘create’ a ready-to-use shoe. In fact, the CAD program running on a desktop computer is a virtual 3D model of an object.\textsuperscript{12}

There is also a specific term used for this procedure, namely the 3D Printer Design Files (3DPFs)\textsuperscript{13} that can be created from scratch by using the aforementioned 3D modeling software. This even allows the inclusion of internal, movable parts.\textsuperscript{14}

It would be fair to say that as a word processor is considered to be better than a simple typewriter, as it gives the author of the text the opportunity to edit the text by freely adding, deleting etc., the same applies to the CAD program/software that enables designers to freely modify the file in order to meet their needs.

\begin{footnotes}
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Alternatively, there is also the option of 3D scanning. This may probably work as follows: someone may take a picture of the object he would like to print from a variety of angles.

Afterwards, they “transfer” these photos to their computer and through special software (e.g. uploading to a relevant cloud) they are transformed into a file containing the 3D object.

There is a variety of such software, for example Autodesk 123D Catch that is offered for free, whereas Microsoft has also developed a similar service. We cannot underestimate the trend of applications for iPhones or Android devices that can turn such phones into a 3D scanner.

Anderson states to the point that “this sort of “guided scanning” may mean that someday if you want to duplicate an object, you may only need to point your phone at it, following the phone’s discretion to move around the object and zoom in on sections, and press “print”. A duplicate, perhaps even in colour, will appear in your desktop 3D printer”.\(^{15}\)

Irrespective of the way that a CAD file is created, the design is considered present and can be widely distributed like any other computer file.\(^{16}\) This is a crucial point from which potential infringements of Intellectual Property Rights, that will be discussed in the following chapters, derive.

\(^{15}\) Anderson C., op cit.(1), at 98 (2012).
\(^{16}\) Weinberg M., op cit (4) (2010).
Chapter II: Intellectual Property and 3D printing with references to UK, US and EU legal frameworks

The first 3D printing case related to intellectual property – especially to copyright – dates back to 2010 and concerns a DMCA takedown notice that was sent to Thingiverse in relation to a Penrose Triangle (or the “impossible triangle”) file posted on the website\(^{17}\). The Penrose triangle is an “impossible figure” that was published by Penrose and Penrose in a 1958 article in the British Journal of Psychology.\(^{18}\) An impossible figure is a type of optical illusion consisting of a two-dimensional figure that is instantly and subconsciously interpreted by the visual system as representing a projection of a 3D object, although it is not actually possible for such an object to exist\(^{19}\).

A few months later, there this case was followed by another takedown notice, as concerned two Warhammer 40,000 style miniatures.\(^{20}\) More specifically, at the early 2013, HBO, that owns the rights in “Game of Thrones”, sent a cease and desist letter to Fernando Sousa, that was the creator and the one that was ‘offering for sale an “Iron Throne Dock” [replicating] the Iron Throne featured on the Series’.\(^ {21}\) Furthermore, at the end of 2013, makeCNC.com sent a cease and desist letter to Google, claiming that a website was ‘selling [their] Copyrighted design works and products used in 3d printing and CNC patterns’.\(^{22}\)

\(^{19}\) Ibid. at 31.
\(^{20}\) Thompson C., “3D printing’s forthcoming legal morass” Wired (31 May 2012) http://www.wired.co.uk/news/archive/2012-05/31/3d-printing-copyright
\(^{21}\) Hurst N., “HBO Blocks 3-D Printed Game of Thrones iPhone Dock” Wired (13 February 2013) http://www.wired.com/design/2013/02/got-hbo-cease-and-desist.
\(^{22}\) The DMCA notice is available at Chilling Effects https://www.chillingeffects.org/dmca512c/notice.cgi?NoticeID=1385945.
Based on the above, even without mentioning the exact facts and each case’s particularities, it is obvious that 3D printing technology, as it was analysed in the previous Chapter, can be used in a manner that may lead to an infringement of intellectual property rights.

The present Chapter will discuss the various ways in which 3D printing-related IPRs (namely copyright, design, trademarks, and patents) are protected in the EU, UK and US legal systems.

As it is impossible to analyse all of them in great detail within the context of this thesis, I will focus on the most interesting legal approaches, taking of course into consideration their well-known historical differences and particularities.

A. Copyright

The term “copyright”, though consistently used in relation to rights in authors’ works, may be used with other meanings as well. It may, for instance, be used to describe the area of law dealing with authors’ works, or to describe the particular right granted under the relevant statute protecting such works.

Another point is that different national legal systems describe the subject matter of copyright differently, some covering only productions which may be classified as literary, dramatic, musical and artistic works, others also including productions such as sound and film recordings.

Generally, copyright is a territorial right, it provides the longest period of protection, and it is free and applies automatically from the moment of the artistic creation. What is protected by copyright is essentially the “expression of ideas” and not the ideas themselves\(^\text{23}\), whereas at the same time apart from the requirement that the idea has to be expressed - the so-called principle of “fixation” in the copyright terminology - such fixation has also to be “original”. The notion of originality is of great importance and has different approaches worldwide, as it will be discussed below.

\(^{23}\) This the so-called principle of “idea-expression dichotomy”, that is fundamental in US.
i. UK

Under Section 1(1)(a) CDPA 1998, it is stated that copyright subsists in original literary, dramatic, musical or artistic works (closed list system) and of course the work must be “fixated” and original.

Under Section 4(1)(a) and 4(2) “artistic work” means 24:

(a) a graphic work (including any painting, drawing, diagram, map, chart or plan, and any engraving, etching, lithograph, woodcut or similar work), photograph, sculpture (including a cast or model made for purposes of sculpture) or collage, irrespective of artistic quality;

(b) a work of architecture being a building or a model for a building; or

(c) a work of artistic craftsmanship.

As it occurs from the above list, 3D printing is not part of the works that are explicitly protected by copyright.

Trying to include it in one of aforementioned categories, in order to qualify protection, it could be considered as a sculpture; but according to the judgment in the case Lucasfilm v Ainsworth 25 “not all three-dimensional representations of a concept can be regarded as a sculpture, but an object will not be disqualified from being one from having additional uses”. 26 3D printing could also be considered as a work of artistic craftsmanship; but according to the judgment in the case George Hensher Ltd v Restawhile Upholstery (Lancs) Ltd 27 “…a work has to be the outcome of a craftsman’s activity aiming at an artistic result…” 28.

26 Ibid.
27 George Hensher Ltd v Restawhile Upholstery (Lancs) Ltd [1976] AC 64.
28 Ibid.
Some writers\textsuperscript{29} consider that 3DPFs (as discussed in the previous Chapter) “...may be protected by literary copyright in the same manner as a computer software, which as a series of instructions, it resembles...”. However, neither such option seems convincing enough; the prevailing view considers 3DPFs to be graphic works protectable by copyright irrespective of artistic quality, as long as they are original of course.

The notion of originality is concerned with the relationship between an author or creator and the work. That is, originality is not concerned with whether the work is inventive, novel, or unique. The traditional British approach to originality is reflected in the fact that the author or creator must have exercised the requisite intellectual activities i.e. the competent labour, skill and judgment.

The originality requirement for works protected irrespective of their artistic quality, according to Torremans\textsuperscript{30}, “demands that the work should not be copied, should originate from the author, and its creation should involve the minimal amount of skill and labour”.

On the basis of this approach, it could be concluded in the majority of cases that by using the competent modeling software, the articles created will be original, regardless of a copyright infringement of a previous existing work.

Situation changes as regards the 3D scanning process, also discussed in the previous Chapter, where it was stated that this is an automatic process which leads to mere digital copies of the physical articles, so 3D scanned files do not cover the requirements of originality that could provide them the adequate protection under copyright.

It is another case when the creator further modifies the scanned files and results in a “derivative” work, meaning that these modified files will be protected by copyright, being distinct original works.

\textsuperscript{29} Bradshaw S., Bowyer A. and Haufe P., op. cit. (13) (2010).

ii. US

The provisions of the United States Code that are applicable to copyright are reflected in the Chapters 1-13 of Title 17.\(^{31}\)

Section 101 contains a long list of works included in the term “pictorial, graphic and sculptural works”: these include two-dimensional and three-dimensional works of fine, graphic and applied art, photographs, maps and technical drawings, including architectural plans.

3DPFs seem to be included in the aforementioned term as “technical drawings”. Moreover, they respect the requirement of being fixed on a tangible medium of expression given that “they can be perceived, reproduced or otherwise communicated, either directly or with the aid of a machine or device”.\(^{32}\)

Moreover, it is very important to notice that the definition descriptions in section 101 also seek to exclude “useful articles”. A “useful article” is an article having an intrinsic utilitarian function, which is not to merely portray the appearance of the article or to convey information. This is the fundamental principle of severability that has been further developed into what has been called the “severability test”.

More specifically, some functional objects undoubtedly also serve certain decorative and creative purposes protected by copyright.\(^ {33}\)

Following Weinberg’s example\(^ {34}\), the severability test briefly describes the case when an uncopyrightable object (e.g. a vase) and a copyrightable object (the decoration on the vase) can exist in the same object (the decorative vase). Under this test, any decorative elements of the object that exist outside the scope of the useful object are protectable under copyright.

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\(^{33}\) Weinberg M. op. cit. (4) (2010).
\(^{34}\) Ibid.
Always according to Weinberg\(^{35}\): “If an object has both artistic and useful features, the copyright does not extend to protect the entire thing. Instead, copyright protection is limited to the artistic features that can stand alone – assuming there are copyrightable features that can stand alone.

It protects those features by ‘severing’ them from the rest of the object. If the artistic and functional features cannot be separated, the law errs on the side of keeping useful objects available to everyone and excludes the object from copyright protection altogether.”

In a report accompanying the Copyright Act, Congress explained that it did not intend copyright to protect industrial products that happen to have “aesthetically satisfying and valuable” shapes.\(^{36}\) Instead, only “physically or conceptually” severable elements could be protected by copyright.\(^{37}\) But of course this is not easy; the “severability test” has been applied in the following cases leading to different outcomes in different circuits. Specifically, there will be briefly mentioned four cases and will be described the competent rules used in order to find severability.

The first case concerned a pair of fancy belt buckles\(^{38}\), where there was to determine if artistic elements play a primary or secondary role in the object in order to find severability.

The second case dealt with four department store mannequins: two male and two female torsos without necks, arms, or backs\(^{39}\), where there was to find out whether any potentially severable elements were driven by utilitarian needs.

\(^{35}\) Weinberg M. “What’s the deal with copyright and 3D printing?”, (2013).
\(^{37}\) Ibid.
\(^{38}\) Kieselstein-Cord v. Accessories by Pearl, Inc., 632 F.2d 989 (2d Cir. 1980).
\(^{39}\) Carol Barnhart Inc. v. Econ. Cover Corp., 773 F.2d 411 (2d Cir. 1985).
The third case was about a ride back\textsuperscript{40}, where there was to determine if there are creative elements that were designed without regard for functional requirements.

The last case involved a mannequin head sold to beauty schools and used to teach hair styling\textsuperscript{41}, where there was to determine if independent, artistic judgment drove the creation of the non-functional elements.

There have not been settled any cases yet concerning the rule regarding severability, but taking from the above mentioned cases the prevailing one is the rule expressed in the “beauty school head” case.

According to Weinberg\textsuperscript{42}: “If the elements of the design are non-functional and were developed without regard to utilitarian pressures, they may be protected by copyright.

However, if the design of elements was largely influenced by the practicalities of making and using the object, they are unlikely to be protected by copyright.”

iii. EU

Due to the numerous local regimes, copyright is probably the least harmonized across the European Member States. An effort of harmonization has been introduced by the Directive on the harmonization of certain aspects of copyright and related rights in the information society, the so-called Copyright Directive\textsuperscript{43}.

For instance, no definition is given as to what is subject to copyright protection, leaving the Member States to determine whether copyright protection should apply to industrial designs in their domestic law.\textsuperscript{44}

\textsuperscript{40} Brandir Int’l, Inc. v. Cascade Pac. Lumber Co., 834 F.2d 1142 (2d Cir. 1987).
\textsuperscript{41} Pivot Point Int’l, Inc. v. Charlene Prods., 372 F.3d 913 (7th Cir. 2004).
\textsuperscript{42} Weinberg M. op. cit. (35) (2013).
One could easily reach the conclusion that the 28 Member States of the EU have 28 different copyright laws and the conditions and requirements for protection vary.

Regarding the copyright protection of 3D printing objects, besides the “severability test” (as analysed above) that is also used in some European countries apart from the US, for instance in Italy, there is also a new trend that concerns the principle of “multiple forms”.

This principle applies in terms of assessing originality: the more the shape is dictated by a technical result, the less the creator is able to integrate their artistic expression, and the less the work is likely to be protected by copyright.

It can be considered that the “multiplicity of forms” might help to determine whether or not the author was forced to create in a certain way, the creation being therefore somewhat “imposed”.

B. Industrial Design

i. UK

Design protects the way that a product looks like and the specific particularities of such appearance. In the UK, two different types of legal rights apply: the UK registered designs and the UK unregistered design rights (UKUDR).

1. UK registered design

A designer may seek protection through registration under the RDA 1949, for terms that may extend to 25 years.

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47 Ibid.
Such protection extends only to new designs, a term which is defined to mean “the appearance of the whole or a part of a product resulting from the features of, in particular, the lines, contours, colors, shape, texture or materials of the product or its ornamentation”. 49

Features of appearance are not taken under consideration in case that they are exclusively related to the product’s technical function and also in case that they depend on the features of another article with which the article in question is to be connected. 50 Registrations are possible as regards the appearance of part of a product, and parts intended to be assembled into a complex product.

Valid registration is only possible if the design is “new” and has “individual character”. 51 A design is “new” if no identical design, or no design whose features differ only in immaterial details, has been made available to the public before the date of application.

A broad definition as to when a design is made available to the public is specified 52, but this is subject to a series of limitations, the most important of which relate to the designer’s own disclosure and obscure disclosure which could not reasonably have become known to specialists in the design sector operating in the EEA. 53

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49 RDA, section 1(2). Previous restrictions confining protection to features that have eye appeal, and articles with appearances that matter to consumers, have been removed.
50 RDA, section 1A(1)(b), 1C(1) to (2).
51 RDA, section 1(2),(3).
52 RDA, section 1B(5). This is assessed from the view point of the “Informed user”, a new fictional character, discussed in Woodhouse UK v Architectural Lighting [2006] RPC 1.
53 RDA section 1B (6) (a) (the so called “safeguard clause”); and (c) (the 12 month grace period as regards disclosures by the design or any successor in title). The other disclosures which are ignored under section 1B(6)(b), (d) and (e), relate to disclosures which are in breach of confidence or otherwise abusive.
A design has “individual character” if the overall impression an informed user gets differs from the overall impression made by designs which have previously been made available to the public.\textsuperscript{54}

In deciding whether a design satisfies this requirement, the tribunal is directed to take account of the “degree of freedom of the author in creating the design.”

2. UK unregistered design

According to section 213(2) of the CDPA 1988 UKUDR “design” means the design of any aspect of the shape or configuration (whether internal or external) of the whole or part of an article.\textsuperscript{55}

Design right does not subsist in a method or principle of construction use and features of shape or configuration of an article, according to specific particularities mentioned at Section 213(3)(a)(b)\textsuperscript{56}, whereas Section 213(3)(c) excludes from the design protection the surface decorations (this includes 2D designs on 3D articles).\textsuperscript{57}

In order to be protected under the frame of the unregistered design in UK, a design has to fulfil the requirement of originality in the sense it is not ‘commonplace in the design field in question at the time of its creation’\textsuperscript{58} and it should be recorded in a design document or have an article made to the design.\textsuperscript{59} Besides the exclusion of the design protection mentioned above\textsuperscript{60}, Section 213(3)(b)(i) CDPA 1988 further provides the so-called “must fit” exclusion. More specifically, there is stated that ‘Design right does not subsist unless and until the design has been recorded in a design document or an article has been made to the design’.

\textsuperscript{54} RDA, section 1B(3). The informed user is discussed in The Procter & Gamble Company v Reckitt Benckiser (UK) Ltd [2007] EWCA Civ 936; Case T-9/07 Grupo Promer Mon Graphic SA v OHIM (18 March 2010) (Fifth Chamber) and Case T-153/08 Shenzhen Taiden Industrial Co Ltd v OHIM (22 June 2010) (Second Chamber).
\textsuperscript{55} CDPA 1988, s 213(2).
\textsuperscript{56} CDPA 1988, s 213(3)(a)(b).
\textsuperscript{57} CDPA 1988, s. 213 (3)(c).
\textsuperscript{58} CDPA 1988, s. 213 (3)(c).
\textsuperscript{59} CDPA 1988 s. 213 (1)-(4).
\textsuperscript{60} CDPA 1988 s. 213(3)(a).
There is also provided the so-called “must-match” exception as stated in Section 213(3)(b)(ii) CDPA 1988 concerning the aesthetic appearance of the product. ⁶¹

**ii. US**

The United States have introduced a type of protection for designs that lasts for fourteen years, starting from the date of grant ⁶².

As stated in the chapter 16 of the US Code: “Whoever invents any new, original and ornamental design for an article of manufacture may obtain a patent therefore, subject to the conditions and requirements of this title” ⁶³. The design cannot be protected separately from the product ⁶⁴.

An industrial design has to be original, novel and non-obvious to be granted protection. The novelty requirement is satisfied if “the overall appearance of the design in the eyes of an ordinary observer is different from the appearance of any other design in the prior art” ⁶⁵.

Therefore, as it becomes evident, a third requirement - besides novelty and the individual character – applies in the US; the non-obviousness, which introduces more difficult standards for the designs.

The notion of the “ordinary observer” has led to more discussions than the “informed user” in the European Union, as it will be discussed below.

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⁶¹ For a careful analysis of the exclusions from the scope of the design rights, see Martin Howe, Russell-Clarke and Howe on Industrial Designs (Sweet & Maxwell 2010) 35-49; 201-215.


The Supreme Court, in the Gorham case, had clearly stated that the ordinary observer should not be an expert or someone versed in the trade, but rather someone with “ordinary acuteness, bringing to the examination of the article upon which the design has been placed that degree of observation that men of ordinary intelligence give”.66

However, in the case Arminak & Associates v Saint - Gobain Calmar, the Court of Appeals (Federal Circuit) upheld the decision of the District Court by stating that ordinary observer in this case should be the industrial purchaser.

This decision was related to the circumstance that the product at issue, a sprayer shroud design, was a component part of a product bottle and could not be seen alone by the final consumer.67

Concerning the issue of infringement, the designer was required, until recently, to prove two distinct tests: the so-called Gorham test and “point of novelty” test68.

The former examines whether the two designs can be considered as being identical by asking if an ordinary observer might buy the accused copy mistaking it for the other one69.

The “point of novelty test” questions whether it was the novelty of the registered design, distinguishing it from prior art, which was appropriated by the accused design70.

66 Gorham Manufacturing Co. v. White, 81 U.S. at. 528 1871.
69 Ibid.
70 Ibid.
iii. EU

In terms of harmonization, as already stated above in relation to copyright, the EU design law includes a Regulation\textsuperscript{71} that applies ‘as it is’ in the domestic regime\textsuperscript{72} (that leaves enough room for each country to transpose it differently into its domestic law).

In both pieces of law, the definition of design refers to the ‘appearance of the whole or a part of a product resulting from the features of, in particular, the lines, contours, colours, shape, texture or materials of the product or its ornamentation’.\textsuperscript{73}

The Regulation provides for the existence of both a Registered Community Design (RCD) and an Unregistered Community Design (UCD) with a central registry\textsuperscript{74}.

The RCD term is identical with the registered design provided by the Directive, i.e. 25 years (5 years that can be renewed 4 times)\textsuperscript{75}.

The UCD protection is substantially shorter since it lasts no more than 3 years\textsuperscript{76}. In contrast with the RCD, the UCD occurs upon public disclosure and prevents commercial use of the design only if an actual copy is proven.\textsuperscript{77}

Also ‘a design shall be protected by a Community design to the extent that it is new and has individual character’.\textsuperscript{78} The EU design rights to do although protect all the different particularities and features of the product.

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\textsuperscript{73} EU Designs Regulation, art 3; RDA 1949, s. 1(2).

\textsuperscript{74} Office for Harmonization in the Internal Market (OHIM).


\textsuperscript{76} Art. 11 Regulation (EC) No 6/2002.


\textsuperscript{78} EU Designs Regulation, art 4(1); RDA 1949, s. 1C(1).
Further ‘a design applied to or incorporated in a product which constitutes a component part of a complex product shall only be considered to be new and to have individual character:(a) if the component part, once it has been incorporated into the complex product, remains visible during normal use of the latter; and (b) to the extent that those visible features of the component part fulfil in themselves the requirements as to novelty and individual character’. 79

Designs dictated by their technical function80 and designs of interconnections (‘must fit’ exception)81 are not protected by design. Further from such protection are excluded designs contravening public policy or morality.82

In view of these exclusions, it could be said that many 3D printing items shall not qualify as designs. Spare parts constitute an important example, as they are likely to fall under the ‘technical function’ or ‘must fit’ exclusions.

C. Trademarks

Trademarks are signs that identify and distinguish the origin of goods and services. In the EU, trademark law is mostly harmonised, as a result of the EU Trade Marks Directive83 and Regulation84.

The purpose of this intellectual property right is consumer protection and not the protection of the creators themselves. The trademark gives to consumers the ability to be aware of the origin of the product and the ability to distinguish it from other similar products. Given its particular purpose, the protection is limited in the “use in commerce”. Copying is not in itself a violation of the law.

79 EU Designs Regulation, art 4(2)(a)-(b); RDA 1949, s. 1B(8)(a)-(b).
80 Ibid., art 8(1); RDA 1949, s. 1C(1).
81 Ibid., art 8(2); RDA 1949, s. 1C(2).
82 Ibid., art 9; RDA 1949, s. 1D.
As trademarks do not only protect word representations, the notion of “trade dress” that relates only to the shape of the item has been developed. An interesting example of a trademark is the shape of coca cola’s bottle.

It should be kept in mind that manufacturers will always strive to expand the scope of trademark protection given that it is potentially infinite in time\(^85\) (due to the fact that it lasts only for the period of time that the renewal fees are paid through the years).

Concerning the relation of trademark and technical features, it was mentioned in the \textit{Philips v. Remington}\(^86\) case that the theory of “multiple forms” does not apply to trademark: If the sign is necessary for a technical result, it is excluded.

In the common law system, especially as regards tort law, the notion of “passing off” has been developed meaning that ‘no man may pass off his goods as those of another’\(^87\).

\section*{D. Patents}

Patents may be described as inventions of “new methods of manufacture” and “a patent may be granted only for an invention in respect of which the following conditions are satisfied, that is to say (a) the invention is new; (b) it involves an inventive step; (c) it is capable of industrial application”\(^88\). Their protection is to be distinguished from the one granted under other intellectual property rights and especially copyright.

Firstly, the rights under a patent arise under different legislations - for example the Patents Act 1977 applies in the UK - and are valid for a shorter period of time (in general 20 years).

\begin{footnotesize}
\begin{itemize}
\item \(^{85}\) Weinberg M. op. cit (4) (2010).
\item \(^{87}\) Reckitt & Colman Products Ltd v Borden Inc [1990] RPC 341.
\item \(^{88}\) The Patents Act 1977 (PA 1977), s 1(1).
\end{itemize}
\end{footnotesize}
Furthermore, a patent can be infringed even when the maker of the allegedly infringing article had no knowledge whatsoever of the existence of the particular invention or article covered by the patent. The drawings etc. describing the patent may themselves be subject to copyright protection.

The most obvious connection between patents and 3D Printing is the one resulting from patents relating to 3D Printing technology that will not be further developed in this paper.

According to Mimler\textsuperscript{89}: “3D printing does have the potential to affect patent rights and will become more and more relevant for this field of IP law”.

Chapter III: Issues concerning Intellectual Property Rights and 3D printing

In the previous chapter, the various types of intellectual property rights concerning 3D printing have been discussed and the major differences between the different legal systems mentioned herein, namely the UK, the US and the EU system - with its particularities amongst the Member States – have been underlined.

Based on the above, it can be observed that the easier products are created using the 3D printing process, the more intellectual property rights are involved. Also 3D files are more easily reproduced through the Web.

A. Reproduction through the Web

Digital 3D files that enable the creation of 3D objects may easily be disseminated through and reproduced on the Internet. The reproduction on the Web is nowadays a common phenomenon as regards some fields that are protected under intellectual property rights, referring namely to music files and files that are copyright protected. Many countries accept the possibility for a product to be protected by several IP rights; as a consequence, printing an object might not infringe a specific IP right while breaching another one.90

The English case Lucasfilm v Ainsworth91 provided that there was no copyright protection regarding the helmets created. This decision was confirmed by both the Court of Appeal and the Supreme Court.

In the US case of Lucasfilm92, the District Court found that there was a copyright infringement in respect of Mr. Ainsworth’s acts and it imposed damages of $20 million.

Therefore, it can easily be deduced that a case-by-case approach will be followed, especially in the challenging Web environment.

The major difference between 3D files and music or movie files is that the former can be protected by more than one intellectual property right at the same time. On top of it, their owners can modify them more easily compared to the latter, whenever they want and in any manner of their preference. Such opportunity given to the owners can be interestingly linked to the famous iPod (Apple) commercials and especially the song “Technologic” used therein.93

As technology progresses rapidly and the various programs and software that enable the creation of 3D files are becoming friendlier to the average user, it is apparent that everyone will challenge themselves by “interfering” with the 3D file and changing some of its features, irrespective of their substantial (or not) character.

An illustration of the above can be found in the following cases, which dealt with whether the objects at issue constituted an infringement or not:

At the end of 2011, a conflict occurred between Thomas Valenty and the UK firm Games Workshop94. Thanks to his printer from MakerBot, Thomas had created some figurines inspired by the figurines warhammer95 and posted them on the website Thingiverse, a website for 3D file sharing, mentioned already in the previous chapters.

Actually, there was no certainty that Thomas would have been condemned if the case had been brought before a Court, as he was accused of having copied the style of the game, which cannot be protected96.

93 Daft Punk, “Technologic”, album Human after all, 2005. The first verse of this song goes with: “Buy it, use it, break it, fix it, Trash it, change it, mail - upgrade it, Charge it, point it, zoom it, press it, Snap it, work it, quick - erase it, Write it, cut it, paste it, save it, Load it, check it, quick - rewrite it, Plug it, play it, burn it, rip it, Drag and drop it, zip - unzip it, Lock it, fill it, call it, find it, View it, code it, jam - unlock it, Surf it, scroll it, pause it, click it, Cross it, crack it, switch - update it, Name it, rate it, tune it, print it, Scan it, send it, fax - rename it, Touch it, bring it, pay it, watch it, Turn it, leave it, start - format it”.
94 Thompson C., op. cit. (20) (2012).
95 The warhammers is a collection of figurines (around 30mm) owned by Games Workshop.
96 Thompson C. op. cit (20) (2012).
The figurines had been tweaked before being scanned and posted on Thingiverse. The question that arises here is whether these figurines constitute infringing articles or not.

The same question might be asked for the Penrose triangle case (mentioned in the first chapter) since the 2D Penrose triangle was in the public domain. On the one hand, it could be argued that the 3D form created by D. Schwanitz was creative enough to be separately copyrightable. On the other hand, copyright allows for similar independent creations and the alleged infringing work might be considered as another interpretation of the same underlying public domain Penrose triangle.

The truth is that given the rapid technological process in the 3D printing field, the materials used during this process to create the final product will hugely vary, affecting more aspects of the everyday life, for instance food, fashion, medicine etc.

This may lead to situations in front of the courts in future cases, where the competent judge will have to determine whether, for example, there is an unlawful distribution of a 3D printable bottle covered by thumbtacks.

The judge will face difficulties to determine whether this object is covered by some or any intellectual property rights; at a second level, it will not be easy to determine whether a highly similar bottle constitutes an infringement of the one at issue and things will get more complex for judges in case particular drawings etc. are also involved.

On the contrary, they will definitely face fewer problems when they are called upon to decide whether an unlawful distribution of a copy of a music file has occurred, as it is easier to assess whether that file is under copyright protection and the alleged infringing file is a copy of the genuine one and not a new creation.

\[97\text{ Rideout B., op. cit. (17), p. 170.}\]
\[98\text{ Ibid.}\]
\[99\text{ Ibid.}\]
B. Enforcement

The well-known pirating organization, The Pirate Bay, declared in 2012 that the next major type of circumvented consumer products would be a 3D object:

“One of the things that we really know is that we as a society will always share. Digital communication has made that a lot easier and will continue to do so. (...) Today most data is born digitally.

It’s not about the transition from analog to digital anymore. (...) We believe that the next step in copying will be made from digital form into physical form. It will be physical objects”\(^{100}\).

After having examined all the aforementioned situations concerning the dissemination of the file through the Web and their easy reproduction, we may say that it is not an easy task to assess the alleged online infringements concerning 3D printable objects.

The situation is getting more complex when the need to enforce the rule that is infringed arises. This statement is particularly pertinent to cyberspace and could lead to the observation that copyright protection has never been stronger while copyright enforcement has never been weaker than today\(^{101}\).

A good example as regards the enforcement through the Internet is the French law “HADOPI” under which an ad hoc independent administrative authority, also called HADOPI, was established to ensure the enforcement of copyright protection on the Internet.\(^{102}\)


\(^{101}\) This idea was enhanced by Balázs Bolo, a member of the panel at the presentation “Balancing of fundamental rights in online copyright enforcement” (24 January 2013, Computer, Privacy & Data Protection Conferences, 6th edition, Halles of Schaerbeek, Brussels).

\(^{102}\) Law n° 2009-669 of 12 June 2009 promoting the distribution and protection of creative works on the Internet (Loi HADOPI 1). This law was completed by the Law n° 2009-1311 of 28 October 2009 relating to the protection of literary and artistic property on the internet through criminal law (HADOPI 2) which was basically enacted in order to reintroduce the repressive section of HADOPI 1 censured by the Constitutional Council.
This authority prevents Peer-to-Peer sharing of pirated contents via the three-strikes procedure.

These are: a warning email through the identified IP address, a certified letter and, if the offender still does not comply, a suspension of Internet access from two months to one year.103 A court appeal is possible only during the third phase.

C. CAD files and their protection under copyright

The core purpose of copyright is to grant a monopoly for any reproduction and distribution of the protected work to the rightholder.

As stated in the first chapter of this thesis, a 3D object can be created either by a 3D program that uses special software or it can be a copy of the initial object created by using a 3D scanner.

As a first statement, we could say that everyone is able to digitally create an unprotected object and further print it without infringing any copyright. Furthermore, we could say that everyone is able to use a 3D scanner, scan an unprotected object and obtain a 3D digital copy of it.

Indeed, it could be further considered that “a mere scan should not be independently protected”104 and “the fact that many 3D scanners explicitly try to reproduce the scanned object as faithfully as possible further undermines claims of originality”105.

In that way, the unprotected scanned file could be integrated in a CAD file, providing the option to modify it according to the owner’s taste without infringing any copyright.

104 Weinberg M., op cit (35), p. 15.
105 Ibid.
On the other hand, the reproduction of a copyrighted object is an infringing act. So, using a 3D printer to reproduce an article protected by copyright should definitely constitute an infringement of the copyright that subsists in the genuine object.

In the UK, for instance, this applies irrespective of the material form in which it occurs\textsuperscript{106}, therefore including the “transcription of a work into a digital form”\textsuperscript{107}, whereas, concerning artistic works, according to section 17(3) CDPA 1988: “the making of a copy in three dimensions of a two-dimensional work and the making of a copy in two dimensions of a three-dimensional work” is also a reproduction. Hence, the creation of a digital version of a copyrighted work is an act restricted by copyright\textsuperscript{108}.

Assessment on whether CAD files are protected under copyright varies. According to certain opinions, CAD files lack creativity in order to deserve independent protection.

Weinberg states that: “If there is only one way to represent a given useful object [not protected by copyright] in a CAD program, it is unlikely that a court would grant the designer of the object copyright protection in the design file”\textsuperscript{109}.

In the UK, situation is less complex due to section 51 of the CDPA 1988 and the restriction/limitation that applies thereto, which states that “it is not an infringement of any copyright in a design document or model recording or embodying a design for anything other than an artistic work or a typeface to make an article to the design or to copy an article made to the design.”

According to section 51(3), a “design document” means: any record of a design, whether in the form of a drawing, a written description, a photograph, data stored in a computer or otherwise; such definition enhances the theory that 3DPFs do in fact constitute design documents.

\begin{footnotesize}
\textsuperscript{106} CDPA 1988, s. 17(2)
\textsuperscript{107} Cornish W., Llewelyn D. and Aplin T., Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights, 8\textsuperscript{th} edition, Sweet and Maxwell, 2013, at. 482.
\textsuperscript{109} Ibid, p.17.
\end{footnotesize}
In that case, it means that using the 3D file to “print” an unprotected object would not infringe the copyright of the 3D file, while sharing such 3D files would constitute an infringement of this copyright\textsuperscript{110}. 

To close this section, one should notice that “the copyrightability of a CAD file will basically depend on the copyrightability of that underlying object”\textsuperscript{111}. Queries concerning the potential protection of CAD files as computer programs have also been made, but this will not be analysed in the present thesis. The only reference that will be made is the following statement by Rideout: “What differentiates 3D CAD files from other computer programs is that the 3D CAD files are basically just a triangular representation of a 3D object.

The CAD files themselves do not control how 3D printers operate; they merely serve as more of a blueprint for software to utilize. As a result, Courts would likely not find CAD files to be considered copyrightable software\textsuperscript{112}.

D. The private use exception

As stated above, copyright grants monopoly rights to its rightholders. This situation is “broken” by the limitations and exceptions, as applied to each legal system, one of which refers to the possibility to copy for private use.

i. EU

As concerns the European Union, the “law of copying remains as diverse as its cultural traditions”\textsuperscript{113}, even after the adoption of Directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the harmonisation of certain aspects of copyright and related rights in the information society.

\textsuperscript{110} Bradshaw S., op cit 13, p. 25 (2010).
\textsuperscript{111} Rideout B. op cit. (17), p.168.
\textsuperscript{112} Ibid.
Article 5(2)(b) of the Directive allows Member States to provide for limitations to the reproduction right provided for in Article 2 in respect of reproductions made for private use and for ends that are neither directly nor indirectly commercial, on condition that the rightholders receive fair compensation.

The private copy was first advanced as a necessity for the respect of private life; nevertheless, Digital Right Managements (DRMs) - also called Technical Protection Measures (TPMs) – allow the prevention of private copy without intrusion in the private sphere.¹¹⁴

Concerning TPMs, Article 6(4) has been of special concern to rightholders, as it would oblige Member States to “take appropriate measures to ensure that rightholders make available to a beneficiary of an exception or limitation provided for in national law”, in accordance with certain exceptions or limitations listed in Articles 5(2) and (3) “the means of benefiting from that exception or limitation”.

There are special provisions as to the application of this provision to the exception under Article 5(2)(b), namely the one provided under Article 6(4)(b).

Article 5(5) also provides for the so-called “three-step-test” which states that a measure limiting the rights of the copyright owner “shall only be applied in certain special cases which do not conflict with a normal exploitation of the work or other subject-matter and do not unreasonably prejudice the legitimate interests of the rightholder”.

As illustrated by the case law in France and Belgium, the private copy has been strongly undermined by the Courts¹¹⁵.

¹¹⁴ Geiger C., “The answer to the machine should not be the machine: safeguarding the private copy exception in the digital environment” (2008) p. 122.
This allows some authors to consider that the private copy has “lost the game” against TPMs.\textsuperscript{116}

ii. UK

CDPA 1988 has been amended by the Copyright and Rights in Performances (Personal Copies for Private Use) Regulations 2014. There is provided an exception in respect of reproductions on any medium made by a natural person for private use for non-commercial ends.\textsuperscript{117}

Section 28B(1) CDPA 1988 provides the requirement for making personal copies with its specific particularities, given that “the copy (a) is a copy of (i) the individual’s own copy of the work, or (ii) a personal copy of the work made by the individual, (b) is made for the individual’s private use, and (c) is made for ends which are neither directly nor indirectly commercial”.

There is also stated in Section 28B(5) which are the uses that fall under “the private use” prerequisite. Moreover, “copyright in a work is infringed if an individual transfers a personal copy of the work to another person”.\textsuperscript{118} Here in fact is inserted another exception in the UK law concerning copies “acquired by means of a download resulting from a purchase or a gift”;\textsuperscript{119} so we assume that it applies to 3D files “lawfully acquired by the individual on a permanent basis”.\textsuperscript{120} This means that copies obtained from illegal sources shall not be covered by this exception.

However, it is too early to interpret this new exception without the assistance of the judiciary, as the “uniqueness” of the 3D printing technology causes many difficulties.

\textsuperscript{117} Explanatory Note to The Copyright and Rights in Performances (Personal Copies for Private Use) Regulations 2014.
\textsuperscript{118} CDPA 1988, ss 28B(6), (7), (8), (9).
\textsuperscript{119} CDPA 1988, s. 288(4).
\textsuperscript{120} CDPA 1988, s. 288 (2)(a).
Chapter IV: Recommendations

Without any doubt, there are various issues that concern the multiple fields of intellectual property rights and from a 3D printing point of view these may get highly complex. IPRs were created to foster creativity but were also developed to strike the balance between the parties involved, such as the creators, the various rightholders or beneficiaries, the potential users etc.

The IPRs are valuable assets nowadays and have to be correspondingly protected. Regarding the increasingly developed area of 3D technology, the following suggestions could be made.

A. Use of Technical Protection Measures – Involvement of Internet Service Providers

There is a US patent called “Manufacturing control system” that was granted in October 2012; its purpose is to control copy in 3D files, checking if a license has been agreed before allowing the file to be printed.\(^{121}\) That suggests that the manufacturers of the 3D printer could implement Digital Rights Management (DRMs) on their printers. The use of this technology is linked to the private use exception, as analysed in the previous chapter.

A risk arises in relation to the use of TPMs: the potential prevention of legal copies from the one hand and the potential protection of works that are not covered under IPRs on the other hand.

However, the truth is that over the years the use of DRMs has not been proven to be an adequate solution to avoid the illegal downloading of movies and music. The situation as regards CAD files remains to be seen; there is an interesting statement towards this direction, namely that “the answer to the machine cannot be found only in the machine”\(^{122}\).

\(^{122}\) Geiger C., op cit (114).
As regards the issue of ISPs, I will give the example of the United States that has a specific framework for copyright and sets a detailed procedure in which the intermediary merely acts as a mere messenger between the rightholder and the publisher, the so-called “notice and take down” procedure\textsuperscript{123}, accompanied by the provision of “safe harbor”\textsuperscript{124}.

The “notice and take down” procedure resembles the French HADOPI system analysed above, and provides that the intermediary should never be liable for infringements unless the infringing content is not “taken down” according to the procedure, after the request of a party concerned. In this procedure, the intermediary (i.e. the ISP) merely acts as a mere messenger between the rightholder and the publisher\textsuperscript{125}.

Concerning the “notice and down” procedures that appeared as an outcome of 3D printing alleged copyright infringements and especially the Penrose triangle and the warhammer, as discussed in previous chapters – both related to the online sharing platform called Thingiverse – the alleged infringers seemed to be in good faith and it is still doubted whether these alleged infringements were actual infringements; nevertheless, the infringing content in both cases was removed from the platform.

**B. The necessary promotion of new business models**

“Ultimately, all stakeholders in industry, from manufacturers and rightholders to distributors, will need to be creative in preparing for the third industrial revolution”\textsuperscript{126}. In this respect, Mendis also stated that she would not defend stringent IP laws for this new technology, but rather find a sustainable solution in new business models\textsuperscript{127}.

\begin{flushright}
\textsuperscript{123} 17 U.S.C. §502. \\
\textsuperscript{124} 17 U.S.C. §502 (c). \\
\textsuperscript{125} 17 U.S.C. §502. \\
\textsuperscript{126} Mendis D., op. cit. (90), p. 167-169. \\
\textsuperscript{127} Ibid. p. 155.
\end{flushright}

-32-
This kind of ideas stems from the fact that the existing situation in the marketplace regarding music and movie files has failed to compete adequately with the rapid evolution of the digital world.

“Faster than a speeding bit, the Internet upended media and entertainment companies. Piracy soared, and sales of albums and films slid. Newspapers lost advertising and readers to websites. Stores selling books, CDs and DVDs went bust”\(^{128}\).

The above statement describes the consideration that the music and film industries really reacted slowly and took them a lot of time to move from optical disks to online platforms, whereas at the same time the sales price remained high while the use of peer-to-peer files was a commonplace.

As regards the 3D printing market, a way to avoid the aforementioned situations and “do not miss the boat” concerning the infringements on the Internet, could be the creation of more online stores, operating in the same rationale as the very well-known Shapesway, Imaterialise, or Cubify platforms.

Of course, a real risk of monopoly might be lying here, such as the one we currently experience with iTunes\(^{129}\); this monopoly would arise at the expense of the artist or the manufacturer, who will be the weak counterpart against the giant hosting platform.\(^{130}\)

The platform invites the creators (in the case of 3D printing, the designers) to become members of the community and “open an online shop” to which the potential users will pay a fee in order to legally buy the 3D file and print it themselves instead of the illegal downloading and printing.

\(^{128}\) “Pennies streaming from heaven” The Economist (17 August 2013) 


\(^{130}\) Ibid.
There are, of course, other suggestions as well, including but not limited to the option of a wider and stronger system of licensing\textsuperscript{131}, the use of an open-source system\textsuperscript{132} or a shorter and weaker copyright protection, but these will not be a part of the analysis in the present thesis.

\textsuperscript{131} Ibid, at 169.
\textsuperscript{132} Rideout B., op. cit. (17) p. 176.
Conclusion

“When legislative interventions fail to recognize new technological, economic, and business needs, social change happens and new forms of creation and dissemination flourish beyond, or in spite of the law”.\textsuperscript{133}

A new round in the battle between technology and intellectual property rights, which is also the title of the present thesis, seems to have started and it has never been so real but the number of clashes is still small.

The problem starts with the continuously rising number of 3D printing users, who are becoming more and more enthusiasts of the new paths this technology offers. But the problem gets more complex as long as the aforementioned users do not take into account the involvement of the various intellectual property rights.

It is commonly accepted that there is a need to reform legal systems (meaning all of them and not only the UK, US and EU systems that were analysed herein) in order to reach legal certainty and strike a balance between the widespread technology and the law.

The need for reform is also obvious as regards the existing business models, which are not keeping up with the rapid technological developments. Intellectual Property cannot be an instrument for maintaining the status quo or protecting existing business models.\textsuperscript{134}

After all, a 3D printer is “a powerful new tool for experimenting with the design of the physical world, for thinking, for generating new culture, for stretching our imaginations”.\textsuperscript{135}

\textsuperscript{134} Dimita G., Copyright and Shared Networking Technologies (DPhil thesis, Queen Mary, University of London 2010).
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