

Title: Intellectual Property Rights at Crossroads: The Copyright and Patent Implications relating to 3D Printing

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Abstract

Through an analysis of copyright and patent laws, this chapter considers the implications arising from 3D printing and 3D scanning. In particular, the chapter explores the elements of the 3D printing process, that is, designing, using, sharing, printing and distributing a CAD file and, through its application to copyright and patent laws, considers the 3D printing process from the perspective of protection, exceptions and limitations as well as infringement. Drawing on the most recent literature including diverse studies on 3D printing, this chapter navigates through some of the issues in need of policy consideration and reform. In particular, the chapter highlights the challenges posed by this new technology as well as the legal gaps in need of review. The chapter concludes with some thoughts for the future.

Keywords: 3D printing, 3D scanning, copyright, patent, protection, infringement, exceptions and limitations

List of Abbreviations

3 D	three dimensional
Covid19	Coronavirus
CAD	computer aided design
CDPA	Copyright, Designs and Patents Act 1988
CJEU	Court of Justice of the European Union
CPC	Convention for the European Patent for the Common Market (Community Patent Convention)
DSM	digital single market
DSM Copyright Directive	Directive on Copyright in the Digital Single Market 2019
EEA	European Economic Area
EPC	Convention on the Grant of European Patents of 5 October 1973
EU Unitary patent package	Unified Patent Court Agreement, 2013
E&L	exceptions and limitations

FDM	fused deposition modelling
hESC	human embryonic stem cells
InfoSoc	Information Society Directive 2001
IP	Intellectual property
IPR	Intellectual property rights
Paris Convention	Paris Convention for the Protection of Industrial Property 1883
Patent Cooperation Treaty	Patent Cooperation Treaty 1970,
TRIPS	Agreement on Trade-Related Aspects of Intellectual Property 1994
UK	United Kingdom
UPC	Unified Patent Court
UPCA	Unified Patent Court Agreement
UKIPO	UK Intellectual Property Office
WIPO	World Intellectual Property Organization
WCT	World Copyright Treaty 1996

1. Introduction

Intellectual Property (IP) law aims at providing incentives to foster innovative and creative activities by awarding an exclusive, temporary, and limited right to – for example – the creator of an artistic work or the inventor of a technical innovation, while also balancing societal interests. By striking the right balance between the interests of innovators and those of the wider public, the intellectual property rights (IPR) system aims to build a society in which creativity and innovation can flourish (Brown et al, 2019). IPR comprises diverse types of rights, including copyright, patents, trade marks and designs as well as related rights such as database rights and trade secrets. This paper will focus on copyright and patents from the perspective of 3D printing.

Technologies such as 3D printing as well as many others before it such as the printing press (1440), the tape recorder (1886), the xerox photocopy machine (1959) and notably the Internet (1991), amongst others, have continuously challenged IPRs. In recent years, the impact of 3D printing on IPRs has been the concern of policy makers, particularly as a result of its penetration of the consumer market in the late 2000s. In 2009, the original patents granted for Fused Deposition Modelling (FDM) expired, paving the way for low-cost 3D printers and, through the existence of the Internet, opened doors to a new kind of file-sharing (Lipson and Kurman, 2013; Mendis, 2013). Up until that point, file-sharing had been limited to music, films, games, and the like; however, the emergence of 3D printing laid the foundation for consumers to share files online, which contained blueprints for hobby-like products which could be 3D printed, thereby affecting not only copyright (relating to music, films, games, and so on) but also all other IP rights such as patents, trade marks and designs, leading to infringement concerns.

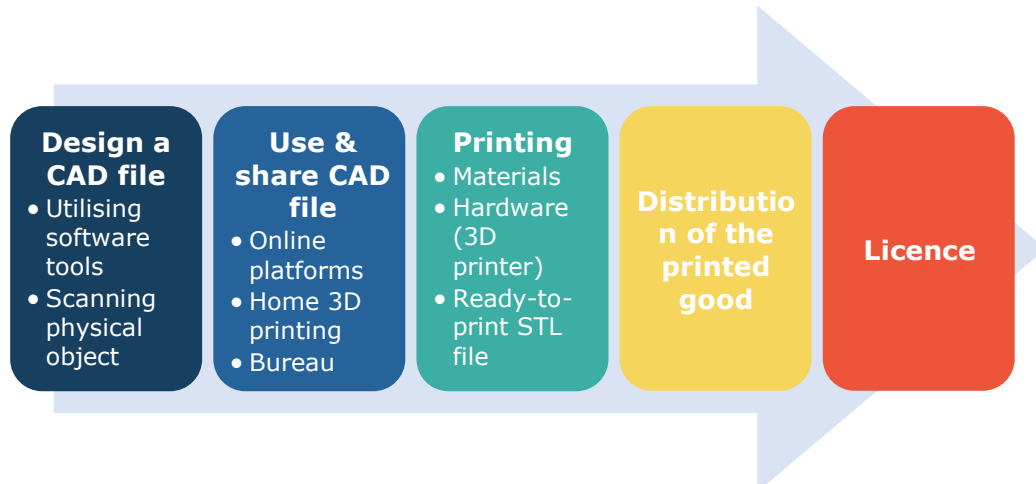
Recognising these challenges, policy makers began to explore the various threats posed to IPRs as a result of 3D printing. For example, in 2013, the UK Intellectual Property Office (UKIPO) commissioned a study which explored the challenges to IP from an industrial and consumer (online platforms) perspective. The study, presented in two parts, recommended a ‘wait-and-see’ approach (Mendis et al, 2015). That was in 2015. The study made a further recommendation for further research and in 2017 the UKIPO commissioned a second study, which was completed in 2019. (Daly et al, 2019). Around the same time, the European Commission had begun work in this area, and in 2018 commissioned its own study to a group of academics and industry specialists. The work – led by Bournemouth University, UK – focused on industrial 3D printing and IPRs from the point of view of seven sectors (aerospace, automotive, health, consumer, energy, tooling, and construction) and was completed in April 2020 (Mendis et al, 2020). These are some examples of large-scale projects commissioned by government institutions, amongst others, which have explored the impact on IPR as a result of 3D printing. Apart from this major, policy-driven work, there have been many more funded projects and much has been written on the topic over the years, with many academics and practitioners contributing to knowledge (Rideout, 2011; Mendis, 2013; Mendis, 2014; Mendis et al, 2015; Ballardini et al, 2015; Margoni in van den Berg, Svan der Hof and Kosta (eds) 2016; Mendis, 2016; Malaquias, 2016; Ballardini et al, 2016; Ballardini, Norrgård and Partanen (eds) 2018; Ballardini et al, 2018; Mendis, Lemley and Rimmer (eds) 2019; Ballardini, & Alen-Savikko, 2019; Mendis et al, 2020).

This chapter draws on the research conducted by the authors in the field of 3D printing and IPRs during the past few years whilst drawing on wider knowledge gained from policy work from funded projects and the wider academic literature on this topic. In doing so, the paper will in particular explore copyright and patents as these relate to 3D printing and will analyse their application from the perspective of the *protection* of CAD files, design data, materials and hardware, *infringement* of those rights and any *exceptions* which may apply to those who may wish to reproduce protected works for private use. The chapter will conclude with some thoughts for the future.

2. Protecting the elements of the 3D printing process via Copyright and Patent Law: From CAD files to design data to materials and hardware

By way of introduction, copyright protection attaches to original works of creativity, including software programs, which can portray the creator’s personal touch or input, while patents may be granted for technical inventions that are new, involve an inventive step, and are capable of industrial applicability (and are sufficiently disclosed) (Brown et al, 2019). These rights give their holder exclusive rights to their works for a limited term (depending on the IPR) and, in turn, exclude others from using the subject matter in question without the rightholder’s permission. For example, copyright signifies exclusive rights to authors with regard *inter alia* to reproducing and disseminating their works, while patent protects an invention from being commercially used, sold, imported, and otherwise exploited by third parties (Brown et al, 2019). Their relevance to 3D printing will be discussed in the light of the 3D printing process as illustrated below. To better understand the application of copyright and patent law to 3D printing, the following

diagram adapted from the European Commission Study is used. It reflects and combines the 3D printing process and IPR aspects which are most relevant to 3D printing.



The 3D Printing Process – Adapted from Mendis et al, Intellectual Property Implications of the Development of Industrial 3D Printing (European Commission, 2020)

2.1. Copyright Law

Copyright law is governed by international laws such as the Berne Convention for the Protection of Artistic and Literary Works 1886 and more recently, the Agreement on Trade-Related Aspects of Intellectual Property (TRIPS) 1994 and the World Copyright Treaty (WCT) 1996 and through EU Directives such as the Information Society Directive 2001 (InfoSoc Directive) and the EU Software Directive 2009. These laws, as well as the main copyright provisions contained within the UK's Copyright, Designs and Patents Act 1988 (CDPA 1988) as amended, provide for the legal protection of 'computer programs'.

The focus of this section will be whether a *CAD file* is capable of copyright protection. To answer this question, two sub-questions will be explored: (a) is a CAD file a 'computer program' under copyright law? and (b) does it reflect the author's own intellectual creation? In relation to the second question, the test is one of assessing a creator's own input or their personal touch in the creation of a copyright work. In other words, it should not be copied from another, but should be original.

Before proceeding to answer these questions, it must be pointed out that, from a copyright perspective, a distinction exists between a CAD file and a 3D model. The 3D model will attract artistic copyright and this has been clarified by policy makers and academic commentators alike (Rideout, 2011; Mendis, 2013; Mendis, 2014; Mendis et al, 2015; Mendis, 2016; Malaquias, 2016; Ballardini, Norrgård and Partanen (eds), 2018; Mendis, Lemley and Rimmer (eds) 2019; Mendis et al, 2020). However, protection of a CAD file is less clear and it is this aspect which will be explored below.

2.1.1 Is a CAD File a ‘computer program?’

In terms of the first question – is a CAD file a ‘computer program’ under copyright law – the Software Directive 2009 provides some guidance. It defines a computer program as “*the expression in any form, language, notation or code of a set of instructions, the purpose of which is to cause a computer to execute a particular task or function*”. Furthermore, where a designer provides options for mass customisation, can the designer’s work be considered as ‘original’ – thus attracting copyright – or does it fall into the realms of data, instructions or mathematical expressions for the 3D printer to function?

Part of the answer lies in understanding protection of the source code and object code. The *source code* is a restatement of the functions to be performed as a set of algorithms through a human-readable computer language which in turn allows a computer program to be written and understood by human programmers. This is different from the *object code*, which is a translation of the source code, generally by a computer running under a compiler program, into a machine-readable language (Guarda, 2013; Murray, 2019; *Bezpečnostní softwarová asociace-Svaz softwarové ochrany v Ministerstvo kultur; SAS Institute Inc., v World Programming Ltd*, para. 39). From a copyright perspective, protection will attach to the expression of the computer code – whether it be source or object code. Furthermore, Recital 7 Software Directive states that “*preparatory design work leading to the development of a computer program provided that the nature of the preparatory work is such that a computer program can result from it at a later stage*” should be considered a computer program.

Based on the above, the following conclusions can be drawn. First, a CAD software suite (similar to a *Microsoft Office* suite) which allows a designer to create a 3D model can attract literary copyright, thereby protecting the source code that underlies it. Second, utilising the software tools provided, a 3D model can be designed allowing a computer to execute particular tasks. This could attract literary copyright in the context of the object code, embedded as part of the CAD file format (Mendis in Mendis, Lemley and Rimmer (eds) 2019; Mendis et al, 2020).

These conclusions suggest that a CAD file *may be* capable of attracting literary copyright protection as a computer program although further clarity would be beneficial. This then gives rise to the second question: if a CAD file can be protected as a computer program, does it reflect the author’s own intellectual creation?

2.1.2 Does a CAD file reflect the author’s own intellectual creation/personal touch?

This question is difficult to answer, as the law is unclear on this point. The uncertainty arises from the ‘utilitarian’ nature of a CAD file. This is so because a 3D model comes into being by bringing together a combination of commands, options, defaults, and iterations consisting of words, figures, or mathematical concepts (Mendis 2018, Mendis in Mendis, Lemley and Rimmer (eds) 2019; Mendis et al, 2020). Where the designer provides options for mass customisation, the issue becomes more complex, as it raises the question whether the designer’s creative steps indicate their ‘own intellectual creation’, as a basis for the existence of copyright protection (Lee,

2012; *Infopaq International A/S v Danske Dagblades Forening* [2010]; *Painer v Standard Verlags GmbH* [2012]), thereby going beyond functionality involving words, figures, instructions, or mathematical concepts.

Furthermore, the digital 3D model and the resulting physical product are distinct from each other – and not necessarily a reproduction of the former. Case law supports this view (*Abraham Moon & Sons Ltd v Andrew Thorner and Others* [2012]; *Brigid Foley Ltd v Elliott and Others* [1982]). Here, the Court distinguished between the design document and the resulting product stating that “once made, a fabric would not look the same as it did on a CAD system even if one was used. With CAD, it would not be possible to feel the fabric, which is an important part of the process”.

In this context and from a copyright perspective it is important to distinguish a CAD file from a digital 3D model and the resulting physical model – all of which can attract separate protection. At the moment, it is clear that a digital 3D model attracts artistic copyright and case law points to the fact that the resulting physical model will attract copyright protection, separate from the 3D digital model. However, less clear is protection of a CAD file and the ‘construction graph’ created by a designer for mass customisation purposes which reflects a creator’s intellectual creation (Mendis et al, 2017; Mendis, 2018). It is suggested that a designer using their own intellectual creation should be able to claim artistic copyright of the model *as well as* literary copyright of the ‘construction graph’, which could be considered as a mini computer program within the larger CAD software suite attracting its own copyright (Mendis 2018, Mendis et al, 2020).

2.1.3 Design Data

Data *per se* cannot be protected under copyright law, as copyright protects the expression of an idea but not the idea itself.

However, data sets may be protected under the *sui generis* Database Directive as long as the criterion of ‘substantial investment’ is met. Yet, although data contained within a series of categorised CAD files might lead to ‘databases’ that fall under the scope of protection of the Database Directive, in most cases it seems unlikely that this would be the case. This is because, in order to attract database protection, apart from demonstrating ‘substantial investment’ (in setting up the database), it is also necessary to reflect the systematic or methodological arrangement and individual accessibility of (CAD) files arranged according to different themes. This could be challenging and therefore each outcome will be decided on a case-by-case basis (Mendis et al 2020; Pihlajarinne & Ballardini in Ballardini et al, 2019). The difficulties outlined here can be reflected through the Court of Justice of the European Union (CJEU) case of *British Horseracing Board*. In this case the CJEU clarified that ‘investment’ refers to the resources used with a view to ensuring the reliability of the information contained in that database in order to monitor the accuracy of the materials collected. In any case, even if protection is attained, it should be noted that data *per se* contained within each CAD file cannot be protected under copyright law, as noted above.

2.2. Patent Law

European patent law operates on a complex multi-level system consisting of some major international treaties, including *inter alia* the *Paris Convention* (Paris Convention for the Protection of Industrial Property 1883), the *Patent Cooperation Treaty* (Patent Cooperation Treaty 1970), the *TRIPS Agreement* 1994 as mentioned above, the *Marrakesh Agreement Establishing the World Trade Organization* 1994 and the *European Patent Convention (EPC)* (Convention on the Grant of European Patents of 5 October 1973), as well as national patent systems. Today, the EPC provides the main framework for centralised pre-grant examination of parallel national rights. The EPC also indirectly harmonised European patent law in several substantive aspects. However, it did not provide a unitary title of patent rights. Notwithstanding the long-lasting efforts of trying to harmonise enforcement of European patent law (the last of such efforts being the EU Unitary patent package (Agreement on a Unified Patent Court, [2013]), to date, enforcement still remains confined to national level (Ballardini, Norrgård and Bruun (eds), 2015; Mendis et al, 2020).

Regarding patent protection, the most relevant provision is Article 52(1) European Patent Convention (EPC) 2000, which states that “European patents shall be granted for any inventions, in all fields of technology, provided that they are new, involve an inventive step and are susceptible of industrial application”. Moreover, Article 83 EPC provides that in order to qualify for patent protection, inventions must be sufficiently disclosed.

At first glance, patenting 3D printed technologies related to hardware (for example 3D printers and scanning machines), materials and software (such as firmware used to operate the machines and other computer-implemented inventions included in the process), raises no special concerns – ‘business as usual’, one could say. It should, however, be acknowledged that some challenges could arise in the context of 3D printing of human tissue or bio-printing, especially in relation to moral considerations. In fact, Article 53(a) EPC and Article 6(1) EU Biotechnology Directive specify that inventions are unpatentable “where their commercial exploitation would be contrary to *ordre public* or morality”. Concerns might arise in particular when bioprinting encompasses new forms or improved versions of ‘biological’ material and processes, such as bioink. Yet, possibilities for relying on patent protection might have a great impact on the development of these technologies as it affects whether or not investments will be made in this technology. Indeed, the question here is not what applications are technically possible, but rather whether they should actually be achieved (Minssen and Mimler in Ballardini, Norrgård and Partanen (eds), 2017; Mendis et al, 2020). In Europe, the application of the morality exclusion in patent law has been heavily influenced by advances in the field of biotechnology. While the patenting of bioprinting may pose challenges similar to those raised in biotechnology (for example with regard to use of human embryonic stem cells (hESC) in bioink) (see, for example, Biotechnology patent at the EPO: <https://www.epo.org/news-events/in-focus/biotechnology-patents.html>), future bioprinting applications, for example, use of xenogenic cells, creation of enhanced organs, or – in the future – maybe even cloning human beings through bioprinting, might be banned by European patent law, or at least require a new assessment as to their compatibility with *ordre public* and morality. (Hornick and Rajan, 2016).

Another quite controversial issue in terms of patent protection and 3D printing relates to the application of patents both to inventions in CAD files *per se*, and to those related to the design data included in the 3DP process. Concerning patent protection of CAD files, the main issue relates to the fact that, increasingly, inventions are being developed that can be made only via CAD and 3D printing techniques. Even though it is possible to rely on patents to protect the method for making the invention (process patent), this might not be enough. The more valuable these inventions become, the stronger the protection needs to be. Thus, protecting a CAD file *per se* through patent law might be an important strategic alternative for inventors. Yet, to date, it remains to be seen whether such types of claims could be accepted, for instance by the European Patent Office. Concerning protection of the valuable design data included in, for example, a CAD file or data derived from scanning, patent law is not well equipped. As is well known, the patent system has historically been a poor protector of data and data processing in general. Data *per se* is not patentable subject matter, while merely assembling, organising or manipulating data is not itself eligible for patent protection (Pihlajarinne and Ballardini in Ballardini, Pitkänen and Kuoppamäki (eds), 2019). On the other hand, data could possibly be a subject of patent protection should it be conceived as a ‘product’ obtained by using a process patent, although this possibility also remains quite abstract (Zech, 2016; Drexler, et al, 2016).

3. 3D Printing and Exceptions: Private and Non-Commercial Use – Implications for Copyright and Patent Law

Notably, intellectual property rights are not absolute, but rather relative rights. In the EU context, intellectual property rights are subject to a set of established exceptions and limitations (E&L). In other words, the scope of E&L is to ensure a balance between the interests of IP rightholders and users while protecting the good (that is between protection and access) (Brown et al, 2019). Any exception to rights needs to meet the requirements set in Article 30 of the TRIPs agreement, which clarifies that such exceptions should be limited; should not unreasonably conflict with normal exploitation of IPR; and should not unreasonably prejudice the legitimate interests of the IP owner, taking into account the legitimate interests of third parties.

Indeed, E&L vary from country to country and according to each IP right. However, in the context of the 3D printing process (that is, designing a CAD file (*step 1*), using and sharing a CAD file (*step 2*), printing a 3D model (*step 3*) and distributing the printed good (*step 4*)), the most relevant E&L in the context of copyright and patents are private and non-commercial use and copying; issues of repair and re-use of protected products; and research and experimental use (under patents). Indeed, this discourse is strongly related to issues of protection, meaning that the relevance (or not) of possibly applying E&L to waive infringements is dependent on whether or not, for example, CAD files or 3D printable materials are in fact protectable via copyright and/or patents.

3.1 Copyright Law

3.1.1. Private Use Exception

Article 5(2)(b) InfoSoc Directive sets out the private use exception with reference to *practices “that are neither directly nor indirectly commercial, on condition that the rightholders receive fair compensation which takes account of the application or non-application of technological measures referred to, in Article 6 to the work or subject-matter concerned”*. In this context, three scenarios can be considered. These include application of the private use exception to (a) home 3D printing; (b) printing at a service bureau or public place; and (c) sharing a CAD file. Each of these scenarios will be considered in turn.

It is important to note that the UK does not have a ‘private use’ exception; therefore, this section will be considered from the perspective of EU law. Having said that, the UK does have a research and private study exception (s29 CDPA 1988) which can apply to 3D printing from the perspective of E&L.

In considering **home 3D printing**, under Article 5(2)(b) InfoSoc Directive, if an individual carries out 3D printing at home – and does so from a protected CAD file – but does it for their own consumption and does not share it or disseminate it through online platforms, then such an activity will not amount to copyright infringement and will qualify for the private use exception (Margoni in van den Berg, Svan der Hof and Kosta (eds), 2016; Malaquias, 2016). On the other hand, engaging in direct or indirect commercial activity in return for remuneration (for example, direct remuneration, advertising) by sharing the printed product via an online platform will defeat the exception.

Application of the private use exception to **printing at a service bureau or public place** depends very much on whether the service bureau or public place (such as a library) is being ‘commissioned’ by someone else (a ‘commissioner’) to carry out a 3D printing service. For example, bureau services which are ‘commissioned’ to 3D print products in exchange for remuneration will be seen as a commercial activity and so they will not be able to rely on the private use exception. Therefore, bureau services will need to actively exert their control to avoid copyright infringement and liability; in most cases, such concerns are generally addressed by the bureau services’ user agreements at the point of an end-user registering/signing up (Mendis, 2015; Mendis et al, 2020).

On the other hand, if a commissioner (an end-user) engages in 3D printing activities in a university library, public library, or research institution (in other words, not in their home), they could benefit from the private use exception if the activity they engage in is for a non-commercial purpose and is based on a lawful source (Malaquias, 2016). Similarly, they could also benefit from the research or private study exception (Article 5(3)(n) InfoSoc Directive 2001) or use for the sole purpose of illustration for teaching or scientific research as long as the source, including the author’s name, is indicated (unless this turns out to be impossible) and is for a non-commercial purpose (Article 5(3)(a) InfoSoc Directive 2001).

Sharing of CAD files can be separated into uploading and downloading. Article 3 Infosoc Directive - ‘communication to the public’ right – states that authors “*have the exclusive right to*

authorise or prohibit any communication to the public of their works, by wire or wireless means, including the making available to the public of their works in such a way that members of the public may access them from a place and at a time individually chosen by them". In the light of this Article, an end-user who uploads a CAD file to an online platform and makes it available to an indeterminate number of public users and does so without the author's consent will infringe the 'communication to the public' right (*Stichting Brein v Ziggo BV et al* [2017]; *GS Media BV v Sanoma Media Netherlands BV and Others* [2016]).

On the other hand, the private use exception will apply to those who upload CAD files to a small group of friends via a private account or to a password-protected intranet website. Similarly, if uploading is for private use purposes in accordance with Article 5(2)(b), or for research or private study and is carried out in accordance with the conditions set out in Article 5(3)(a) and (n) InfoSoc Directive, these exceptions can apply in such a scenario (Malaquias, 2016; Mendis in Mendis, Lemley and Rimmer (eds) 2019; Mendis et al, 2020).

Downloading a CAD file from an unlawful source and for purposes of reproducing it without the creator's permission will infringe copyright laws. However, and as mentioned above, downloading from a lawful use for private use or research or private study will not defeat the exception.

3.2. Patent Law

3.2.1. Private and Non-Commercial Use

Even if differences between EU jurisdictions might apply, as noted, it can be stated that all EU countries agree that private use refers to the type of use of protected innovations carried out solely for the individual's personal use or, sometimes, for friends or family, but not for the benefit of the public at large (World Intellectual Property Organization, Standing Committee on the Law of Patents, (2014). Non-commercial use, on the other hand, refers to use devoid of economic benefit for the user. It is also acceptable that the conditions should be cumulative in order for the exception to apply, that is, the use should be both 'private' and 'non-commercial'. In cases where conduct is of mixed purpose, it seems necessary to look at the intention of the user, even if the resulting information has a commercial benefit (Bently and Sherman, 2014).

Discussion over application of the private and non-commercial use exception in European patent law has been quite sparse. The reason is quite clear and relates to the simple fact that the use of patented inventions by private persons for non-commercial purposes has been difficult for both technological and economic reasons. Additionally, the activities of hobbyists and DIYers that have used patented inventions have generally been disregarded because these have normally been for 'one-time use' only and, as such, have been considered unimportant for patent owners. However, 3D printing technology is expected to change this scenario, especially because it calls for a re-evaluation of the role of users in the production and distribution chain. Notably, this change is likely to affect consumers and industrial 3D printing alike, for example in relation to printing spare parts. Overall, this might call for the need to reconsider the whole relevance of the private use exception in patent law (Mendis et al, 2020).

In the context of **‘printing at home’**, generally speaking, we could say that home desktop printing is usually likely to meet the requirement of ‘private’, as opposed to ‘public’, and not necessarily ‘secret’, use. However, it should not be forgotten that different interpretations could arise in specific situations; these could include cases such as if a printed object is further shared with others, or if a person engages in ‘home printing’ and routinely uses it, for instance, as part of their professional activity (Ballardini and Lee in Ballardini, Norrgård, and Partanen, 2017).

When we consider **printing at a 3D service bureau or other public spaces**, it is important to note that whether a 3D printer is located in a private or commercial establishment is not relevant for the applicability of the exception, as the cumulative conditions of ‘private’ and ‘non-commercial’ should relate to the purpose of the activity only. This also means that the exception is applicable only to acts done by a private user as such. In other words, the printing of an infringing object by a commercial entity (such as a service bureau), even if done on behalf of a private user, would not be caught by the exception and would instead infringe (Ballardini and Lee in Ballardini, Norrgård and Partanen 2017; Mendis et al, 2020).

Finally, a trickier question is whether and to what extent the private use exception can apply where the **CAD file is shared**. In patent law, whether sharing a CAD file could equate to, for example, making, using, offering for sale, or selling a protected item would largely depend on whether the CAD file can be protected by patents in the first place, and on the relationship with the CAD files and the patented objects that they represent – both issues that for the time being are unclear, as previously presented. Indeed, different interpretations of this relationship might lead to different outcomes in the application of the private use exception.

3.2.2. Research and Experimental Use

In the context of patent law the research and experimental use exception could also become relevant, particularly in regard to medical 3DP. This exception allows performance of tests and research for preparing regulatory approvals for a certain limited period before the end of a patent right (Bently et al, WIPO Standing Committee on Law on Patents, 2009). It can be argued that the more 3DP technology is used in healthcare, the more relevant this exception is likely to become. This is perhaps also one lesson that we can learn from the Coronavirus (Covid19) pandemic, where we have seen a quite rapid acceleration of the uses of 3D printing in healthcare – as well as of IPR clashes.

3.2.3. Spares and Repairs – Exhaustion of Rights

In relation to the exhaustion of rights principle, the most important application relates to the context of (legitimate) repairs, as opposed to (illegitimate) reconstructions of a patented invention. The doctrine of exhaustion limits the extent to which patent holders can enforce their rights on a sold patented product after it has entered the market with the rightholder’s consent. In other words, the first authorised sale of a product by the patent holder (or a licensee) results in the exhaustion of patent rights for that sold product. Consequently, purchasers of the sold product may use, resell and import the product in those EEA territories where the exhaustion

principle applies without additional consent from the patentee (Mohri, (2010)). The exhaustion principle in patent law also covers loan and ‘ordinary repair’ of a product. ‘Ordinary repair’ of a product sold is allowed only insofar as such repair does not equate to ‘making’ the invention (Ballardini, Norrgård and Minssen, 2015). However, the distinction between ‘making’ versus ‘repairing’ in European patent law is not straightforward. Indeed, it is not clear whether and to what extent purchasing a patented item and subsequently modifying or repairing it, is allowed. Generally speaking, there is no real agreement on the interpretation of ‘repair’ in the EU, as the notion of ‘repair’ is not mentioned in any patent statute in Europe and national case law on the issue is scarce. On the one hand, it is commonly agreed that patentees do not have a monopoly on the right to repair their patented products. On the other, however, some courts have specifically stated that there is no such right as the right to repair (UK: *United Wire Ltd v Screen Repair Services (Scotland) Ltd* [2001]; *Schütz (UK) Ltd v Werit (UK) Ltd (Rev 1)* [2013]; in Germany: BGH 14.07.1970, GRUR 1971, 78, 80 Diarähmchen V, BGH 17.07.2012, docket no. X ZR 97/11 Palettenbehälter II). In the context of 3D printing these issues are highly important especially with regard to spare parts. Indeed, the possibilities that this technology enables for the production of spare parts is likely to throw much attention on this doctrine, pushing the legislator and the courts to further clarify the limits between permissible repair and impermissible reconstruction (Mendis et al, 2020).

4. 3D Printing and Patent and Copyright Infringement: Making, Sharing, Printing and Distributing

In this section, we will consider infringement scenarios in the 3D printing context, particularly from the point of view of making, sharing, printing and distributing a protected innovation. In doing so, steps 1-4 of the 3D printing process will be considered, that is, designing a CAD file (*step 1*), using and sharing a CAD file (*step 2*) printing and distributing (*steps 3 and 4*) the CAD file.

Each of these issues will be considered from the perspective of copyright and patent law, although the authors have placed emphasis on different steps as relevant and in view of their importance. For example, under both copyright and patent law, the discussion is based mainly on designing a CAD file (*step 1*) and using and sharing a CAD file (*step 2*): these raise many important and complex questions. Under copyright law, designing a CAD file raises questions on reproduction through scanning as well as reproduction based on out-of-copyright works. Conversely, the discussion on patent law focuses on ‘making’ versus ‘repairing’ a patented invention, which gives rise to various infringement scenarios. Under both types of law, using and sharing a CAD file paves the way for infringement, as discussed below.

4.1 Copyright Law

Article 2 InfoSoc Directive refers to the reproduction right, according to which an author of a work has ‘the exclusive right to authorise or prohibit direct or indirect, temporary or permanent reproduction by any means and in any form, in whole or in part’. In other words, whoever reproduces a work protected by copyright law without the authorisation of the rightholder will be infringing the law.

In a 3D printing setting, this gives rise to three main scenarios, of which two will be discussed in detail in the present context. These include:

- a) the process of designing a CAD file (either from inception or through scanning); and
- b) sharing a CAD file through online platforms.

The third scenario involves printing a CAD file and distributing the printed object, which gives rise to an infringement if it is sold or distributed without the rightholder’s consent, contrary to Article 4(1) InfoSoc Directive.

4.1.1 Designing a CAD File: From Inception or Scanning?

Where a CAD file is designed without reproducing another person’s work, this will not infringe any copyright laws. Therefore, a CAD file which has been designed ‘from scratch’ will reflect the designer’s intellectual creation/personal input and in turn will attract copyright, as it will be deemed ‘original’ (Mendis in Mendis et al, 2019).

Conversely, scanning a physical product with a view to generating a CAD file raises a number of questions. If the scanned work is protected and the CAD file is a direct replica of it, then it will infringe Article 2 InfoSoc Directive. However, any alteration or modification to the scanned physical object, which in turn reflects the author’s intellectual creation, could be considered a ‘derivative work’. To satisfy the criterion, the modification has to be ‘substantial’. Cases such as *Painer*, *Antiquesportfolio* and *Art and Allposters*, although relating to 3D printing *per se*, provide some guidance here.

For example, in *Painer* the Court established that portrait photographers could meet the originality standard by making creative choices in setting up, shooting and developing a photo (*Painer v Standard Verlags GmbH* [2012]). In *Antiquesportfolio*, photographs of antiques were held to be copyright works taking into account the positioning of the object, the angle at which it is taken, the lighting and the focus. The court stated that such elements could all be matters of aesthetic or even commercial judgement, *albeit* in most cases at a very basic level but nevertheless sufficient to demonstrate a degree of skill for copyright to exist in the photographs (*Antiquesportfolio.com Plc v Rodney Fitch & Co. Ltd.* [2001]; Ong 2010; Lee 2012). On the contrary, in *Art and Allposters*, the CJEU held that transferring an image from a paper poster to a canvas through a chemical process infringed the copyright of the paper poster as the ‘new work’ incorporated the image of the protected work.

Therefore, in terms of scanning, a CAD file that reflects a replica of the protected object will infringe copyright law. If the scanned object is ‘substantially modified’ to create a new product,

thereby demonstrating the author's own intellectual creation, it will be considered 'original' and therefore will attract copyright protection (Mendis, 2014; Mendis et al 2020).

Another scenario is where scanning involves out-of-copyright works, that is, where copyright protection has expired or where the work in question was never in copyright. In such a scenario, Article 14 Directive on Copyright in the Digital Single Market 2019 (DSM Copyright Directive) states that when the term of protection of a work of visual art has expired, any material resulting from an act of reproduction of that work will not be subject to copyright or related rights, '*unless the material resulting from that act of reproduction is original in the sense that it is the author's own intellectual creation*'. This Article is highly relevant in the light of 3D scanning which involves restoration and reconstitution of out-of-copyright works, that is, museum artefacts (Birnhack, 2001). In such cases, Ong supports the view that copyright can subsist in recreative works which have been scanned from out-of-copyright works on the basis that skill and judgement have been exercised in the recreation of such works (Ong, 2010). Therefore, similar to the previous point, the important aspect is establishing 'authorial input'.

4.1.2 Sharing a CAD File Through Online Platforms

Sharing CAD files via online platforms can give rise to copyright issues, from the perspective of someone who is 'uploading' such a file as well as someone who is 'hosting' it. In the former scenario, the newly introduced 'upload filter' under Article 17 DSM Copyright Directive 2019 stipulates that online content sharing services should adopt their 'best efforts', 'in accordance with high industry standards of professional diligence and act 'expeditiously' to remove any infringing content when notified by the rightholders. However, Article 2(6) DSM Copyright Directive establishes that certain providers of services such as 'open source software developing and sharing platforms' and 'online marketplaces' amongst others do not come within the definition of 'online content sharing service providers'.

In view of this section, it is possible that industry-focused 3D printing platforms may be exempt from the 'upload filter' obligation if they can be deemed to come within open source software developing and sharing platforms or 'online marketplaces'. If not, and as discussed in section 3.1.1., an end-user who uploads a CAD file to an online platform and makes it available to an indeterminate number of public users and does so without the author's consent will infringe 'communication to the public' right (*Stichting Brein v Ziggo BV et al* [2017]; *GS Media BV v Sanoma Media Netherlands BV and Others* [2016]).

In terms of 'hosting', Article 17.5 of the Directive provides the following guidance in determining whether a hosting service can be held liable for infringement. These include:

- a) the type, the audience and the size of the service and the type of works or other subject matter uploaded by users of the service;
- b) the availability of suitable and effective means and their cost for service providers.

Further guidance is provided in Recital 66 of the Directive, which clarifies 'smaller platforms' as those which (a) have been in existence for less than three years; (b) have a turnover of less than

10 million euros; and (c) have less than 5 million monthly users. To avoid liability, these platforms will need to demonstrate that they have acted expeditiously to remove unauthorised content.

Online platforms dedicated to 3D printing which have less than 5 million monthly users will also need to ‘monitor’ and ensure that they act expeditiously to remove unauthorised content in order to ensure they avoid liability. The current law, therefore, places quite a burden on start-ups in this field (Mendis et al, 2020).

4.2. Patent Law

Another important set of questions relates to possible infringements of patented 3D printed related technologies, as well as CAD files and data. Here, the starting point is the traditional doctrines that govern infringing acts and the scope of protection (literal and equivalent infringement) (see Convention for the European Patent for the Common Market (Community Patent Convention, CPC), [1976] OJ L 17/1 Agreement on a Unified Patent Court, [2013] C 175/1 (UPC); and Unified Patent Court Agreement (UPCA)). In sum, direct patent infringement occurs when someone “makes, sells, places on the market, uses, offers, imports or stores” a patented invention without authorisation (Article 25 UPCA), whereas indirect infringement occurs when the “means that relate to an essential element of the invention are supplied on the national territory (where the patent has effect) to any person other than a party entitled to exploit the patented invention with the knowledge that such means will be used in an infringing product or method” (Article 26 UPCA).

In the 3D printing process, issues of direct patent infringement might arise in at least two contexts: one relates to the relation between the physical and digital (in the CAD file) representation of the invention, whereas the other concerns interpretation of the concept of statutory right of ‘making’ versus ‘repairing’ a patented invention.

The first issue is very much linked to protection and boils down to the open question as to whether and to what extent protection of the invention in the physical product is also extended to the digital representation of the product in CAD files. To some extent, this link is not very clear under the current rules. Generally, whether sharing a CAD file representing a patent-protected object over the Internet would give rise to patent infringement is not a question that can be answered without scrutinising the patent claims.

Concerning ‘making’ and ‘repairing’, on the one hand, reproducing (or ‘making’ or even remaking) someone else’s patented invention is an infringement. On the other, however, whether and to what extent modifying or repairing the physical embodiment of a patented invention, after the first sale, equates to an infringement, is not very straightforward under current rules. For instance, in the context of 3D printing, it is clear that anyone who uses a 3D printer to print a device as claimed in the patent (without permission) would be ‘making’ the device and, thus, directly infringing upon the patented invention. But what if someone ‘makes’ only some parts of the claimed product? When is this act considered an illegitimate ‘making’ of the invention, as

opposed to a legitimate ‘ordinary repair’ of it? Indeed, all this is linked to interpretation of the so called ‘principle of exhaustion’, according to which once a patented product is put into the market with the authorisation of the patentee, the patentee no longer has any enforceable right to control the subsequent resale, importation or use of that same physical item within the domestic market. ‘Ordinary repair’ of the product is also included in the exhaustion principle (Mendis et al, 2020).

Due to lack of harmonisation on this issue, the interpretation of whether an act is or not to be considered as ‘ordinary repair’ is a question that often needs to be addressed on a case-by-case basis. Considering the relevance of 3D printing for the production of spare parts, this issue is of key importance and as such is an issue that calls for further interpretation and harmonisation within the EU. At the same time, however, the fact that 3D printing allows easy-to-make digital changes (to a CAD file) that might result in significant physical modifications (once the product is printed out), adds further complexities to the already challenging interpretation of the line between ‘making’ and ‘repairing’, requiring even more interpretative guidelines (Mendis et al, 2020).

5. Conclusions and Recommendations

This chapter explored the implications for copyright and patent laws as a result of 3D printing. In particular, the authors considered these issues from the perspective of protection, exceptions and limitations, and infringement, identifying areas of the law in need of review as a result of the emergence of this latest technology. In this final part of the chapter, the authors draw conclusions from the discussion above on copyright and patent laws and set out some thoughts for the future.

In terms of *protection*, the chapter began with a consideration of *copyright law*. Two main questions were posed in terms of protection of a CAD file. Firstly, can a CAD file attract copyright for it to be considered a computer program? Secondly, does it reflect the author’s own intellectual input or personal touch – in other words, is it an original work of the creator? Based on the above discussion it was concluded that a CAD file could potentially be considered a computer program attracting literary copyright. However the current law does not specify this clearly. As 3D printing becomes more widespread, further clarity in this area is needed.

Secondly, in terms of the 3D model, it is clear that it attracts artistic copyright. However, where a designer provides options for mass customisation, reflected through a complex ‘construction graph’, then whether it is eligible for literary copyright protection is unclear. Yet, a CAD design which gives options to an end-user can certainly be deemed to be a designer’s own input or personal touch, thereby reflecting the copyright requirement of author’s own intellectual creation. In looking ahead to the future, it is recommended that a designer using their own intellectual creation should be able to claim artistic copyright of the 3D model *as well as* literary copyright of the ‘construction graph’, which in turn could be considered as a mini computer program within the larger copyright-protected CAD software suite.

In bringing the section on copyright and protection of a CAD file to a conclusion, the chapter explored design data and established that data *per se* cannot be protected under copyright law; however, although challenging, it is possible for data sets to be protected under the *sui generis* Database Directive if certain conditions are met.

From the viewpoint of *patent law*, the chapter shed light over the fact that even though some elements of 3D printing and the 3D printing process raise no critical challenge to the existing body of legal rules, nevertheless some important gaps in the legislation need to be addressed.

In terms of ensuring the right level of protection to 3D printed related inventions, the main gap is found in the context of protection of CAD files via patent law. As explained, the current patent legal framework does not provide clarity as to whether and to what extent CAD files are protectable, for example as product or method patents. Similarly, CAD data is not easily protectable via patent law. As such, the most commonly used tool to protect inventions related to CAD files and data is currently trade secrecy and contractual agreements. Even though we do not recommend expanding the reach of patent law to protect data, we could see it as beneficial to clarify whether it is possible to claim, for instance, CAD file types of patent claims and, if so, how such claims should be defined. Moreover, another possible place whether IP could be developed relates to the applicability of patent rules in the context of bioprinting. Looking at the current stage of technological development in this regard, however, this seems to be more a long-term than a short-term issue.

The chapter then turned to a consideration of *exceptions and limitations*, where three main scenarios were considered from the perspective of copyright and patent laws: (a) home 3D printing; (b) sharing of CAD files; and (c) printing at a bureau service or other public place.

From a *copyright* perspective, 3D printing at home for individual and private consumption will qualify for the private use exception. To be eligible, it is also worth noting that the private use exception does not extend to sharing/disseminating CAD files through online platforms. In such a scenario – where an end user shares and disseminates a CAD file with/to an unlimited number of people without the author’s consent in return for remuneration – direct or indirect – this will defeat the exception. Downloading a CAD file from an unlawful source and for purposes of reproducing it, without the creator’s permission, will mean that the private use exception will not apply. However, downloading from a lawful use for private use or research or private study will not defeat the exception.

Where the printing is done for an end user by a 3D printing service bureau, the above discussion centred around the ‘commissioned’ (3D printing service bureau) and the ‘commissioner’ (end user). In the case of the former, where a 3D printing shop/bureau service is commissioned to 3D print a product for an individual in exchange for remuneration, this will be seen as a commercial activity and therefore they will not be able to rely on the private use exception. On the other hand, an individual who engages in 3D printing activities in a university library, public library or research institution (in other words, not in their home), that is, a ‘commissioner’ – could benefit from the private use exception if the activity they engage in is for a non-commercial purpose and is based on a lawful source. If the same activity is carried out in a 3D printing service bureau in exchange for remuneration, the exception will not apply.

From the point of view of *patent law*, the chapter shed light over various gaps in the law which appeared to be present. First, in the context of the private and non-commercial use exception, the most challenging issue relates to the act of sharing CAD files. In fact, whether and to what extent the private use exception can apply in the case of sharing of CAD file largely depends on the

relationship between CAD files and the patented objects that they represent. This is unclear under current rules. Different interpretations of this relationship might lead to different outcomes in the application of the private use exception. Indeed, further clarification of the law in regard to the legal relation between the protected physical item and its digital representation (and vice-versa, that is, between the protected digital item and its physical concretisation) would benefit from further clarification. Moreover, important issues relate to the limitation of exhaustion of rights, especially because whether and to what extent a third party is allowed to repair a patent-protected item without permission is not well harmonised in the EU, while different interpretations might apply. To avoid fragmentation and increase legal certainty, this issue would benefit from a common approach, at least at the EU level.

Finally, the chapter explored copyright and patent *infringements* in 3D printing from the perspective of making, sharing, printing and distributing.

Under *copyright law*, creating a CAD file ‘from scratch’, so to speak, will not infringe copyright law. Creating a CAD file through scanning raises more questions. A direct scan of a protected product (a replica) will infringe the law unless any alterations or modifications to the scanned object can be demonstrated to reflect the author’s intellectual creation/personal input. Secondly if the scanning involves out-of-copyright works, in accordance with Article 14 DSM Copyright Directive this will be considered an act of reproduction of that work unless, once again, the author’s own intellectual creation can be demonstrated. However, more clarity would be welcome. Another interesting point considered was in relation to ‘hosting’ CAD files on online platforms. The newly introduced Article 17 DSM Copyright Directive sheds some light and guidance here – however, all these areas remain open to further clarity.

Finally, when looking at *patent infringements* in 3D printing, the most problematic elements relate, on the one hand, to lack of clarity between the digital and physical representations of a protected innovation, and, on the other, to the fact that, under the current interpretation of indirect patent infringement doctrines in Europe, whether a digital file (other than software) can qualify as ‘means’ for the purpose of the law is not clear. Considering the current stage of technological development and digitalisation, however, we would welcome clarification in this regard concerning which digital and physical items could be considered as equally good for this purpose.

As 3D printing continues to be embraced by ever more industrial sectors as well as by consumers, it is only prudent that the law in this area should be clarified. On a positive note and as mentioned in the above discussion, government institutions have begun policy work in this area with much interest; but as is always the case, technology moves much faster than legislation. Therefore, in looking ahead to the future, the hope is that law will be clarified rapidly, thereby allowing innovators, businesses and consumers to benefit from 3D printing whilst staying within the bounds of the law.

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