The Intellectual Property Implications of the Development of Industrial 3D Printing

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Final Report, 12 February 2020

This Study commissioned to Bournemouth University was carried out for the European Commission by

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The authors are grateful to Ms. Sophie Hallett-Jones (Added Scientific until 2018; now Protean Advanced, UK) and Dr. Alfred Radauer (Technopolis Group, Austria) for their contribution and assistance during the course of the project and at the time of writing this report.

The project team would also like to thank the interviewees and members of the Expert Advisory Board for their participation, time and insights which were valuable in navigating through the complex issues relating to the intellectual property implications of industrial 3D printing.

12 February 2020

EUROPEAN COMMISSION

Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
Directorate F — Innovation and Advanced Manufacturing
Unit GROW-F.3 — Intellectual Property and Fight against Counterfeiting

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Luxembourg: Publications Office of the European Union, 2020

ISBN 978-92-79-82008-3 doi: 10.2873/85090

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BACKGROUND AND CONTEXT

3D printing is one of the priority areas of technology in the European Union (EU). In 2017, the European Commission identified 3D printing as one of the main factors in bringing about industrial transformation.[1] The *Vanguard Initiative,*[2] a network of European regions which is dedicated to advancing industrial innovation in Europe, strengthens this ambition through its commitment to 'high performance production through 3D printing' as one of its pilot projects. This was further reinforced in November 2017 when the European Parliament published a Working Document which was adopted on 3 July 2018[3] recognising the importance of Intellectual Property (IP) in the area of 3D printing and Additive Manufacturing (AM).

There exists an abundant literature which addresses how IP laws may theoretically be affected by the development of 3D printing. This literature often identifies the challenges for IP enforcement created by the development of 3D printing. IP rights are one of the most controversial issues in the discussion about AM and 3D printing and the need to adapt the IP regime is often questioned. Despite an abundance of literature, there is still a lack of consistency in the application of the law relating to 3D printing.

What is 3D Printing?

3D printing is a broad term for all relevant technologies adopting a process of joining materials, usually layer upon layer, to make objects from 3D model data. From its beginnings as Rapid Prototyping (RP) for creating a prototype for product development, 3D printing is now recognised as a manufacturing system, known as Rapid Manufacturing (RM), Digital Manufacturing (DM) or Direct Digital Manufacturing (DDM).

THE STUDY

The aim of this Study was to analyse the IP implications of the development of industrial 3D printing and clarify how the existing IP framework brings protection to IP rights holders. It identifies potential challenges and how they can be removed and opportunities in need of clarification in order to aid the competitiveness of the AM sector in Europe. The focus is on seven industrial applications of AM: health, aerospace, automotive, consumer goods/electronics, energy, industrial equipment and tooling and construction and building sectors. This report identifies the pertinent IP considerations according to different elements in the 3D printing process, i.e. designing a CAD file, using and sharing a CAD file, printing the CAD file, distributing the printed good and finally, licensing it, as illustrated below.

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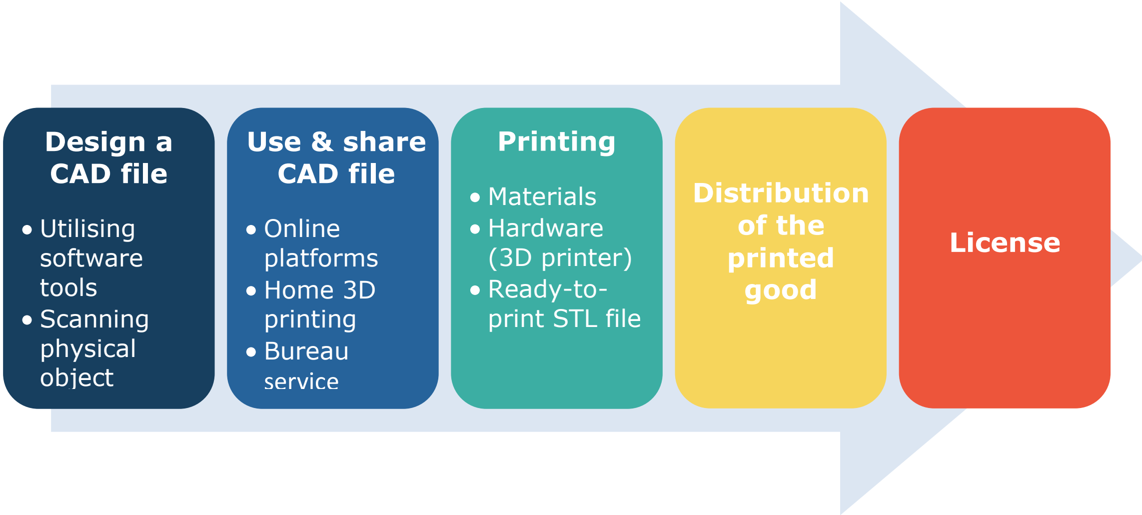
[1] European Commission, Reflection Paper on Harnessing Globalisation COM (2017)240(17) (10 May 2017) at https://ec.europa.eu/commission/sites/beta-political/files/reflection-paper-globalisation_en.pdf

[2] Vanguard Initiative at https://www.s3vanguardinitiative.eu/

[3] European Parliament, (Committee on Legal Affairs) *Working Document: Three-Dimensional Printing, a Challenge in the fields of Intellectual Property Rights and Civil Liability* (23 November 2017) http://www.europarl.europa.eu/sides/getDoc.do?type=COMPARL&reference=PE-612.302&format=PDF&language=EN&secondRef=01 and Text adopted by the European Parliament in 2018 at http://www.europarl.europa.eu/doceo/document/TA-8-2018-0274_EN.pdf



From a digital model to licensing a 3D printed product – The 3D Printing Process

The impact of 3D printing on sustainability and the circular economy is a key consideration. Although outside the scope of this Study, it is briefly examined in Chapter 1 with reference to key projects in this area[4] and the UN Sustainable Development Goals.

METHODOLOGY AND STRUCTURE OF THE REPORT

This Study employed legal and qualitative data collection techniques. A legal analysis comprising a literature-based review of the current EU IP law was utilised together with a systematic review technique to explore the various legal issues. Key themes were first examined through a mapping exercise of the seven industrial sectors before eliciting industry views through semi-structured interviews with 41 industry participants – in an attempt to garner industry opinions. Analysis of the combined legal and industry data led to the final conclusions and recommendations. The report commences with an introduction defining the technical elements of 3D printing before identifying pertinent IP considerations according to the different elements in the 3D printing process (designing a CAD file, using and sharing a CAD file, printing, distribution of the printed good and finally, licensing). Chapters 2–5 set out the legal issues relating to protection, exceptions and limitations, infringement and licensing. Conclusions and recommendations are presented in chapter 6.

THE STUDY TEAM

This research was led by Professor Dinusha Mendis, a specialist in IP law, from the Centre for Intellectual Property Policy and Management (CIPPM) at Bournemouth University, UK. The wider team included a network of legal experts with expertise in IP drawn from the UK, Germany and Finland. Industry and business expertise was provided by one of the most prominent leaders in the world of AM/3D printing, *Added Scientific Ltd, UK.* Qualitative and policy expertise was supplied by experts from

[4] The Atkins Project (led by Loughborough University, UK) https://www.lboro.ac.uk/service/publicity/news-releases/2009/03_ATKINS.html and a collaborative project between Universities of Nottingham (UK), Yale and MIT (USA) concluded that 3D printing can be a low-carbon manufacturing solution.

academia and industry (Technopolis Group). An *Expert Advisory Board* included academic, industry and practice experts from different aspects of the 3D printing and AM value chain, including the world's largest 3D printing and AM company, *Stratasys Ltd.*

CONCLUSIONS

(See also pp. 177-184 for more details)

Protection

CAD file: Lack of clarity in relation to the protection of CAD files, from a legal (patent, copyright design and trade mark laws) and industry perspective.

Design data: The law is clear, however, confusion amongst interviewees regarding the protection of data and data sets.

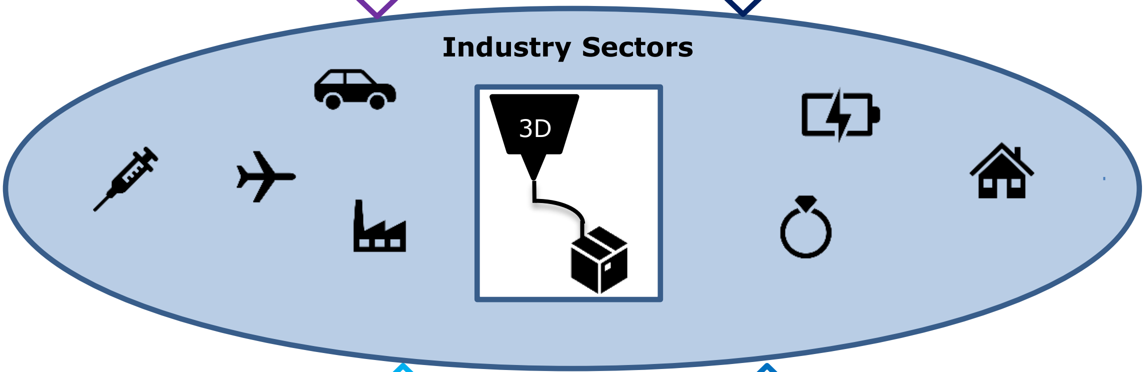
Materials and hardware: The law in relation to hardware is clear and developed - as also echoed by industry participants. However, there is confusion in relation to the protection of materials; also technical standards was seen as a barrier, more so than IP laws.

Exceptions and Limitations

Home 3D Printing: Patents, copyright and design laws can generally benefit from the 'private use' exception where 3D printing is carried out for private or individual use in one's home.

Printing or Scanning at a Bureau/ Other Public Service: likely to fall outside the private use exception depending on individual circumstances.

Sharing a CAD file: will defeat the exception when uploaded to a publicly accessible website.



Infringement

Designing a CAD File: Designing a CAD file from 'scratch' will not infringe IP rights in accordance with the current law.

Sharing a CAD file: Sharing, hosting and downloading a CAD file without the IPR owner's consent will infringe the current law. It is unclear whether re-creating an existing product through 3D scanning leads to a new IP right or infringes existing IP rights.

Printing a CAD File: Printing and distributing the 3D model without the IP rights holder's consent will constitute an IPR infringement in accordance with the current law.

Licensing and Traceability

Licensing: Licensing of CAD files, has the potential to create new business models and reduce the barriers to entry for start-ups and SMEs.

Traceability systems are still under-developed with the potential to become more important in future years as 3D printing continues to grow. Until then, SMEs and industries will benefit from clear and affordable technological solutions.

RECOMMENDATIONS

(See also pp. 177-184 for more details)

Protection

CAD File: Clarify what elements of a CAD file can be protected, and for which IPRs.

Consider a separate legal assessment of the CAD file and the 3D model it encompasses.

Clarify whether software embedded in a CAD file can be considered a 'computer program' in accordance with EU copyright law.

Design Data: Raise awareness amongst industries regarding the the applicability of trade secrets, contracts and database rights for protecting data *and* data sets.

The 3D model should be considered as a distinct 'work' separate from the resulting physical product. The law in this regard should be clarified

Materials and Hardware: The law is well developed for *hardware* and policy makers should retain the current rules.

In relation to materials, patent law and technical standards should be reviewed and clarified to progress its development.

Exceptions and Limitations

Limit the private and commercial use exception by adopting the 'three-step test' language from copyright law to cover "acts which do not unduly prejudice the normal exploitation of the design".

Interpret both the 'commissioner' and the 'commissioned' in 3D printing service bureaux in a manner which does not fall under the private and non-commercial use limitation.

Distinguish between lawful and unlawful sources being 3D printed or 3D scanned in printing bureaux.

shop

Licensing and Traceability

Industries to engage more effectively in licensing CAD files and adopting new business models in reducing the barriers to entry for start-ups and SMEs.

New technologies such as the blockchain and watermarks could act as potential solutions whilst also providing possible mechanisms for traceability.

Infringement

At present, the reach of IP rights (particularly trade marks) does not extend to non-commercial infringement which nevertheless has the potential to cause substantial commercial damage to IP owners.

If such activities lead to market failure in the future, due to unauthorised use of trade marks, then the law might have to be reviewed to close this protection gap.

CHAPTER ONE

3D PRINTING: AN INTRODUCTION

> *'3D printing allows companies to do new things that customers clearly want. So embracing it is a way to be productive in moving forward. You can choose to attack it, but history suggests that that would not be a very productive way to engage with a new technology'.*[5]

1. History and Development of 3D Printing Technology

It is unknown precisely when 3D printing technology was first realised and there are differing accounts about it, but it is presumed that it originated from numerous 3D printing-related activities in around the 1950s and 1960s. A Report titled 'Early Research and Development' authored by Terry Wohlers states that the first attempt to create solid objects using photopolymers using a laser, took place in the late 1960s in Battelle Memorial Institute in Columbus, Ohio.[6] The account goes on to say that the photopolymer resin that was used in the process was invented in the 1950s by DuPont.[7]

The next noteworthy development can be traced back to the 1970s – to an article written on 3 October 1974 in the *New Scientist* by British author David Jones. Jones, writing his column under the pen name 'Daedalus' made a tongue-in-cheek proposal that:

> *... Many liquid monomers can be polymerised to solid by ultraviolet light, or even visible light. Accordingly, a laser-beam shone through a tank of monomer should leave an optically straight fibre in its path ... two different laser-beams traversing the tank would then form a solid spot of polymer at their point of intersection. By scanning this point around, any type of solid object at all could be made up: even complex interlocking and re-entrant shapes quite impossible to mould. This effortless optical sculpture would revolutionise the plastic arts in all senses.*[8]

The initial patents in this area were granted during the 1970s–1980s, and were filed and granted in different parts of the world, including the United States of America (USA), Japan and France. For example, the first patent was granted in USA to Wyn Kelly Swainson in 1977 for the same idea described by David Jones, although Swainson had filed the patent in 1971[9] before Jones' article was published.[10] Although Swainson's patent did not lead to a commercially available system, it paved the way for practical additive manufacturing of 3D parts under computer control (rapid

[5] A quote from one of the interviewees of this Study.

[6] Terry Wohlers, Early Research and Development at http://www.wohlersassociates.com/history.pdf

[7] ibid. E.I du Pont de Nemours and Company is commonly referred to as Du Pont. On 31 August 2017, Du Pont merged with Dow Chemical Company to create DowDuPont.

[8] David Jones, 'Ariadne' Column, 3 October 1974, New Scientist, p. 80.

[9] Application no. 05/165042 filed 23 July 1971. U.S. Patent 4,041,476 'Method, medium and apparatus for producing three-dimensional figure product' granted 9 August 1977.

[10] Dinusha Mendis, "Clone Wars": Episode I – The Rise of 3D Printing and its Implications for Intellectual Property Law: Learning Lessons from the Past? 35(3) European Intellectual Property Review, 155.

prototyping).[11] In Japan, Hideo Kodama of the Nogoya Municipal Industrial Research Institute was among the first to invent the single laser-beam curing approach and applied for a Japanese patent in May 1980 which later expired, without proceeding to examination stage.[12] Following on from these developments in USA and Japan, French engineers, Alain Le Méhauté, Olivier de Witte and Jean-Claude André filed a patent in France titled 'Apparatus for Fabricating a Model of an Industrial Part, involving a Single Laser Beam' (stereolithography process).[13] The French patent was granted in January 1986[14] although, similar to its predecessors, it did not lead to a commercial service.

Ultimately, it was Charles Hull of 3D Systems who led the way for the launch of the first commercial 3D printer in 1988. It was made possible by a patent granted in March 1986 titled 'Apparatus for Production of Three-Dimensional Objects by Stereolithography'.[15] Stereolithography continues to be one of the most exemplary 3D printing technologies within the category of 'Vat Photopolymerisation'.[16] However, since then, the technology has developed significantly leading to further patents which have been granted, for different 3D printing techniques as discussed below.

One of the most significant differences between the early days of 3D printing (1988) and the present time has been its infiltration of the consumer market. In 2009, the same year that ASTM International 42 published a document, containing standard terminology for Additive Manufacturing,[17] the patents on Fused Deposition Modelling (FDM) expired paving the way for low-cost 3D printers[18] which was initially made possible by the Rep-Rap project.[19]

The penetration into the consumer market not only opened doors to low-cost 3D printers, but it also paved the way for other complementing industries such as those offering easy-to-use open software for designing and modelling, online tools for modifying files and online platforms dedicated to 3D designs. Low-cost 3D printers together with online platforms allowed the industry to reach out to consumers and other businesses in a manner not seen before. *'What once cost $200,000 suddenly became available for below $2000'.*[20] This significant change ushered in new

[11] Adrian Bowyer, The Self-Replicating Rapid Prototyper – Manufacturing for the Masses, Keynote Address on the RepRap Project given by Dr. Bowyer at the 7th National Conference on Rapid Design, Prototyping and Manufacturing, June 2006 at http://reprap.org/wiki/PhilosophyPage

[12] Terry Wohlers, Early Research and Development at http://www.wohlersassociates.com/history.pdf Kodama cited having difficulties in securing funds for additional research and development.

[13] Hannah Rose Mendoza, Alain Le Méhauté: The Man Who Submitted Patent for SLA 3D Printing Before Chuck Hull (15 May 2015) at https://3dprint.com/65466/reflections-alain-le-mehaute/

[14] Application no 84 11241 filed 16 July 1984. French Patent 2567668 'Dispositif Pour Réaliser Un Modèle de Pièce Industrielle' granted 17 January 1986.
See application at https://bases-brevets.inpi.fr/fr/document/FR2567668/publications.html

[15] Application no. 06/638,905 filed 8 August 1984. U.S. Patent 4,575,330 'Apparatus for Production of Three-Dimensional Objects by Stereolithography' granted 11 March 1986.

[16] 3D printing technologies by which the report means are those which are identified by the ASTM committee F42 on Additive Manufacturing Technologies. Those encompass binder jetting, directed energy deposition, material extrusion, material jetting, powder bed fusion, sheet lamination and vat photopolymerization. See *ASTM F2792-12a: Standard Terminology for Additive Manufacturing Technologies* (2012).

[17] ASTM international formerly known as American Society for Testing and Materials (ASTM) is an international standards organisation that develops and publishes voluntary consensus for technical standards for a wide range of materials, products, systems and services. See https://www.astm.org/Standards/ISOASTM52900.htm

[18] A Brief History of 3D Printing at https://www.3dhubs.com/guides/3d-printing/

[19] https://reprap.org/wiki/RepRap

[20] A Brief History of 3D Printing at https://www.3dhubs.com/guides/3d-printing/

businesses and new business models[21] whilst existing businesses embraced the new momentum in the 3D printing industry.

1.1. Adoption of 3D Printing in the Industrial Sector: From Charles Hull to the Present Times

This Study focuses on 7 industrial sectors, namely, aerospace, automotive, health (medical), consumer goods, energy, tooling and construction. This section provides a brief overview of the adoption and development of 3D printing and 3D scanning technologies within these sectors – before moving to a discussion of the different elements of 3D printing.

One of the early adopters of this technology was the aerospace industry with companies such as Pratt and Whitney[22] leading the way. During the late ’80s and ’90s the aerospace industry benefited significantly from 3D printing by rapidly making prototype shapes for concept verification or as patterns for investment casting. Furthermore, most parts had a high level of geometric complexity and needed to be fabricated in small numbers.[23] 3D printing applications and the relevant research in the aerospace industries are continuously growing due to the development of laser-based 3D printing technologies, such as direct metal laser sintering or selective laser melting, as well as the emergence of advanced high temperature super alloys.[24]

Another area in which 3D printing was applied relatively early was the automotive industry. 3D printing has been used in the automotive industries in a number of ways including concept modelling, functional testing, or rapid manufacturing. However, the current use of 3D printing within this industry is largely dependent on rapid prototyping and rapid manufacturing (please see below for further information on rapid prototyping and rapid manufacturing) of small and complex parts which do not have an impact on the safety of the vehicles.[25]

In the medical industries, 3D printing, especially stereolithography, is largely used as a supportive surgery tool, helping medical officials plan effective and accurate surgery by using a medical model of a patient’s anatomy obtained by 3D scanning including computed tomography (CT) or MRI scan.[26] The construction of implants specifically customised for patients in reconstructive and plastic surgery as well as dental practice has also benefited from parts fabricated with high accuracy and quality afforded by 3D printing and scanning.[27] In relation to tissue and organ engineering, 3D printing and scanning has been utilised to create organ and tissue structures like kidneys by

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[21] Dinusha Mendis and Phil Reeves, The Current Status and Impact of 3D Printing Within the Industrial Sector: An Analysis of Six Case Studies (Intellectual Property Office, 2015).

[22] Pratt & Whitney is an American aerospace manufacturer with global service operations. It is a subsidiary of United Technologies. Pratt & Whitney’s aircraft engines are widely used in both civil aviation and military aviation. Its headquarters are in East Hartford, Connecticut.

[23] Jürgen Gausemeier, Thinking ahead the Future of Additive Manufacturing – Analysis of Promising Industries (DMRC; 2011).

[24] L. Jyothish Kumar and Chandrathil G. Krishnadas Nair, ‘Current Trends of Additive Manufacturing in the Aerospace Industry’ in David Ian Wimpenny, Pulak M. Pandey and L. Jyothish Kumar (eds), Advances in 3D Printing & Additive Manufacturing Technologies (Singapore: Springer; 2016).

[25] Jürgen Gausemeier, Thinking ahead the Future of Additive Manufacturing – Analysis of Promising Industries (DMRC; 2011).

[26] David Wimpenny, ‘Overview of medical applications’ in Julia McDonald, Chris J Ryall and David Wimpenny *Rapid Prototyping Casebook* (New Jersey: Professional Engineering Publishing; 2001).

[27] John Giannatsis and Vassilis Dedoussis, ‘Additive fabrication technologies applied to medicine and health care: a review’ [2009] 40 *International Journal of Advanced Manufacturing Technology,* 116.

additively layering a patient's own cultured cells or stem cells as materials – leading to the emergence of bioprinting.[28]

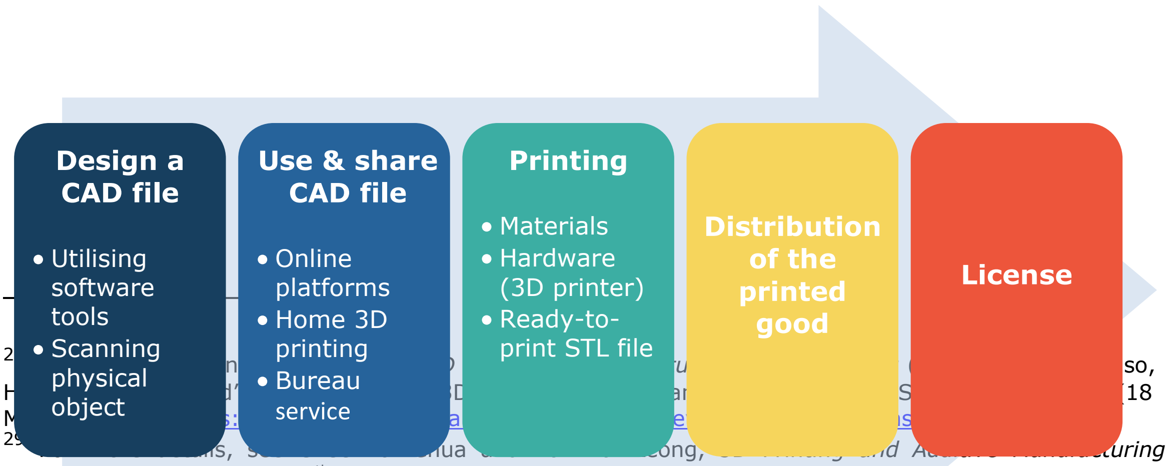
Other industries which benefit from using 3D printing technology include the consumer goods, energy, industrial and tooling and construction sectors. In the context of consumer goods, notwithstanding the conventional notion that reliance upon automation process is inappropriate for jewellery making, the jewellery industries have seen a gradual expansion of 3D printing into the jewellery manufacturing process, following the recent trend of increased customisation.[29] However, the limited availability of materials as well as poor surface finish are still deemed crucial barriers that 3D printing confronts in the jewellery industries.[30]

The adoption and exploitation of 3D printing technology could offer considerable opportunities to industries. According to a Delphi study by Jiang et al., industry and research experts interviewed in the research unanimously believed that, as 3D printing technology matures, a broad range of applications might be made possible in the future, by virtue of, for example, 3D printed products consisting of multi materials and/or containing embedded electronics.[31]

Nonetheless, the adoption and exploitation of 3D printing technology in the industries might be faced with a number of challenges. On the one hand, 3D printing provides for geometric complexity at no cost, very low start-up costs, customisation of each and every part, low-cost prototyping with quick turn around and a large range of materials all of which will be of great value to existing and new businesses. On the other hand, 3D printing is less cost-competitive for a higher volume of products, has limited accuracy and tolerance and involves post-processing and removal of support material. None of these are barriers which cannot be overcome, but it illustrates that 3D printing may be better suited for certain industries than for others.

1.2. The 3D Printing Process: Design, Use, Share, Print, Distribute and License

The overarching working principle of 3D printing is that a digital model is turned into a physical three-dimensional object by adding materials layer upon layer – hence the term additive manufacturing. The diagram below, illustrating the 3D printing process, captures the different elements associated in designing a 3D model to printing a



[28] ... so, ... [18 ...

[29] ... *principles and applications,* 4th ed., (Singapore: World Scientific; 2014).

[30] Jürgen Gausemeier, *Thinking ahead the Future of Additive Manufacturing – Analysis of Promising Industries* (DMRC; 2011).

[31] Ruth Jiang, Robin Kleer and Frank T. Piller, 'Predicting the future of additive manufacturing: A Delphi

Figure 1 From a digital model to licensing a 3D printed product – The 3D Printing Process physical three-dimensional product.

Each of these elements will be discussed in turn thereby identifying their significance, in this introductory section, before proceeding to consider the legal issues in chapters 2–5.

1.3. Designing a CAD File

3D printing commences its journey with a Computer-Aided Design (CAD) design file, more commonly known as a CAD file – which is the 'vessel' which carries the 3D model, and in effect, is the blueprint of the physical model. Without this CAD file, a 3D printer is unable to print anything. In basic terms, it is very much like a 2D printer, which relies on it being 'fed' a *Microsoft Word*, *Excel, PowerPoint* file to produce a printout. Similarly, a 3D printer also relies on it being 'fed' a CAD file. As Lipson and Kurman eloquently state: *'a 3D printer without a design file and an attached computer is as useless as an iPod without music'.*[32]

However, it is also important to point out that a design can be manufactured (3D printed) in many ways and is not necessarily limited to a CAD file commencing the process. For example, a design can be achieved through a mathematical formula, which can also lead to a 3D printed product.[33] Whilst this is true, the most common industry standard is CAD design, and therefore this report will focus on CAD files as the starting point to 3D printing an object.

Therefore, similar to files which are used in the 2D world – *Word, PowerPoint, etc.* – emanating from the *Microsoft Office* suite, the software for designing digital models is made possible by the common industry standard CAD.[34] Utilising CAD software or through scanning a physical object, a 'CAD file' can be created. As such, CAD software is used by designers who wish to make a digital model – sometimes for printing a prototype or end product and other times for illustration (when designing a kitchen or bathroom for example) or simply sharing with others. Once the CAD file is ready, it is transferred and saved into a neutral file format such as STL, ready for 3D printing. In essence, a STL file represents the digital model which will be 3D printed but, does not include information, allowing a third party to edit the original CAD file. Minor changes can be made to the STL geometry such as the removal or addition of holes, addition of text, utilising software such as Magics etc.; however, importing a STL file into CAD software in order to make more significant changes will lead to the original file structure being lost. This important information – i.e. a designer's intellectual property – is found in the CAD file, prior to it being transferred into STL format.

Figure 2 and Figure 3 reflect the distinction between a ready-to-print STL file (Figure 2) and a CAD file (Figure 3). Figure 3 which illustrates a CAD file, represents the steps which have been taken by a designer to create a 3D model, as reflected through the 'construction graph' or 'model tree' as seen on the left hand side of the diagram (outlined by a red border).

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[32] Hod Lipson and Melba Kurman, *Fabricated: The New World of 3D Printing* (John Wiley & Sons Inc 2013).

[33] Jonas Martinez, Samuel Hornus, Haichuan Song and Sylvain LeFebvre, Polyhedral Voronoi diagrams for Additive Manufacturing, (2018) 37(4) ACM Trans. Graph, 1.

[34] For a History and Development of CAD, see https://www.autodesk.com.au/solutions/cad-drawing

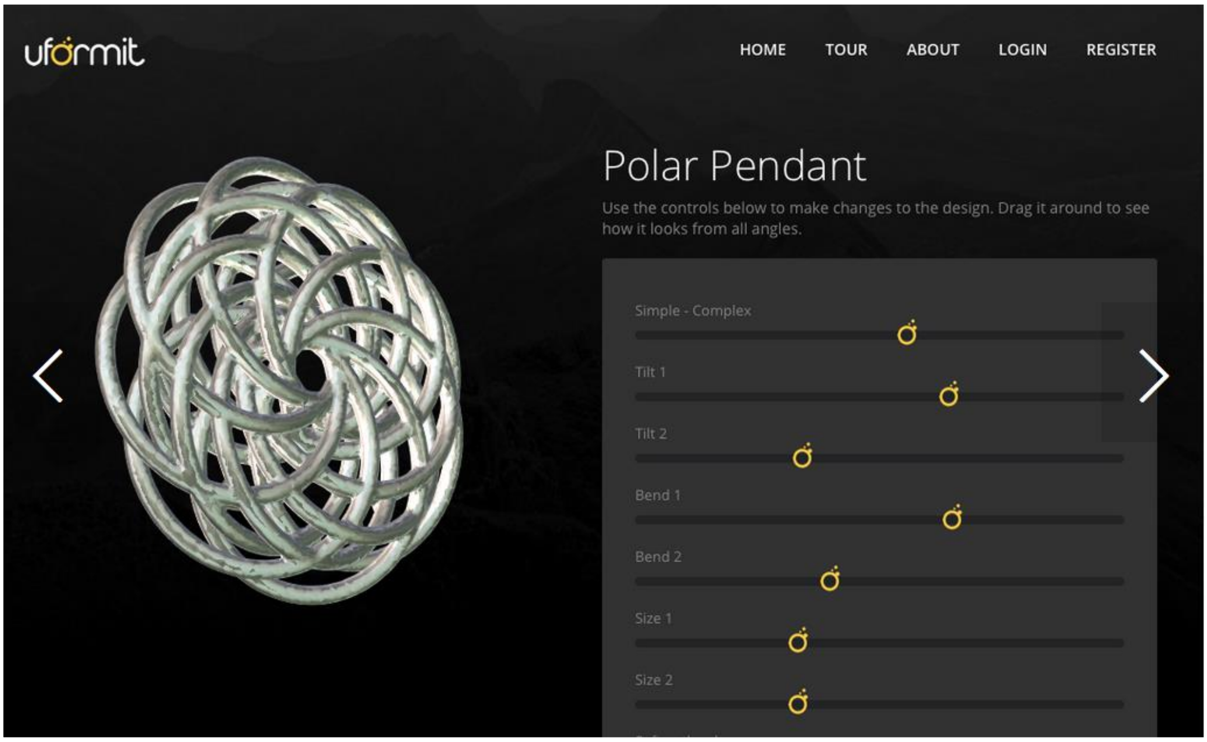

Figure 2 © Uformit (diagram produced by Uformit and used in this Study with their kind permission)

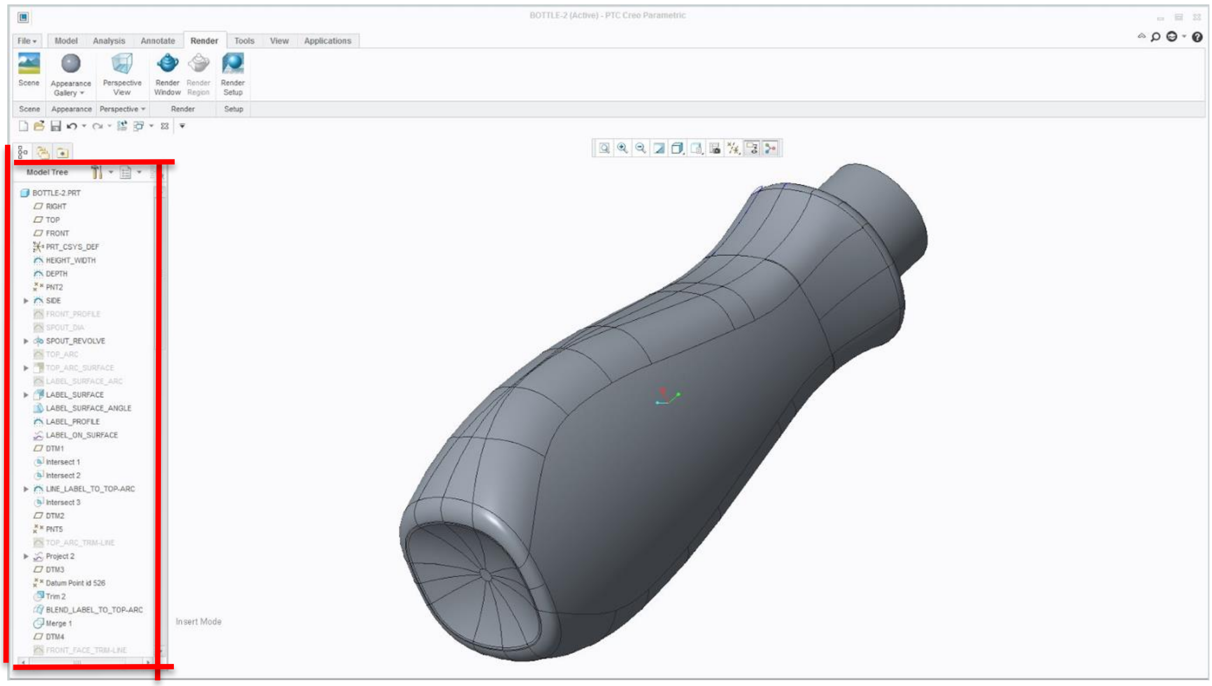

Figure 3 © 3D Hubs (diagram produced by 3D Hubs and used in this Study with their kind permission)

The distinction and significance between a CAD file and ready-to-print STL file was further captured by one of the interviewees of this Study as set out below:

Industry Opinion: CAD Files and Ready-to-Print STL Files

Another scenario where the distinction between CAD and STL files becomes apparent is where designers use CAD software such as *Rhinoceros 3D* as well as a programming environment (called Grasshopper) to create designs. In such a scenario, the (native) CAD file will contain not just the design but also the source code used to develop the design as pictured above. In this study, an issue was identified where sometimes the customers do not only want the design, but they also want the source code (CAD file) that creates the geometry. In this example, the interviewee, a freelancer, recruited the help of a lawyer to tighten up the wording of the contracts. The interviewee explained: '*Now I've been more careful about the contracts to make sure that … in terms of intellectual property for me, I try and make it so the contract is that the company only owns the deliverable and the deliverable is only the design itself*.' The deliverable, to the client '*is the STL file … what we'd call like a done file, an STL or a step file or something like that. And that way, I mean it's not the native CAD file where they can see how it was created or do things like that' (Int.24).*

Industry Opinion 1 CAD files and ready-to-print STL files

As such, designers well versed in CAD software are most likely to create a CAD file from its inception, especially designs which are complex. However, open-source CAD software such as Blender,[35] FreeCAD,[36] OpenSCAD,[37] amongst others have paved the way for the lay person to design CAD files, although these are mostly less complicated.[38] The reach of CAD software to the mass market has raised various questions about its legal status – both from the (theoretical) legal and industry perspectives. The legal aspects are considered in chapters 2–5. The industry opinion on this point is set out below:

Industry Opinion: Seeking Clarity in relation to the Protection of CAD Files

Interviewees were asked to indicate their level of agreement with the following inquiring statement: '*There is a lack of clarity in the law regarding the protection of Computer Aided Design (CAD) files.'*

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35 Blender, provided by 3D printing company *Sculpteo,* is a free 3D modelling software https://www.blender.org/

36 FreeCAD provided by 3D printing company *iMaterialise*, is another free 3D modelling software https://www.freecadweb.org/

37 Openscad, provided by 3D printing company, *Ultimaker*, is also a free 3D modelling software http://www.openscad.org/

38 Stephen Hoskins, *3D Printing for Artists, Designers and Makers* (London: Bloomsbury; 2013), pp. 15–16.

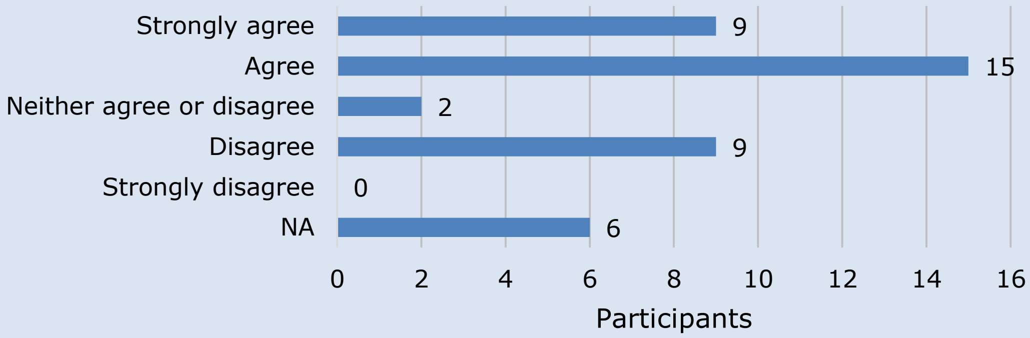

Figure 4 Interviewees' assessment on whether there is a lack of clarity in the law regarding the protection of CAD files

Most participants agreed that there is a certain lack of clarity on how CAD files are protected (see Figure 4). In discussions, several mentioned contractual agreements as an important instrument for the parties to agree on the ownership of Intellectual Property in design files. Uncertainties outlined by the interviewees related to protection, ownership and infringement in a broad spectrum of situations. For example, a designer discussed that there should be clarity on the difference between a 3D model and a CAD file. Apart from the differences in file types, it is important to consider whether the information that is stored is just the geometry of the object, or the information (i.e. mathematical expressions, software code) developed to create that geometry. This designer considered the latter to be his intellectual property, which in his experience was resolved through contractual agreements.

Another interviewee highlighted issues surrounding current file formats which do not make it possible to include information that attributes ownership to the author. A medium-sized, multi-sector company explains: *'If in the future, CADs are subject to copyright (today it is not clear if this is the case) that can lead to certain changes in how that type of information is managed. The 3D file does not have a name and surname; it is a file that does not keep track of the author of each modification done to the design. There are tools that do allow you to have certain traceability but without knowing if it is subject to copyright ... there is some uncertainty' (Int.20).*

Those interviewees disagreeing with this statement believed that the law surrounding the protection of CAD files is clear. Moreover, it was argued that '*other technologies use CAD files as well and companies have been able to protect their IP for the last 30 years or since CAD files started to be used' (Int.22)*. Therefore, in their opinion the protection of CAD files is not a problem and not exclusive to the 3D printing industry.

Industry Opinion 2 Seeking clarity in relation to the protection of CAD files

These issues raised by the industry stakeholders are discussed below, in chapters 2–5.

1.3.1. From Designing to Scanning: The Changing Phases of the Design File

Utilising CAD software (as see in the diagram above) is one of the means in which a CAD file can be created. Apart from this method, a CAD file can also be generated through scanning a physical object. This can be achieved by using various 3D scanners. For example, 3D scanners such as *XYZPrintingScanner 2.0*[39] cost as little €199, whereas *Sense 3D Scanner* (by 3D Systems)[40] or *Matter & Form V2 3D Scanner*[41] is mid-range costing about €434 and €749 respectively to those which are high-end such as *EinScan Pro+*[42] or *SpaceSpider*[43] costing around €5,890 to as much as €19,700 respectively.

Once a physical object has been scanned, the file that is generated needs to be cleaned. For example, the diagram below (Figure 5) is illustrative of a piece of jewellery which has been scanned using the *SpaceSpide*r scanner (first picture, Figure 5). The file that has been generated, reflecting a 'black blob' needs cleaning and can be seen on the laptop screen (second picture, Figure 5). These CAD files generated through 3D scanning, can be cleaned in many ways and there are many open-source CAD software such as Meshmixer,[44] Blender[45] amongst others which assist with this task. Utilising such software, a physical product which has been scanned and cleaned can be replicated as a 3D model as seen in the third picture in Figure 5.

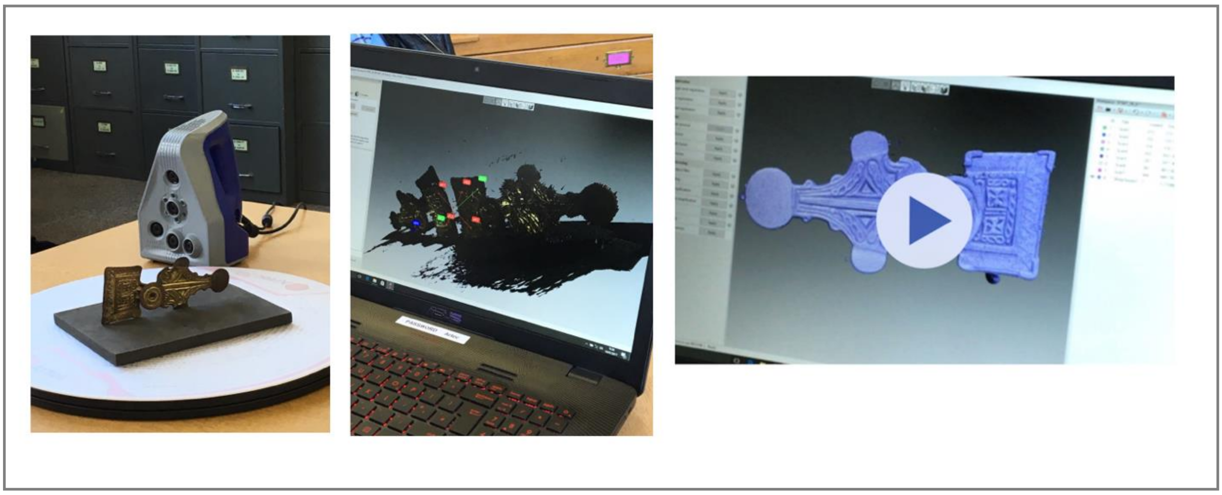

Figure 5 © Dinusha Mendis (AHRC-Funded 'Going for Gold Project' (2015–2017))

During the process of 'cleaning', a CAD file may be modified using online tools or 'apps' as they are known – whether a CAD file has been designed from inception or scanned. A design file can be modified by an end user by using 'sliders'. These 'sliders' (as seen in Figure 2 in relation to the 'polar pendant') can be used for customising any

[39] 3D Scanner 2.0 by XYZPrinting. https://www.xyzprinting.com/en-GB/product/3d-scanner-2-0

[40] Sense Scanner by 3D Systems https://uk.3dsystems.com/3d-scanners/sense-scanner

[41] V2 3D Scanner by Matter & Form https://matterandform.net/scanner

[42] EinScan Pro+ (handheld 3D scanner) by Shining 3D https://www.einscan.com/handheld-scanner/einscan-pro/

[43] SpaceSpider (handheld 3D scanner) by Artec https://www.artec3d.com/portable-3d-scanners/artec-spider

[44] Meshmixer is provided by 3D printing company *Autodesk,* and is used specifically for 'cleaning' a 3D scan or 3D printing http://www.meshmixer.com/

[45] Blender, provided by 3D printing company *Sculpteo,* is a free 3D modelling software https://www.blender.org/

product thereby meeting the full potential of 3D design and 3D printing. This is known as mass customisation and is represented at the design stage, through what is known as a 'construction graph' or 'model tree' (as seen in Figure 3). The model tree reflects the *written iteration* of the 3D model and will act as the reference point for designers as it identifies the steps utilised by the designer to construct the 3D model. As such, it is a very important part of the design process as discussed in this Study.

In terms of stakeholders, 3D scanning has an impact on almost all industries ranging from automotive, consumer, health, aerospace, construction, energy and tooling – as explored in this Study. However, its use within the health sector has grown significantly as discussed above.[46] Scanning technology is also used by museums for preservation and conservation of cultural heritage as well as reproduction of their collections for exhibition. For instance, a marble head of Mecenate was very accurately digitised by means of 3D laser scanning and successfully conserved in the National Archaeological Museum in Italy.[47] Another interesting example is the Jericho Skull exhibited in the British Museum. 3D printing and 3D scanning was utilised to reconstruct it, as a result of which three different versions of the Jericho Skull were produced.[48] These are all displayed alongside the original artwork, offering a realistic and enhanced experience to museum visitors.[49]

It is also important to point out that the new data economy we live in has resulted in a greater reliance on commercialisation of data as a key asset for conducting business.[50] In a 3D scanning scenario, this could involve data derived from designing a CAD file or scanning a physical product. For example, a scanned product produces data points, which needs to be cleaned up, as illustrated above, before it can evolve into a CAD or STL file, capable of being 3D printed. In such a scenario key questions have been raised, such as who holds the ownership, and whether such data can be protected. These questions from a legal perspective are explored in Chapter 2. The view from industry is set out below.

Industry Opinion: is there a Lack of Clarity Relating to the Ownership of Design Data?

Interviewees were asked to indicate their level of agreement with the following inquiring statement: *'There is a lack of clarity relating to the ownership of (scanned) design data'*

[46] See above, 1.1 Adoption of 3D Printing in the Industrial Sector: From Charles Hull to the Present Time.

[47] Roberto Scopigno and others, Digital Fabrication Techniques for Cultural Heritage: A Survey (2017) 36 *Computer Graphics Forum* 6.

[48] Beau Jackson, 'Interview with ThinkSee3D: behind the British Museum's Jericho Skull' (3DPI, 11 Jan 2017) https://3dprintingindustry.com/news/interview-thinksee3d-behind-british-museums-jericho-skull-102746/

[49] Larry Johnson and others, NMC Horizon Report: 2015 Museum Edition (The New Media Consortium, 2015).

[50] Mor Bokhoum, B. Conde Gallego, M. O. Mackenrodt, G. Surblytė-Namavičienė (eds.) *Personal Data in Competition, Consumer Protection and Intellectual Property Law: Towards a Holistic Approach* (Springer, 2018).

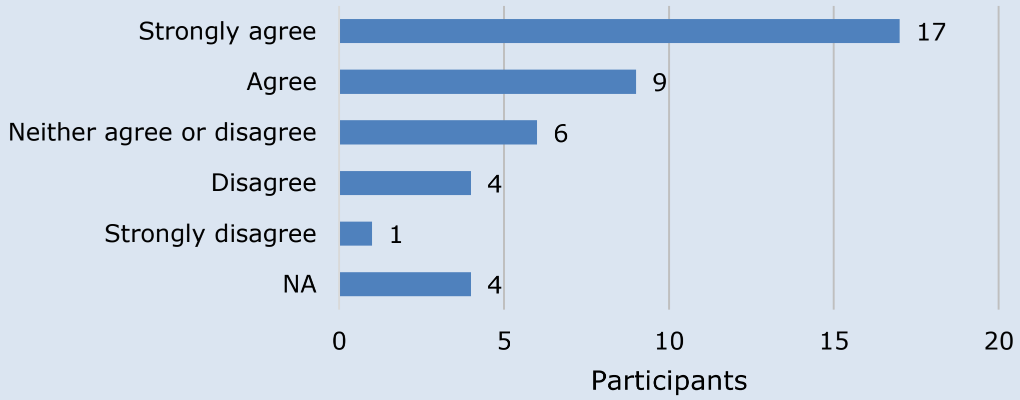

Figure 6 Interviewee's assessment of the lack of clarity regarding the ownership of scanned design data

Although scanning can be regarded as a sophisticated technology, it is also a well-established technology that interviewees have described as analogous to other more conventional technologies such as photography or photocopying. Yet, most participants believe that there is uncertainty regarding the ownership of design data.

The lack of clarity touches on different aspects, particularly when the object is scanned by an actor other than the rights holder: has the object rights holder any rights over the scanned design data? What are the consequences of modifying the form of a scanned object? Does infringement depend on the extent of the modification?

While most participants believed that there is insufficient legal clarification at the moment, a few others thought that it was just a matter of applying the existing law to a new area of technology. Those arguing that it is insufficient underlined the need for clarification on whether the law applies to original or modified scanned design data, and there was no prevalent opinion on whether copyright, data protection laws, contract and trade secret law should apply. One of them argued that '*design data create a completely different set of challenges, and therefore if current laws should apply, they should be fashioned in such a way that it accommodates the peculiarity of design data' (Int.25)*. Voices arguing that current law should be applied without modifications, compared scanning to technologies that have converted physical products into digital files, such as the MP3 in the music industry. According to one participant, this paradigm shift from physical to digital objects required more policing rather than law changes. Another large and established company in the 3D printing sector echoed this view. This company did not identify an issue with scanned design data and stated: '*we do not have any discussions about ownership of data … if you send us a file with a request to print that file … we specify (ownership) in the terms and conditions' (Int.3).*

Industry Opinion 3 Is there a lack of clarity relating to the ownership of scanned design data?

Some interviewees noted the complexity of the scanning processes. Scanning a single object is not straightforward nor immediate, at least with current technology. Not only does it require sophisticated equipment, but also the know-how and time. Therefore, one participant raised doubts on whether scanning will be mass-used to fabricate copies of objects. In the opinion of this expert, for companies, it would be cheaper to buy the original design file or commission it. Similarly, for private consumers, the least complex approach would be to purchase the CAD file and send it to a copy shop or buy the object directly from a manufacturer. As an example, the owner of an electric appliance that required a new spare part could consider different approaches to get the spare part: (1) buying the spare part directly from the manufacturer; (2) downloading the digital representation of the spare part and fabricating it (either at home or in a copy shop); (3) scanning the faulty piece, conducting the necessary adjustments to the geometry of the spare part and having it printed. The likelihood of such a consumer fixing the electrical appliance or buying the original part or the design provided by the Original Equipment Manufacturer (OEM) is more probable than scanning it. One would expect that if the spare part/design is available and the services accessible at an affordable price, this is additional revenue for companies while keeping the asset base low, so the potential profitability of companies that engage in this area fruitfully could be high. An analogy was also made with the commercialisation of media content (music, TV series, films), which is acquired legally by a higher number of consumers due to practical and comfortable distribution schemes. However, there might be cases in which the spare part cannot be bought anymore (e.g. parts from a discontinued product) or parts which have a high cost, and therefore need to be scanned. According to an interviewee, manufacturing 3D printers for the tooling sector, digitising original parts will most probably become an accepted norm in spare parts replacement, and therefore, clarification on the legal aspects would be needed in order to minimise legal costs for companies.

As a final remark, it should be noted that the issue of scanned design data is not exclusive to the 3D printing industry. Not all objects that are scanned are later manufactured (e.g. MRI data is often only used for medical diagnosis), and those that are manufactured might be created with techniques other than additive manufacturing.

1.4. Using and Sharing the CAD File: The Role of Online Platforms and Bureau Services

One of the benefits of online platforms is the ability to disseminate CAD files widely. 'Bureau Services', which are offered by 3D printing companies, offering online platforms, make it possible for end users to order 3D printed products and pay for them online.[51] In this sense, bureau services offer a service to consumers who do not have access to 3D printers or the relevant materials, much like the photocopy shops of the 1970s–1980s and internet cafés of the 1990s. For example, supermarkets such as *ASDA* and electronic retailers such as *PCWorld* in the UK, provided a bureau service in 2014, whereby customers could bring a design to have it 3D printed.[52]

Whilst these experiments by large retail chains have been abandoned, a number of independent bureau services have continued to offer 3D printing and 3D scanning services to end users and businesses alike.[53] As such, registered users of *Shapeways* for example, can create, upload, edit and share their designs on the *Shapeways* online platform without printing it or opt to have it printed and delivered to their homes.

In this context, it is also interesting to note the evolution of bureau services from a consumer peer-to-peer service to a more professional outfit. For example, early

[51] Stephen Hoskins, *3D Printing for Artists, Designers and Makers* (London: Bloomsbury; 2013), pp. 12–13.

[52] Create a 'mini-me' – 3D printing coming to a store near you (27 January 2014) at https://3dprint.com/69089/10-asda-stores-3d-scanners/

[53] 123D users can create, edit and share their designs, to either be printed at home or through a printing service. The printing and delivery service is provided through Sculpteo, i.materialise or Shapeways. See http://www.123dapp.com/about3D

adopters of 3D Hubs originated from the DIY and 3D printing community, when the platform was very much free-form. As such, the goal was to serve as many, mostly one-off, custom maker projects as possible.[54]

As the platform evolved from a peer-to-peer 3D printing network into an all-round manufacturing platform, 3D Hubs' customer base changed. Currently, the majority of orders originate from professionals who source parts for larger, high value engineering projects. These users have become a key part of 3D Hubs' business success.[55]

These online platforms are used by different types of actors in the supply chain. For example, end users share and sometimes modify design files (mostly hobby items) for home 3D printing or printing them at a bureau service such as Shapeways;[56] businesses also use online platforms and bureau services to print parts for their businesses through the use of professional online manufacturing services such as 3D Hubs.[57] In each of these cases, the online platform – a common feature in the digital age – facilitates the process.

At the same time, online platforms have been at the centre of a number of Intellectual Property (IP) infringement issues – causing them to remove such files from their platforms. A study commissioned and completed in 2015 for the UK Intellectual Property Office revealed the exponential growth of online platforms and design files at the time;[58] since then the growth has continued and the number of design files being shared have increased[59] – leading to more instances of IP infringements, as explored in this Study.

1.5. Printing the 3D Model (contained within the CAD File): 3D Printer, Printing Technologies and Materials

The functioning of a 3D printing machine to printing a 3D model requires the use of software (CAD file or STL file as explained above), hardware – i.e. printer – utilising various 3D printing technologies as well as the relevant materials (plastic, resin etc.) and includes a number of basic elements as illustrated in Figure 7 below.

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[54] See, https://www.3dhubs.com/guides/3d-printing/
[55] ibid.
[56] Shapeways at https://www.shapeways.com/
[57] https://www.3dhubs.com/
[58] Dinusha Mendis, Davide Secchi and Phil Reeves, *A Legal and Empirical Study of the Intellectual Property Implications for 3D Printing* (UK Intellectual Property Office, 2015).
[59] Dinusha Mendis, Mark Lemley and Matthew Rimmer *3D Printing and Beyond: Intellectual Property and Regulation* (Edward Elgar, 2019).

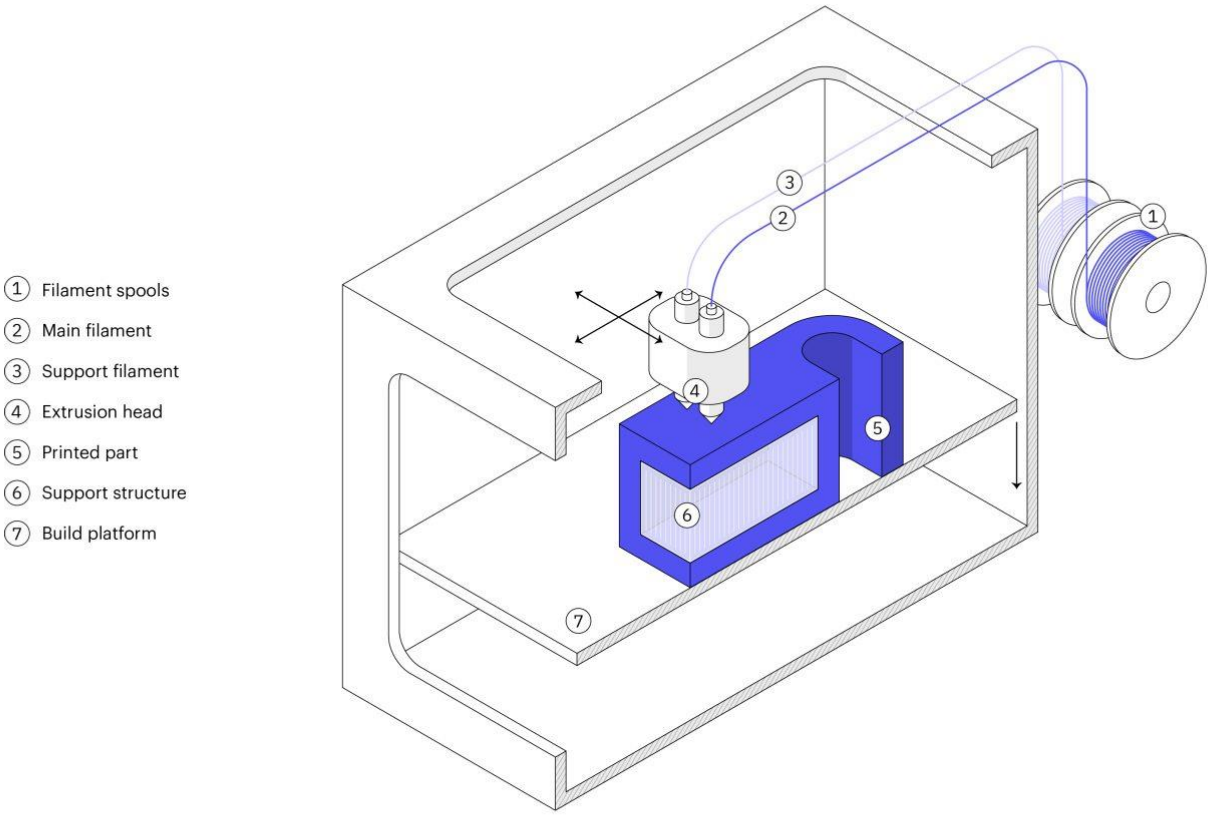

Figure 7 © 3D Hubs (diagram produced by 3D Hubs and used in this Study with their kind permission)

1.5.1. 3D Printing Technologies and Materials

As mentioned above, stereolithography continues to be one of the most exemplary 3D printing technologies[60] and has developed significantly leading to different techniques for 3D printing objects.[61] For example, in 1991, Fused Deposition Modelling (FDM), which is a type of Material Extrusion, was developed by Stratasys, and many more have emerged since then as illustrated below in Figure 8.

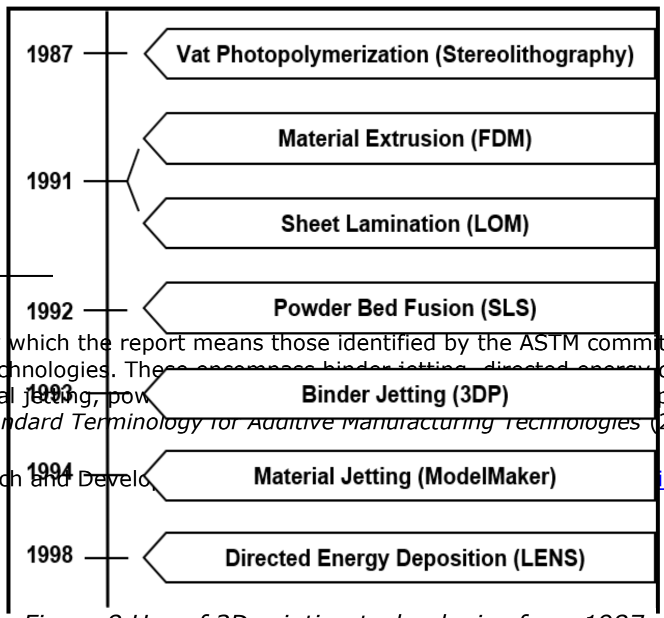

Figure 8 Use of 3D printing technologies from 1987 to 1998

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[60] 3D printing technologies, by which the report means those identified by the ASTM committee F42 on Additive Manufacturing Technologies. The[illegible] deposition, material extrusion, material jetting, pow[illegible] polymerization. See *ASTM F2792-12a: Standard Terminology for Additive Manufacturing Technologies* (2012). See also (n 16).

[61] Terry Wohlers, Early Research and Develo[illegible] istory.pdf

1.5.2. The Development of 3D Printing Technology – Varying Names and Materials

3D printing has been referred to by numerous names, such as Automated Fabrication, which was coined by Marshall Burns in the early 1990s, Freeform Fabrication, or Additive Fabrication, which was popularised by Terry Wohlers.[62] Most recently, the ASTM International recommended the term 'Additive Manufacturing', with a view to consolidating all terms that indicate 3D printing technologies.[63] Prior to the adoption of the term 'Additive Manufacturing', 3D printing was also referred to as Rapid Prototyping, Rapid Tooling, or Rapid Manufacturing or Digital Direct Manufacturing. These terms are noteworthy in that they generally denote what the role of 3D printing has been in the industries and how it has diversified during the past few decades.

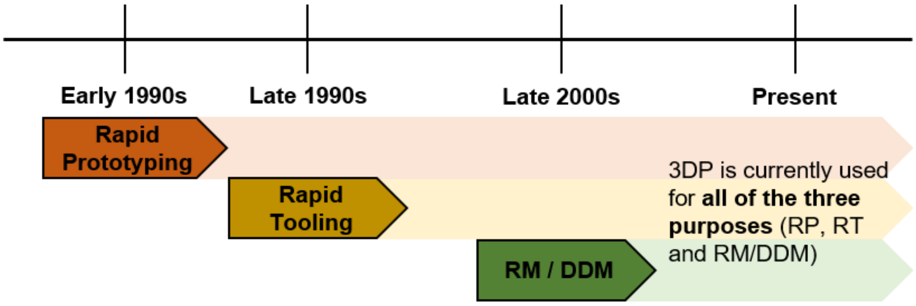

Figure 9 Development of 3D printing since early 1990s

Rapid Prototyping is the earliest form or use of 3D printing which appeared as soon as 3D printing technologies started to come into the market in around the early 1990s. As its name suggests, the term implies that 3D printing technologies were initially used for quickly producing prototypes rather than manufacturing end-use products or components. Some of the major 3D printing technologies introduced above were adopted for the purpose of rapid prototyping in the automotive industries such as *Chrysler Corporation* and *Ford Motor Co*.[64] As 3D printing technologies improved significantly in terms of accuracy and material properties, their use started to diversify, including tooling and direct manufacture of consumer goods.[65]

In relation to materials, in the late 1990s 3D printing technologies benefited from new materials such as heat-resistant polymers and metal alloys, which enabled the emergence of **Rapid Tooling**.[66] Rapid Tooling is used by 3D printing technologies to create production tools.[67] Tooling here might primarily refer to plastic injection moulds since these are most commonly and frequently used tools; however, other types of

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[62] Ian Gibson, David Rosen and Brent Stucker, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, 2nd ed., (New York: Springer; 2015), pp. 7–8.
[63] ASTM F2792-12a: Standard Terminology for Additive Manufacturing Technologies.
[64] Xue Yan and P Gu, A review of rapid prototyping technologies and systems [1996] 28 Computer-Aided Design, 307.
[65] Ian Campbell, David Bourell and Ian Gibson, Additive manufacturing: rapid prototyping comes of age [2012] 18 Rapid Prototyping Journal, 255.
[66] Thierry Rayna and Ludmila Striukova, From rapid prototyping to home fabrication: How 3D printing is changing business model innovation [2016] 102 Technological Forecasting & Social Change, 214
[67] Gibson, Rosen and Stucker (n 62), p. 437.

forming tools, including die casting, sheet metal forming and forging dies could also be covered by Rapid Tooling.[68]

Rapid Manufacturing or Digital Direct Manufacturing is a term that depicts use of 3D printing technologies for production of end-use products or components.[69] Albeit the concept of Rapid Manufacturing was introduced in 1997,[70] it appears that there was no viable system of Rapid Manufacturing during that time, according to Wohlers Report 2003. However, behind the scenes, there has been constant development and research to promote the possibility of Rapid Manufacturing,[71] including the NEXTRAMA Project – one of the examples of a multinational EU project that is designed to encourage the growth of a Rapid Manufacturing system.[72]

A salient point to note here is that these three forms of 3D printing (Rapid Prototyping, Rapid Tooling and Rapid Manufacturing or Digital Direct Manufacturing) currently coexist. This gives rise to varied applications of 3D printing in the industries.[73]

There are various companies involved in the manufacture of 3D printers and materials. One of the most well-known printing companies is HP – and HP has also extended its expertise to manufacturing 3D printers. However, there are many other well-established companies in this field, who have been involved in the manufacture of 3D printers and materials for many years such as such as 3D Systems, Stratasys,[74] Materialise,[75] Voxeljet[76] to name a few. These companies are involved in the manufacture of both hardware (3D printers) as well as materials (and software).

1.6. Distribution of the Printed Product and Licensing

Once 3D printed, the 3D printed (physical) product can be distributed in many ways. It can be done by bureau services as mentioned above or through other retailers.

Licensing is an integral part of IP laws – it allows companies to trade and sell their IP and reach wider audiences. Mendis and Secchi in their commissioned Report for the UK Intellectual Property Office (UKIPO) revealed that the activity on the sharing of CAD files on major online 3D printing platforms have been exponentially increasing

[68] Gideon Levy, Ralf Schindel and J.P. Kruth, Rapid manufacturing and rapid tooling with layer manufacturing (LM) technologies, state of the art and future perspectives [2003] 52 *CIRP Annals – Manufacturing Technology*, 589.

[69] Gibson, Rosen and Stucker (n 62), p. 375.

[70] The concept of Rapid Manufacturing was proposed by Professor Phill Dickens at the European Stereolithography User Group in 1997 after undertaking a project with Flymo in 1996.

[71] David Bak, 'Rapid prototyping or rapid production? 3D printing processes move industry towards the latter' [2003] 23 *Assembly Automation*, 340.

[72] Joseph J. Beaman and others, *WTEC Panel Report on Additive/subtractive Manufacturing Research and Development in Europe* (World Technology Evaluation Center; 2004), p. 25

[73] For example, in the automotive industry, use of 3D printing for rapid prototyping still takes a very significant proportion. Use of 3D printing for rapid tooling in the industries is also remarkable. Wohlers Report 2015 categorised this area as 'industrial and business machines' and it is one of the leading industrial 3D printing application areas, whose share takes up around 17.5% in 2014. See for more detail Vincent Duchêne and others, *Identifying current and future application areas, existing industrial value chains and missing competences in the EU, in the area of additive manufacturing (3D-printing)* (European Commission; 2016), pp. 100–106.

[74] https://www.stratasysdirect.com/

[75] https://www.materialise.com/en

[76] https://www.voxeljet.com/

since 2008.[77] In carrying out this Study, the authors considered the *types and percentage* of licences used on the platforms and their effectiveness of them.

License	Number	Percentage
All Rights Reserved	967	0.02
Attribution-Non-Commercial	4,734	1.20
BSD License	353	0.01
Commons Attribution	64,068	17.00
Creative Commons	57,773	15.00
General License	1,479	0.04
GNU	2,780	0.07
Public Domain	1,511	0.04
NA	251,451	65.30

Figure 10 (Source: Mendis and Secchi, 2015)

Accordingly, the research identified that Creative Commons licences such as Attribution ShareAlike and GNU Public Licence were used on 3D printing online platforms. The data revealed that 35 per cent of users who do license their work are more inclined to use Creative Commons licence, followed closely GNU Public Licence.

However, 65.30 per cent of users engaged in the activities of 3D printing online platforms did not license their work at the time of carrying out this Study (2014), leaving their creations vulnerable and open to infringement whilst losing the ability to claim authorship.[78] Although a lack of licence attribution may be linked to a user's ignorance or misunderstanding of the intricacies associated with each licence, it may sometimes be done intentionally as the file has been uploaded in breach of IP laws.

Based on the interviews carried out in this Study, it revealed that in the 3D printing sector, licensing from others was not a common strategy among small companies, although a few interviewees were open to the idea of getting licences to reinforce their core technology. When asked about the licensing practices of other companies, two of the participants responded that to their knowledge there was hardly any licensing activity in their immediate circle of partners and competitors. Only two start-ups had licensing agreements for patents – and these were owned by universities where the co-founders were previously conducting research in 3D printing topics. One of them explained that such licensing agreements were comparable to the licensing contracts that could be established with other industrial actors. A company (Int.36) explained that they collaborate in research and development projects with universities, and patents are part of the outcomes of the project. Depending on the research agreement, the ownership of the patent might be shared or fully owned by one of the parties, and in case the university owns the patent, the company has the right to license it from the university.

Cross-licensing was another aspect which emerged from the findings in this Study. Two large companies reported that cross-licensing agreements have been critical (not necessarily negative) to the company in one or more occasions. For both companies,

[77] Dinusha Mendis and Davide Secchi, *A Legal and Empirical Study of 3D Printing Online Platforms and an Analysis of User Behaviour* (UK Intellectual Property Office; 2015).

[78] Dinusha Mendis and Davide Secchi, *A Legal and Empirical Study of 3D Printing Online Platforms and an Analysis of User Behaviour* (UK Intellectual Property Office; 2015) at pp. 43–44.

such agreements served to settle patent infringement lawsuits and had a profound impact in their consequent businesses.

Industry Opinion: Challenges and Opportunities of 3D printing in the Industrial Sector

As explored in this Study, there are many opportunities and challenges which 3D printing presents from a technological point of view. In this context, interviewees of this Study were asked to assess whether the challenges faced by 3D printing have developed in existing manufacturing supply chains or whether it needs further consideration. [79]

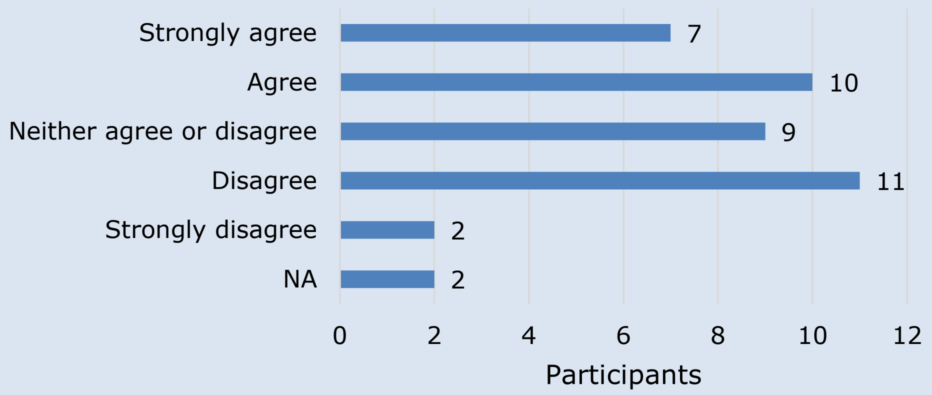

Figure 11 Interviewees' assessment on whether the IP challenges of 3D printing have developed in existing manufacturing supply chains

As it can be observed in Figure 11 this statement divided opinion significantly. Although some participants agreed that the supply chain of 3D printing has evolved from other industrial and production frameworks at a broad level, clear differences were identified by some others.

Some participants pointed out that 3D printing leads to new and innovative scenarios that were unthinkable and simply not present amongst other established manufacturing methods. For instance, low-cost 3D printers, digitisation and the ease with which design files can be shared – not just between business-to-business but also between business-to-consumer (and potentially consumer-to-consumer), has changed the face of 3D printing in today's digital world. The investment and the complexity surrounding installation of a 3D printing machine is significantly lower than that of other manufacturing techniques such as injection moulding or metal casting. Therefore, similar to music and movie piracy, this recent advancement could lead to object piracy. At the moment '*this doesn't happen so much because 3D printing still costs quite a bit, so it is not cheaper than buying an original part that is already fabricated. However, printing services might become much cheaper in the future, and then this might definitely become an issue' (Int.29).*

Another participant explained that a key difference between the supply chains of

[79] In particular, the interviewees were asked the following inquiring statement: 'The supply chain for 3D printing is largely based on existing manufacturing supply chains where the intellectual property challenges have been developed.'

existing manufacturing techniques and 3D printing is that those of the latter are more flexible. In particular, a mismatch is identified between the different players in the sector, i.e. the 'old' existing players within 3D printing and those that are 'new' to 3D printing. The new actors in this field come from different industries and bring with them the experience of different supply chains. An example of this is within the jewellery industry where, for example, engineers have entered the supply chain and are bringing with them different ideas. Supply chains within 3D printing are, as a result, described by one interviewee as interdisciplinary.

Neither agreement nor disagreement was expressed by nine participants. Some of them argued that the supply chain reconfiguration of 3D printing is different to that of other manufacturing techniques in terms of actors, pipelines, procedures etc. However, the IP challenges in the different parts of the value chain are analogous to those encountered in other value chains.

Participants agreeing with the statement considered that the IP challenges of 3D printing have also been experienced in other digital manufacturing techniques (e.g. milling, casting, moulding). Various reasons were discussed: (1) the protection of the hardware and material follows the same rules and challenges in each digital manufacturing approach; (2) they are based on analogous or identical parts of the value chain; (3) they all use CAD files containing digital representation of the object to be fabricated, which is generally regarded as a key IP asset to be protected; (4) they might be combined in the fabrication pipeline (e.g. 3D printed moulds for casting).

What is clear therefore from this inquiry is that the position in relation to the application of IP laws to 3D printing is unclear. For these reasons, this Study will delve deep into the IP implications of industrial 3D printing with the aim of providing some clarity and guidance. As such, this report addresses the existing challenges, whilst identifying the areas of the IP framework which needs to be reviewed and adjusted, in moving ahead with this technology.

Industry Opinion 4 Challenges and Opportunities of 3D printing in the Industrial Sector

1.7. Contributing to Sustainability Goals and the Circular Economy through 3D Printing

In a 2017 Working Document on 3D printing produced by the Committee on Legal Affairs of the European Parliament, the following motion was presented: '*whereas 3D printing would lower both transport costs and CO_2 emissions*'.[80]

This Working Document identified the important role that IP laws play in 3D printing but also raised the important question in relation to 3D printing and its impact on the environment[81] (i.e. use of plastic, resin for 3D printing). When materials are heated at high temperatures, the 3D printing process has the potential to produce fumes with

[80] European Parliament, (Committee on Legal Affairs) *Working Document: Three-Dimensional Printing, a Challenge in the fields of Intellectual Property Rights and Civil Liability* (23 November 2017) at http://www.europarl.europa.eu/sides/getDoc.do?type=COMPARL&reference=PE-612.302&format=PDF&language=EN&secondRef=01

[81] See also, UN Sustainable Development Goals at https://sustainabledevelopment.un.org/?menu=1300 SDG9 states that 'the intensity of global carbon dioxide (CO2) emissions from manufacturing industries declined by more than 20 per cent between 2000 and 2016 …'

toxic by-products, known as volatile organic compounds (VOC) which can be harmful to the environment.

However, researchers at Loughborough University, UK, in collaboration with a number of industry partners, illustrated the many 'green' aspects of 3D printing through the *Atkins Project.*[82] Furthermore, researchers at the University of Nottingham, UK in collaboration with Yale University and MIT (USA) highlighted two key elements which makes 3D printing a 'greener' technology[83] – echoing the European Parliament's motion. These include (1) the *reduction in waste* due to the lack of excess cutting, drilling and milling required in traditional manufacturing (3D printing utilises only the material it needs) and the ability to re-use plastic waste by converting it into plastic filaments; and (2) *accessibility of 3D printing technologies* which allows individuals and companies to manufacture products on site, reducing the need for storage and diminishing the need to transport products to end-users. The researchers also concluded that exposure to particles and VOC emissions produced by 3D printing processes are generally low when applying appropriate precautions.[84]

One of the participants in this Study (Int.40) was a collaborator in the *Atkins project*. This interviewee provided an insight in to how 3D printing can contribute to the circular economy, as captured in the case study below.

1.7.1. Case Study 1: 3D Printing and Sustainability

Case Study and Overview

Sustainability is an important element in any industrial sector. The 3D printing ecosystem has become more aware of sustainability and the impact which the technology can have on the environment. For example, in an attempt to reduce excess cutting, drilling and milling, *Boeing* replaced machining with 3D printing for over 20,000 units of 300 distinct parts (OECD, 2017). As such and as mentioned above, 3D printing presents the benefits of reducing waste through re-using plastic waste and reducing the need for storage and transport costs by manufacturing products on-site.

Combining New Technologies and Sustainability Goals

An interesting example which illustrates sustainability within the 3D printing industry was offered by one of the interviewees from a large multi-national 3D printing company (Int.40). In outlining the scenario, the interviewee spoke of a tool which was created by his former company to quantify and qualify the business and the environmental benefit of light weighting. In other words, this particular company produced a piece of software for carbon foot-printing 3D printed parts, which was then licensed to multi-national companies within the aerospace sector. In practical terms, the 'energy moniroting' software would be utilised by companies in uploading CAD files incorporating the part that needs printing. At the point of upload, the cloud-based service would ask the company to input various bits of information including (a) the type of material, (b) the 3D printing process most likely to be used (selective laser melting, etc.) and (c) the supply chain, made possible by a 'drag and drop' system.

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[82] The Atkins Project: A Low-Carbon Manufacturing Solution (15 January 2015) at https://www.lboro.ac.uk/service/publicity/news-releases/2009/03_ATKINS.html

[83] Martin Baumers, Joost Duflou, William Flanagan, Timothy Gutowski, Karel Kellens, Reid Lifset, 'Charting the Environmental Dimensions of Additive Manufacturing and 3D Printing' (2017) Vol. 1 Issue S1 *Journal of Industrial Ecology* (Special Issue: Environmental Dimensions of Additive Manufacturing and 3D Printing) 1-265 at 9-14.

[84] ibid.

Once this information has been input, the system would calculate the amount of energy emanating from materials, the 3D printing processes, energy utilised during post-processing, heat treatment, shipping costs amongst others, depending which part of the world it will be printed. As part of the project, the piece of software was able to compare the energy consumption between traditional manufacturing and 3D printing and provide the company with the carbon footprint between the two systems. It was also capable of calculating how much fuel could be saved on an aircraft, for example, by utilising 3D printing and suggests the best way forward in lowering the carbon footprint. For example, this could be achieved by comparing plastic and metal 3D printing or laser sintering and injection moulding or metal and direct metal laser sintering and CNC machining in making comparisons between traditional supply chains and 3D printing supply chains – in suggesting the best way forward. As such, this is an excellent example which combines new technologies such as 3D printing and novel technological software tools to achieve sustainability.

Examples

'It [the software] (sic) would look at where you were doing this, so if you said I am doing this in India what it would then do is look up what the CO2 per kilowatt in India is because all countries around the world have very different energy mixes'

'Or if the manufacturing was done in Iceland, it would not involve any energy whatsoever because it is all done through Geothermal'

'So it would go to that level of detail … It would then look at how it's going to be shipped and it would calculate what the embodied energy from the shipping in the supply chain would be' (Int.41).

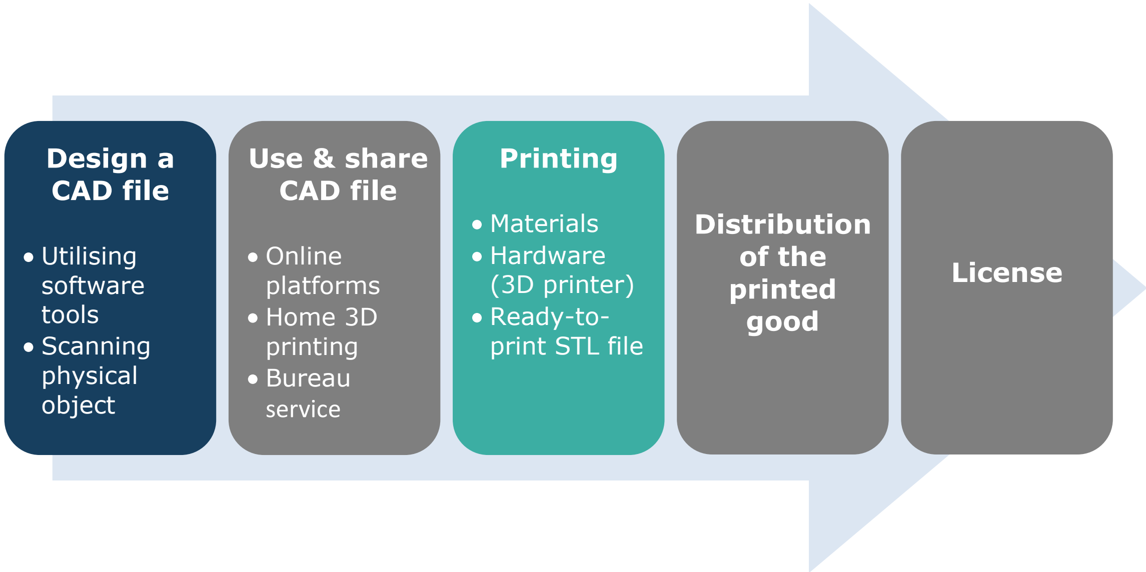
Solutions and Recommendations

- Sustainability is an element of 3D printing, which will need attention. The use of plastic and resin for 3D printing could have an adverse effect on the environment. More projects (as above) which explore and develop carbon foot-printing 3D printed parts are essential. This is a challenge which the 3D printing industry will need to address and adopt.

Case Study 1 3D Printing and Sustainability

CHAPTER TWO:

3D PRINTING AND IP PROTECTION



2. Introduction

This chapter will focus on 'protection' aspects relating to 3D printing. In doing so, the chapter discusses how each of the selected Intellectual Property Rights (IPR) applies to the elements of the 3D printing process as demonstrated in the diagram above (steps 1 and 3).

Moreover, a discussion on how each IPR applies in terms of protecting design data is included. The issue of data does not represent one individual element of the 3D printing process *per se*, but plays a key role in the 3D printing process. As such, the question of how IPR currently applies to design data is an important issue that is equally relevant for all the identified stages of the 3D printing process. Therefore, before proceeding to a discussion on CAD files, printing etc., it is important and relevant to provide some context in relation to the protection of design data in the context of 3D printing.

Generally, data can be divided into personal data and non-personal or design data.[85] However, the issues explored in this report focus on the latter aspect of design data. Sometimes in a scanning scenario these lines can blur: design data can indeed contain 'personal data' where the scanning has taken place in the medical sector, for example. In the context of 3D printing, IPR strategies are likely to be affected by this new business environment, dominated by an increase in the amount of design and potentially personal data leading to new possibilities for data analysis.

In the context of the EU, the acts of *protecting, accessing and processing* data have been identified as the major challenges that might create barriers to the free flow of

[85] Mor Bokhoum, B. Conde Gallego, M. O. Mackenrodt, G. Surblytė-Namavičienė (eds.) 'Personal Data' in *Competition, Consumer Protection and Intellectual Property Law: Towards a Holistic Approach* (Springer, 2018).

data, thus potentially hampering the creation of an EU-wide digital single market.[86] Notwithstanding the importance of non-personal data in the data-driven economy, the important issues relating to non-personal data regulation remain either scattered or unaddressed.

Although there is a lack of ownership-related legislation for data in the EU and its member states, data are partly regulated by IPRs, especially within the copyright, patents, trade marks and designs systems. Moreover, other types of IPRs such as the *sui generis* database right regime as well as soft types of IP and/or unfair competition law regimes, trade secrets[87] and general contractual agreements play a crucial role in the protection of data, as discussed later in this chapter.

Based on the above considerations, this Chapter will explore the following elements of the 3D printing process as follows:

a) Protection pertaining to designing a CAD file, whether it be through software tools or through scanning (*step 1* of the 3D printing process diagram above);

b) Protection pertaining to design data generated through designing a CAD file or through scanning *(an underlying aspect of the entire 3D process, cutting across all steps)*; and

c) Protection pertaining to printing such as materials and hardware (*step 3*, of the 3D printing process diagram above).

When considering the protection of CAD files under each IPR, the Chapter will also consider the protection of the ready-to-print STL file, separate from the CAD file, as relevant.

Accordingly, each of these aspects of protection will be considered in turn and will be integrated with the results from the empirical study emanating from interviews with industry stakeholders.

2.1. Protecting the Elements of the 3D Printing Process via Patent Law

According to Article 52(1) European Patent Convention (EPC) 2000 '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 provides that in order to qualify for patent protection, inventions must be sufficiently disclosed.[88]

Different elements of the 3D printing process encompass inventions that can be protected via patent law. First, patent protection could be extended to the inventions in the CAD files *per se*, even though this is to date highly controversial. Second, patent law can apply to the software related inventions (computer-implemented invention) included in the process, such as firmware used to operate the machines, as far as patentability requirements are met. Third, patents can be used to afford protection to the technical inventions related to the design data included. Fourth,

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[86] European Commission. Shaping the Digital Single Market. https://ec.europa.eu/digital-single-market/en/policies/shaping-digital-single-market

[87] Now harmonised by Directive (EU) 2016/943 of the European Parliament and of the Council of 8 June 2016 on the protection of undisclosed know-how and business information (trade secrets) against their unlawful acquisition, use and disclosure.

[88] See EPC Article 83.

patents can protect the inventions related to the hardware (e.g. 3D printers and scanning machines), as well as the materials.

2.1.1. Protecting CAD Files

The application of patent law to CAD files might be both critical and highly controversial. On the one hand, the CAD file may be the most valuable part of an invention. Certain inventions that are currently patented can, at present, be represented digitally through a CAD file (e.g. by generating it through CAD software, or by 3D scanning a protected item), with the CAD file actually containing key information about the patented invention. In a future context, it can be envisaged that more and more inventions will arise that can be made only via CAD and 3D printing techniques. In this setting, applying patent tools to protect the *methods* for making the invention might not be sufficient. Instead, protecting the CAD file *per se* through patent law might be an important strategic alternative for inventors. At the same time, however, unless it is decided that CAD files can qualify as software-related inventions, the only way to 'patent' a CAD file would be a process patent claiming a specific set of instructions to bring about the CAD file. To our knowledge, to date, there are no published patents in Europe where this type of strategy would appear to have been used in patent claims drafting.[89] Thus, it remains to be seen whether such types of claims could be accepted for instance by the European Patent Office.

In relation to applying patents to software-related inventions (e.g. firmware to operate the machines,) used in the 3D printing process, 3D printing technology does not raise any specific *ad hoc* issues. Instead, general rules and principles relating to the application of patent law to computer-implemented inventions are applicable.[90]

2.1.2. Protecting Design Data

Patent law might, to some extent, be applicable to data (e.g. the valuable design data included in the CAD file or the data derived from scanning, etc.). Generally, the patent system has historically been a poor protector of data and data processing. On the one hand, data *per se* is not a patentable subject matter (Art 52 EPC). Indeed, the case law of the Boards of Appeal of the European Patent Office (EPO) shows that merely assembling, organising or manipulating data is not itself eligible for patent protection. On the other hand, data could potentially be a subject of patent protection should it be conceived as a 'product' obtained by using a process patent.[91] Article 25(c) of the Unified Patent Court (UPC) Agreement, in fact, stipulates that a process patent also provides the right to prevent a third party from 'offering, placing on the market, using, or importing or storing for those purposes a product obtained directly by a process which is the subject-matter of the patent'. At the same time, however, there already exist in the EU court decisions that lean towards an interpretation that would actually

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[89] Rosa Ballardini, J. Lindman, & I. Flores-Ituarte, 'Co-Creation, Commercialization and Intellectual Property Management – Challenges with 3D Printing Technology', (2016) 7(3) *European Journal of Law and Technology*, 1.

[90] These issues have been extensively discussed in the EPO case law and in the literature, thus will not be reiterated in this report. For more details in relation to the challenges and interpretations relating to the application of patents for computer-implemented inventions, see, for instance, R.M. Ballardini, *Intellectual Property Protection of Computer Programs. Developments, Challenges, and Pressures for Change*, Economics and Society – 246 (2012), https://helda.helsinki.fi/handle/10138/35504. Doctoral thesis at Hanken School of Economics (Helsinki, Finland). See also EPO CII Guidelines available at: https://www.epo.org/law-practice/legal-texts/html/guidelines/e/j.htm.

[91] Josef Drexl, 'On the Future Legal Framework for the Digital Economy: A Competition-based Response to the "Ownership and Access" Debate', in Reiner Schulze and Dirk Staudenmayer (eds), *Trading Data in the Digital Economy: Legal Concepts and Tools* (Baden-Baden: Nomos) 222-43 Münster Colloquia on EU Law and the Digital Economy III 1. Auflage 2017, ISBN print: 978-3-8487-4565-4, ISBN online: 978-3-8452-8818-5, DOI: 10.5771/9783845288185-221

indicate that patent protection should not extend to information as the product of a process patent. For instance, in the German court decision by the District Court of Düsseldorf in the *Hunde-Gentest* case[92] the Court noted that, since information was directly accessible for humans without any further technical process, '*information as such lacks technicity and therefore cannot be patented*'.

2.1.3. Protecting Materials and Hardware

Finally, as mentioned above, patent law could be used to protect the technologies related to the hardware (e.g. 3D printing machines and scanners) and materials. Indeed, patents play a key role in affording protection to inventions in this category. Issues related to the use of patent law to protect such inventions remain uncontroversial. This is notwithstanding one outstanding point of controversy which could arise where issues related to ethics and morality come into play in the context of bio-printing.[93]

Bioprinting is an emerging field of technology that is part of the wider field of tissue engineering and uses 3D printing technology.[94] The printing process is controlled by a computer according to a predetermined instruction, usually a CAD file of the respective tissues or object. The ultimate goal of the technology is to replicate functioning tissue and material, up to full organs, which can then be transplanted into human beings.[95] As such, this new technology encompasses new and innovative bioprinting apparatus or 'mechanical' inventions (where patent protection would likely be uncontroversial), as well as new forms or improved versions of 'biological' material and processes, like bioink (the patentability of which could be highly controversial).[96] Considering that possibilities for relying on patent protection might have a great impact on where the greatest investments and Research & Development (R&D) efforts in this technology will be made,[97] the question whether certain types of bioprinting technologies should be barred from patenting is crucial.[98]

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[92] *Landgericht Düsseldorf* of 16 February 2010, Case 4b 0 247/09—Hunde-Gentest, available at: https://www3.hhu.de/duesseldorfer-archiv/?p=813 (accessed 10 September 2016). See also Oberlandesgericht München (Higher District Court Munich) of 22 October 2015, Case 6 U 4891/14, (2015) *Beck-RS* 18783.

[93] Lijie Grace Zhang, John Fisher & Kam Leong, *3D Bioprinting and Nanotechnology in Tissue Engineering and Regenerative Medicine*, 73–74 (1st ed., Academic Press 2015).

[94] Jasper L. Tran, *To Bioprint or not to Bioprint,* (2015) 17 (1) *N.C. J.L. & Tech*., 123, 132, refers to bioprinting as 'the stepchild of 3D Printing and synthetic biology', see also Sean V Murphy & Anthony Atala, *3D bioprinting of tissues and organs*, (2014) 32 (8) *Nature Biotechnology* 773.

[95] Chee Kai Chua & Wai Yee Yeong, *Bioprinting: Principles and Applications*, 53 (1st ed., World Scientific Publishing Company 2015); Mathew Varkey & Anthony Atala, *Organ bioprinting: A closer look at ethics and policies,* (2015) 5 (2) *Wake Forest J.L. & Policy* 275, 277.

[96] ibid. In the future, maybe even cloned organs, stem cells and other biologically engineered tissues may be bioprinted, however, at present this is more a possibility rather than a reality. See also John F. Hornick and Kai Rajan, *The 3D Bioprinting Patent Landscape Takes Shape as IP Leaders Emerge* (July 2016) available at: https://3dprintingindustry.com/news/3d-bioprinting-patent-landscape-takes-shape-ip-leaders-emerge-84541 See also Timo Minssen and Marc Mimler, Patenting Bioprinting-Technologies in the US and Europe – The 5th Element in the 3rd Dimension, in Rosa Ballardini (editor, author), Marcus Norrgård. (editor, author) & Jouni Partanen (editor, author), *3D printing, Intellectual Property and Innovation – Insights from Law and Technology*, (Kluwer Law Int. 2017), ISBN 978-90-411-8382-8.

[97] The bioprinting industry and researchers are increasingly relying on patent protection, with the number of patent applications expected to rise steadily. Minssen and Mimler (2017) include a useful description of the patent landscape in bioprinting, as well as of the key actors. See e.g. John F. Hornick & Kai Rajan, 3D Printing Industry, *The 3D Bioprinting Patent Landscape Takes Shape as IP Leaders Emerge*, https://3dprintingindustry.com/news/3d-bioprinting-patent-landscape-takes-shape-ip-leaders-emerge-84541/ (published 7 July 2016). See also Seung-Schik Yoo, *3D-printed biological organs: medical potential and patenting opportunity,* (2015) 25 (5) *Expert Opinion on Therapeutic Patents* 507, 510.

[98] See Minssen and Mimler (2017).

The most relevant provisions in this context are Articles 52(2) and 52 of the EPC that explicitly codify exclusions which are not considered to be inventions (e.g. discoveries claimed 'as such'). As rightly pointed out by Minssen and Mimler, it is questionable whether the naturally occurring compounds in bioink and other bioprinted products would fulfil the European technicality requirement required in order to 'escape' the 'as such' EPC exclusion.

It should also be noted that with respect to isolated biological compounds, the main provisions of the EU Biotechnology Directive (Biotech Directive)[99] have been incorporated into the EPC Implementing Regulations in 1999.[100] Rule 29(2) of the EPC Implementing Regulations reflects Article 5(2) of the Biotech Directive and defines which biological material originating from the human body can be patented:

> (2) An element isolated from the human body or otherwise produced by means of a technical process including the sequence or partial sequence of a gene may constitute a patentable invention, even if the structure of that element is identical to that of a natural element.[101]

Indeed, what could be an obstacle to the patentability of bioprinting types of inventions relates to possible morality claims that could be raised, based on Article 53(a) EPC and Article 6(1) of the *Biotech Directive.*[102] These provisions state that inventions '*where the commercial exploitation would be contrary to order public or morality*' are unpatentable.[103] Article 6, paragraph 2 of the Biotech Directive (as well as Rule 28 of the Implementing Regulations of the EPC), provides an additional non-exhaustive list of specific case groups describing when inventions are deemed to be unpatentable in the context of subsection 1:

> *2. On the basis of paragraph 1, the following, in particular, shall be considered unpatentable:*
>
> *(a) processes for cloning human beings;*
>
> *(b) processes for modifying the germ line genetic identity of human beings;*

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[99] Directive 98/44/EC of the European Parliament and of the Council of 6 July 1998 on the legal protection of biotechnological inventions.

[100] Decision of the Administrative Council of 16 June 1999 amending the Implementing Regulations to the European Patent Convention, OJ EPO 1999, p. 437–440 and 573 ff.

[101] This approach had also been followed in various decisions of the EPO Board of Appeal. See e.g. T 0272/95 *Relaxin/Howard Florey Institute*, Unreported (EPO 23 October 2002), paras 4 & 6–7; *T 1213/05 Breast and ovarian cancer/University of Utah* (EPO 27 September 2007); *T 0666/05 Mutation/University of Utah* (EPO 13 November 2008) & *T 0080/05 Method of diagnosis/University of Utah* (EPO 19 November 2008).

[102] The TRIPS Agreement Article 27(2) also permits WTO Member States to exclude inventions 'within their territory of the commercial exploitation of which is necessary to protect *ordre public* or morality, including to protect human, animal or plant life or health or to avoid serious prejudice to the environment, provided that such exclusion is not made merely because the exploitation is prohibited by their law'. See Agreement on Trade-Related Aspects of Intellectual Property Rights (Marrakesh, Morocco, 15 April 1994), Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, THE LEGAL TEXTS: THE RESULTS OF THE URUGUAY ROUND OF MULTILATERAL TRADE NEGOTIATIONS 321 (1999), 1869 U.N.T.S. 299, 33 I.L.M. 1197 (1994). National patent laws have also introduced similar bars to that of the EPC, see e.g. s. 1(3)(a) UK Patents Act 1977; s. 2(1) German Patents Act as amended by the Act on Improvement of Enforcement of Intellectual Property Rights of 31 July 2009; and s. 2 (1) Austrian Patent Act 1970 (as amended in 1984).

[103] Minssen and Mimler (2017). See also See T0272/95 Relaxin/Howard Florey Institute (Unreported, Boards of Appeal, European Patent Office), 23 October 2002), [4], [6]–[7]; cf. Howard Florey/Relaxin [1995] EPOR 541; *Cf.* T 1213/05 (Breast and ovarian cancer/UNIVERSITY OF UTAH) of 27.9.2007; T 0666/05 (Mutation/UNIVERSITY OF UTAH) of 13.11.2008 & T 0080/05 (Method of diagnosis/UNIVERSITY OF UTAH) of 19.11.2008.

(c) uses of human embryos for industrial or commercial purposes;

(d) processes for modifying the genetic identity of animals which are likely to cause them suffering without any substantial medical benefit to man or animal, and also animals resulting from such processes.

The question here is thus not on what applications are technically possible, but rather whether they should actually be achieved.[104] The moral concerns might span from the fact that the ability to produce new organs may provide mankind with the key to extend the human lifespan, or even enable immortality,[105] as well as in relation to issues surrounding the 'cells' used for bioprinting, ownership of the bioprinted organ and the religious and socio-cultural acceptance of this technology.[106] In the narrower context of the patentability of inventions involving bioprinting, the main issues concern the naturally occurring compounds in bioink and other bioprinted products.

While Article 53 EPC provides a quite indeterminate definition of order public or morality, the provisions on morality within the Biotech Directive give clearer case groups or examples when an invention is deemed to be immoral.[107] 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 similar challenges as those raised in biotechnology (e.g. with regard to use of human embryonic stem cells (hESC) in bioink), future bioprinting applications, like the use of xenogenic cells or creation of enhanced organs, might require a new assessment as to their compatibility with *ordre public* and morality.

A clear case where bioprinting would collide with patent law related to Article 6(2)(a) of the Biotech Directive and Rule 28(a) of the EPC's Implementing Regulations that declare processes for the cloning of human beings as unpatentable. If bioprinters could at some point in the future be used to replicate human beings using cloning technologies,[108] a patent application containing such a process would fall within the ambit of the provision and be rejected. Another application where bioprinting inventions could be blocked by morality or *ordre public* claims could be in relation to tissue engineering, a technology that allows for several cells (including stem cells) to be used in bioink. In this case similar moral concerns as those raised in biotech in relation to the use of hESC, whereby the treatment often leads to the destruction of the embryo could arise.[109] Moral concerns could also arise in the context of bioprinting as a result of other cell material and tissue taken from human beings (i.e. patents on human DNA).[110]

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[104] Sanjairaj Vijayavenkataraman, *A Perspective on Bioprinting Ethics*, (2016) 40(11) *Artificial Organs* 1033, 1034– 1035.

[105] Chee Kai Chua & Wai Yee Yeong, *Bioprinting: Principles and Applications*, 53 (1*st* ed) (World Scientific Publishing Company 2015); Mathew Varkey & Anthony Atala, *Organ bioprinting: A closer look at ethics and policies,* (2015) 5 (2) *Wake Forest J.L. & Policy* 275, 277.

[106] Sanjairaj Vijayavenkataraman, *A Perspective on Bioprinting Ethics*, (2016) 40(11) Artificial Organs 1033, 1034– 1035.

[107] Hellstadius 2009 at 120.

[108] Jasper L. Tran, *To Bioprint or not to Bioprint,* (2015) 17 (1) *N.C. J.L. & Tech.,* 123, 132. Tran discusses the possibility of this happening.

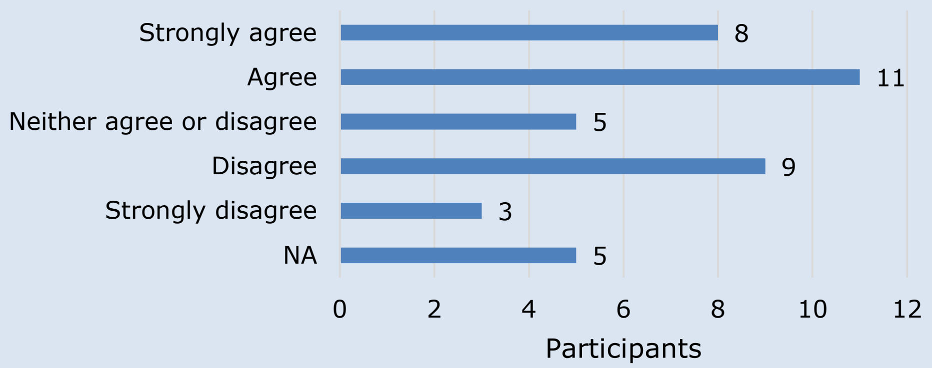
[109] Case C-34/10 *Oliver Brüstle v Greenpeace E.V.* [2011] ERC, I-09821.

[110] See e.g. *T 74/91 Howard Florey/Relaxin*, OJ EPO 388 (23 October 2002).

Industry Opinion: Clarity and development of the IP framework of 3D Printing materials

The interviewees were asked for their opinion on whether the IP law surrounding 3D printing materials needs further clarity and development.

Figure 12 Interviewees' assessment on the need of further clarity and development of IP framework of 3D printing materials



Interviewees were divided on this statement. Several interviewees disagreed because additive manufacturing materials are patented following the same procedures and encountering the same challenges as materials used in any other manufacturing technique. Since 3D printing materials are often not new, their chemical composition is not patentable. In this situation, trade secrets are a common strategy to protect non-patentable knowledge on the choice, treatment and processing of additive manufacturing materials. Another two interviewees also disagreed and argued that the problems and uncertainties concerning 3D printing material are not related to protection, but rather to standardisation (e.g. standardisation of consumables for 3D printers).

Among the interviewees agreeing with the statement, one raised the issue of the chemical transformation of 3D printing materials during the printing process. He noted that there is a lack of clarity on whether a material transformed during the additive manufacturing process can be granted protection despite being a transformation of a protected material. For instance, '*especially in 3D printing, the start material is often very different from the end material, you could start with a powder or a resin … but the chemical composition changes during the printing process'.* The question is *'if the material is protected by IPR, will this IP protection also cover the final material which comes out of the printer?' (Int.33).*

Another interviewee raised the lack of clarity regarding the so-called 'digital materials', which are the result of either arranging a material at a very fine level (e.g. microstructures) to obtain new interesting properties or combining two or more materials in specific concentrations to create a composite material with hybrid characteristics. They are called digital because the arrangement or the concentrations of the 3D printed material/s are decided by computer algorithms that receive the target physical properties as an input. For this interviewee, it was unclear what can be protected when one uses commonly known materials to create digital materials with new properties.

The remaining interviewees agreeing with the statement refered to general IP issues that were not specific to 3D printing (e.g. the legality of fabricating/selling material in countries where the patent was not in force).

Industry Opinion 5 Clarity and development of the IP framework of 3D Printing materials

Industry Opinion: Protection of Hardware in the 3D Printing Process

In terms of hardware, the interviewees of this Study, drawn from various industrial sectors, were asked to comment on the following assertion: '*The IP laws surrounding hardware (the 3D printers themselves) in the 3D printing industry are sufficiently developed.'*

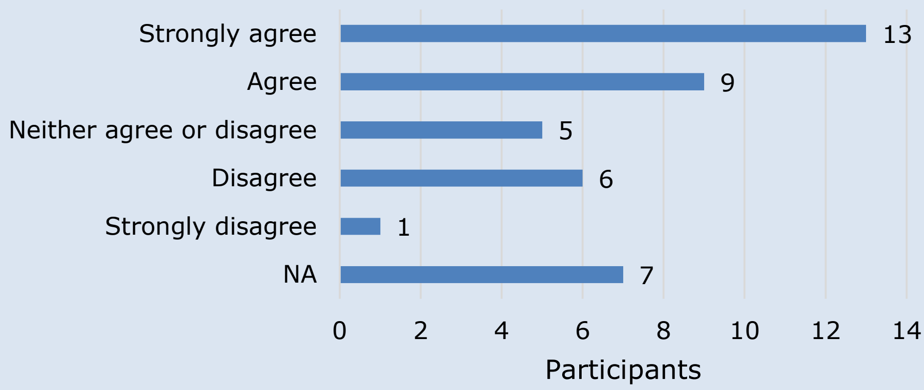


Figure 13 Interviewees' assessment on the IP framework to protect 3D printing hardware

From an IP perspective, most interviewees considered that the protection of technology relating to additive manufacturing hardware, such as the 3D printers or post-processing machines, is not significantly different to that of other manufacturing methods; or they were unaware of any differences. Therefore, there was a general agreement, by some, that the IP framework is sufficiently developed to protect the 3D printing machines, or at least to the same extent as for any other kind of manufacturing machine.

Those who disagreed observed that the hardware is still in an evolutionary stage, and therefore terminology as well as technology, still needs to be standardised.

An issue that was echoed by some interviewees is that 3D printing patents have a broad scope: 'Maybe because you know the manufacturing industry is still relatively young … you may be able to claim a little bit broader in your patent applications because of the inventions or the way of you know manufacturing or producing something is so new but that doesn't necessarily help us over others because others have the same advantage, sometimes there are very broad patents written and we are a little bit surprised by it' (*Int.17*). Although this problem is also present in other technological fields, the interviewees argued that it is affecting 3D printing because it is a relatively novel and rapidly evolving field. For example, even experts revealed knowledge gaps on the significant technical distinctions and advantages over the prior art to draft narrow dependent claims. Other patent related issues, such as patent trolls or the risk of patent infringement were also raised as important concerns by interviewees, but these are also present in other technologies regardless of their maturity and sector.

Industry Opinion 6 Patent protection in the 3D printing process

Industry Opinion: Utility Models as an Infrequent Alternative to Patents

Another approach to protecting technical aspects of an invention included the utility model, which is an exclusive right granted for an invention, similar to a patent but with less stringent requirements (for example, lower level of inventive step), simpler procedures, shorter term of protection and lower costs.[111]

Among the companies interviewed, utility models were used less frequently than patents and trade secrets. Some interviewees were not familiar with this form of protection, which did not necessarily mean that it is not used by the company where they work. As mentioned above, it should be noted that although some interviewees had an IP/legal background, others had a managerial or technical profile.

Four of the companies interviewed stated that they have filed utility models as an alternative and second option for obtaining protection, for instance, where patenting was not possible (i.e. the invention has been leaked or published accidentally prior to patent filing) or rapid registration process is needed. Nevertheless, since utility model protection is not available in all countries one company argued that they prefer patents over utility models (*Int.36*). Others simply felt that utility models were not relevant for the 3D printing/additive manufacturing sector but could be relevant for the end user who wants to protect a particular kind of functional aspect of a design.

Industry Opinion 7 Utility Models as an Infrequent Alternative to Patents

Summary

- Application of patent law to certain aspects of the 3D printing process is unclear and controversial under the current status quo.
- One problem relates to the extent to which patents can be used to protect CAD files *per se*. The current legal regime is yet unclear in this respect. New strategies to file 'CAD-types' of claims might arise in the future, but it remains unclear whether patent offices in Europe and elsewhere will accept such claims.
- In relation to the application of patent law to software inventions related to the 3D printing process general rules and principles as for CII patents will apply.
- Patent law can have some applicability for protecting the technical inventions relating to the design data in the 3D printing process. Patent law does not apply to data *per se*.
- Another set of problems relate to the possibilities to apply patent protection to bio-printing related innovations due to possible moral and ethical questions raised by these inventions.

[111] The requirements and procedures for obtaining protection, the duration of protection and the cost of utility models vary from country to country.

2.2. Patent Protection and Exploitation in Technology Companies: SMEs v Large Companies

The use of patents to protect different aspects of the production process was also evident with the interviewees, from the protection of the printing process, the hardware, the materials, the post-production process, to the resulting product.

There were no significant differences in the choice and suitability of the different IP rights used by companies operating in different sectors (i.e. medical, aerospace, automobile, etc.), using 3D printing technologies (e.g. stereolithography, fused deposition modelling, etc.) or materials, nor operating in different countries. Just one difference on the use of patents to protect 3D printing technology was found depending on the patented subject. The disparities in the use and exploitation of patents were mainly related to company size. The main difference between the interviewed SMEs and large companies concerns the resources available for patenting. The high investment (e.g. financial, human resources, time) relating to patents was raised by several SMEs as one of the main challenges of protecting a technological invention: '*It is always a question of how much effort you want to put inside and how much money do you want to spend to protect something compared with the risks that you see that someone else gets the benefit out of that' (Int.37)*.

According to large companies, their main challenge with protecting IP through patenting is the optimisation of resources in order to file the patent as soon as possible in order to bring the product to market in record time. As one interviewee explained *'that's not always easy because, of course, inventors need to take time to explain their invention … [and] work together with the attorneys to get patents written. … we have sometimes some difficulty with prioritising internally: on the one hand we want the developer to work fully on getting his product finished and to market, and on the other hand we want him to take some time helping file a patent so that's not always [possible] in daily business' (Int.26).*

Differences in the exploitation of patents were also observed across company sizes rather than operative sectors or countries. All but two Small and Medium Sized (SMEs) companies developing 3D printing technology used patents to protect features or functionalities of products that they intended to commercialise, although they noted that they would be open to licensing those patents if the opportunity would arrive. An additional motivation observed in just one small company in the sample was the use of the patent as a mechanism to attract investor funding. Patent blocking was not a practice observed among the interviewed SMEs. It was also regarded as an inappropriate strategy at the moment for the industry by three representatives (*Int.26*, *Int.33*, *Int.28*) of two SMEs and a large company. They argued that the technology still needs further development – i.e. in terms of material and mechanical quality, as well as production and economic development – and patent blocking would be an obstacle for important innovation avenues.

In comparison, large firms reported a wider diversity of reasons for patenting, as well as more experience with licensing agreements. They also had more resources to invest in patenting activity and reported cases in which a patented invention was not incorporated into a product, but was supported by the company for speculative reasons. For example, two large companies interviewed invested in the development of a strong patent portfolio to have a good negotiating position in case of disputes, and to license IP to third parties. A consultancy company specialising in the field of 3D printing, explained that this is problematic for new companies entering the market: *'the last year has been a steep increase … in filing patents … Today patents are not filed for inventions but to block competitors with a cloud of patents and the competitors don't even know where to start' (Int. 22).*

Companies developing 3D printing hardware, materials, and software methods (e.g. firmware to operate the machines, CAD software applications) were seen to protect their innovations mostly through patenting. Similarly, companies involved in the production of 3D printed objects were also seen to protect processes with patents. An alternative to patents is utility models, which seemed to be used less frequently by technology companies in the 3D printing market (noting as well that they are not available in all countries), as illustrated through examples from industry.

2.3. Protecting the Elements of the 3D Printing Process via Copyright Law

In accordance with international laws such as the Berne Convention for the Protection of Artistic and Literary Works 1886 and more recently, the Trade Related Aspects of Intellectual Property (TRIPS) 1994 and the World Copyright Treaty (WCT) 1996, copyright law broadly protects literary and artistic works.

These international laws, as well as the EU Information Society Directive (InfoSoc Directive)[112] and the EU Software Directive,[113] provide further information on this broad scope of protection as well as the protection of computer programs – aspects relevant to this discussion.

For example, the Berne Convention states that copyright protection 'shall include every production in the literary, scientific and artistic domain, whatever may be the mode or form of its expression'.[114] The TRIPS Agreement echoes the Berne Convention, although having come into being in the 'computer age', it provides guidance in relation to computer programs and compilation of data. A 'computer program' under Article 10 of TRIPS is defined as a 'literary work' – whether it be object code or source code.

These sentiments are further confirmed in Articles 2 (scope of copyright protection), 3 (application of Articles 2–6 of Berne Convention) and 4 (computer programs) of WCT 1996.

Article 2, in particular, clarifies that copyright protection extends to expressions and not to ideas, procedures, methods of operation or mathematical concepts as such. This is particularly relevant for the present discussion and will be explored in more detail below.

At the EU level, the InfoSoc Directive confirms the scope of protection of copyright and related rights of its predecessors (in Article 1) and also confirms the legal protection of computer programs.

Furthermore, Article 2(1) of the Software Directive provides guidance on the 'author' of a computer program as 'the natural person or group of natural persons who has created the program or, where the legislation of the Member State permits, the legal person designated as the rightholder by that legislation'.

Having set out a brief overview of the relevant sections applicable to the present analysis, the discussion below will now consider these laws within the relevant elements of 3D printing – in particular CAD files and design data.

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[112] 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.

[113] Directive 2009/24/EC of the European Parliament and of the Council of 23 April 2009 on the legal protection of computer programs.

[114] See Article 2(1) Berne Convention for the Protection of Artistic and Literary Works 1886.

2.3.1. Protecting CAD Files

2.3.1.1. Is the CAD File a 'Work' under Copyright Law?

From a policy perspective, it may be questioned whether the legal nature of a *CAD file* should be addressed separately from the legal nature of the *(digital) 3D model, encompassed within the CAD file*. For example, practices in the music sector, have shown that in terms of copyright protection, usually the digital copy of the original work receives the same protection as the physical work as long as the physical work meets the requirement of originality to attract copyright protection.

In this context the legal status of the CAD file needs addressing, separate from the 3D model. As mentioned in Chapter 1,[115] a CAD file is akin to *Microsoft Word*, *Excel or PowerPoint* which is the 'basis' for creating a literary work or an artistic work and what is 'fed' into a printer – either a 2D or 3D printer. The main point to bear in mind is that the digital 3D model *cannot exist without* the CAD file. This is different to a compact disc (CD) and CD case carrier, which can exist exclusive of each other. In the case of a CAD file and a digital 3D model, they co-exist, similar to a MP3 file and the music embedded within it. The difference, however, is that unlike a MP3 file carrying music which is realised through the recording of a human voice or instrument (in the majority of cases), in the case of a CAD file, the design arises from the CAD software itself – unless it is scanned – in which case it is dependent on a physical object. On the other hand, a digital 3D model can be realised as a physical product and in such cases, will exist entirely independently of the CAD file and digital 3D model.

As such it is important to consider the legal status of the CAD file – separate from the digital 3D model – and query what type of work it is, under copyright law.

2.3.1.2. CAD File as a Computer Program?

The Software Directive does not provide a definition of a computer program.[116] However, the initial proposal for a Council Directive on the legal protection of computer programs, submitted by the European Commission, 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.[117]

The wording of the above proposal indicates that the running of a computer program is made possible by the object and source codes, data flows, algorithms, programming language and general user-interface.[118]

Of particular relevance to this Study is the *'source code'* (the restatement of the functions to be performed as a set of algorithms through a human-readable computer language) and the *'object code'* (translation of the source code, generally by a

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[115] See Chapter 1, Section 1.3, Designing a CAD File.

[116] The Institute of Electrical and Electronics Engineers (IEEE) defines software as "computer programs, procedures and possibly associated documentation and data pertaining to the operation of computer systems. *See*, IEEE Std 610.12-1990 Standard Glossary of Software Engineering Terminology.

[117] *COM*(88) 816 final Proposal for a Council Directive on the legal protection of computer programs (Explanatory Memorandum) at https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:51988PC0816&from=EN. See also, *Bezpečnostní Softwarová Asociace – Svaz Softwarové Ochrany v Ministerstvo Kultury* (C-393/09) [2011] ECDR 3 at paras 47 and 60.

[118] IEEE Std 610.12-1990 Standard Glossary of Software Engineering Terminology.

computer running under a compiler program, into a machine-readable language).[119] In other words, the source code allows a computer program to be written and understood by human programmers, whilst the object code (into which the source code must be translated/compiled) allows for the execution of the programme by a specific computer (the same source code can often be compiled into various object codes for various computers).[120]

Furthermore, Recital 7 of the Software Directive states that a 'computer program' is considered to 'include programs in any form including those which are incorporated into hardware'. It also 'includes 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'.

An analysis of Recital 7 of the Software Directive in light of Article 10 TRIPS 1994, Article 4 WCT 1996 and recent Court of Justice of the European Union (CJEU) jurisprudence ascertains that the protection is bound to the program code and to the functions that enable the computer to perform its task. This in turn implies that there is no protection for elements without such functions (i.e. graphical user interface (GUI), or 'mere data') and which are not reflected in the code. In other words, it appears that functionality in itself is not protected. Put simply, copyright protection will attach to the expression of the computer code – whether it be source or object code – in accordance with the above cited law.

This raises some interesting observations. First, it can be concluded that a CAD software suite (similar to a *Microsoft Office* suite) which allows a designer to create a 3D model, using the software, can clearly attract literary copyright, thereby protecting the source code which underlies it. Second, utilising this software, a 3D model can be designed by allowing a computer to execute particular tasks. This will attract literary copyright once again, in the context of the object code, embedded as part of the CAD file format. This is confirmed by the Court in *Bezpečnostní*[121] which suggested that the *programming language and data file formats* 'might be protected, as works, by copyright under [the Software] Directive … if they are their author's own intellectual creation'[122] and following the principles expressed in *Infopaq.*[123]

These conclusions point to the fact that a CAD file may be capable of attracting literary copyright protection as a computer program. This then gives rise to the next question. If the CAD file could be protected as a computer program, does it reflect the author's own intellectual creation?

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[119] See also, Section 3(1)(c) Copyright, Designs and Patents Act 1988 (CDPA 1988) (UK) which states that a computer program and its embedded data are together recognised as a literary work under copyright law. *See also Nova Productions Ltd v Mazooma Games Ltd* [2007] RPC 25 (CA).

[120] *SAS Institute Inc., v World Programming Ltd* (C-406/10) [2012] 3 CMLR 4, para. 39. The Court of Justice of the European Union stated that: "keywords, syntax, commands and combinations of commands, options, defaults, and iterations consisting of words, figures or mathematical concepts which, considered in isolation are not, as such, an intellectual creation of the author... It is only through the choice, sequence and combination ... that the author may express his creativity in an original manner and achieve a result, namely the user manual for the program, which is an intellectual creation' (paras: 66–67). *See also,* K Toft, The case of SAS Institute Inc., v World Programming Ltd [2014] 20(2) *Computer and Telecommunications Law Review*, pp. 59–62 at p. 60; P Guarda, 'Looking for a Feasible form of Software Protection: Copyright or Patent, Is that the Question?' [2013] 35(8) *European Intellectual Property Law*, pp. 445–454 at p. 445; Waelde et al, *Contemporary Intellectual Property: Law and Policy* (4th ed), pp. 64–65.

[121] *Bezpečnostní Softwarová Asociace – Svaz Softwarové Ochrany v Ministerstvo Kultury* (C-393/09) [2011] ECDR 3 at 35 and 38. See also, K Toft, The case of SAS Institute Inc., v World Programming Ltd [2014] 20(2) *Computer and Telecommunications Law Review,* pp. 59–62 at p. 60.

[122] *SAS Institute Inc., v World Programming Ltd.,* (C-406/10) [2012] 3 CMLR 4, para. 39).

[123] *Infopaq International A/S v Danske Dagblades Forening* Case C-5/08 [2010] FSR 20.

2.3.1.3. Does a CAD File Embodying a Digital 3D Model Reflect an Author's Own Intellectual Creation?

This question leads to some uncertainty. In *SAS Institute Inc.,* the CJEU stated that: 'keywords, syntax, commands and combinations of commands, options, defaults, and iterations consisting of words, figures or mathematical concepts which, considered in isolation are not, as such, an intellectual creation of the author … It is only through the choice, sequence and combination…that the author may express his creativity in an original manner and achieve a result, namely the user manual for the program, which is an intellectual creation'.[124]

However, emerging technologies tend to blur the line between source and object codes as debated and reflected in various articles and commentaries.[125] It is akin to co-creation of creative works made possible by technological means, which in turn, has seen the disappearance of the 'traditional author' and raised questions about the end of ownership, as it was once known.[126] New technologies such as 3D printing once again drive us to re-visit regulatory boundaries between the creator and publisher; author and owner as well as other new areas such as CAD files where the nuance of protection appears to be subtle.

The uncertainty arises from the 'utilitarian' nature of designing a CAD file. A designer who uses CAD software to create a 3D model, is essentially reliant on bringing together a combination of commands, options, defaults, and iterations consisting of words, figures or mathematical concepts as illustrated below.

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[124] *SAS Institute Inc., v World Programming Ltd.,* (C-406/10) [2012] 3 CMLR 4; [2013] Bus LR 941, paras: 66-67.

[125] D Mendis, 'Clone Wars': Episode II The Next Generation – The Copyright Implications relating to 3D Printing and Computer-Aided Design (CAD) Files [2014] 6(2) *Law, Innovation and Technology*, pp. 265–281; V Elam, 'CAD Files and European Design Law' (2016) 7 *Journal of Intellectual Property, Information Technology and E-Commerce La*w 146; T Y Ebrahim, 3D Printing, Digital Infringement and Digital Regulation [2016] 14(1) *Northwestern Journal of Technology and Intellectual Property*, 37–74; M Rimmer, The Maker Movement: Copyright Law, Remix Culture and 3D Printing [2017] 41(2) The *University of Western Australia Law Review*, pp. 51–84; M Antikainen and D. Jongsma, The Art of CAD: Copyrightability of Digital Design Files in Rosa Ballardini *et al*., 3D Printing, Intellectual Property and Innovation: Insights from Law and Technology (The Netherlands: Kluwer Law International BV; 2017), chapter 1; D Mendis, In Pursuit of Clarity: The Conundrum of CAD – Seeking Clarity Through Case Law [2018] 40(11) *European Intellectual Property Review,* 694.

[126] Aaron Perzanowski and Jason Schultz, *The End of Ownership: Personal Property in the Digital Economy* (Cambridge, MA: MIT; 2016).

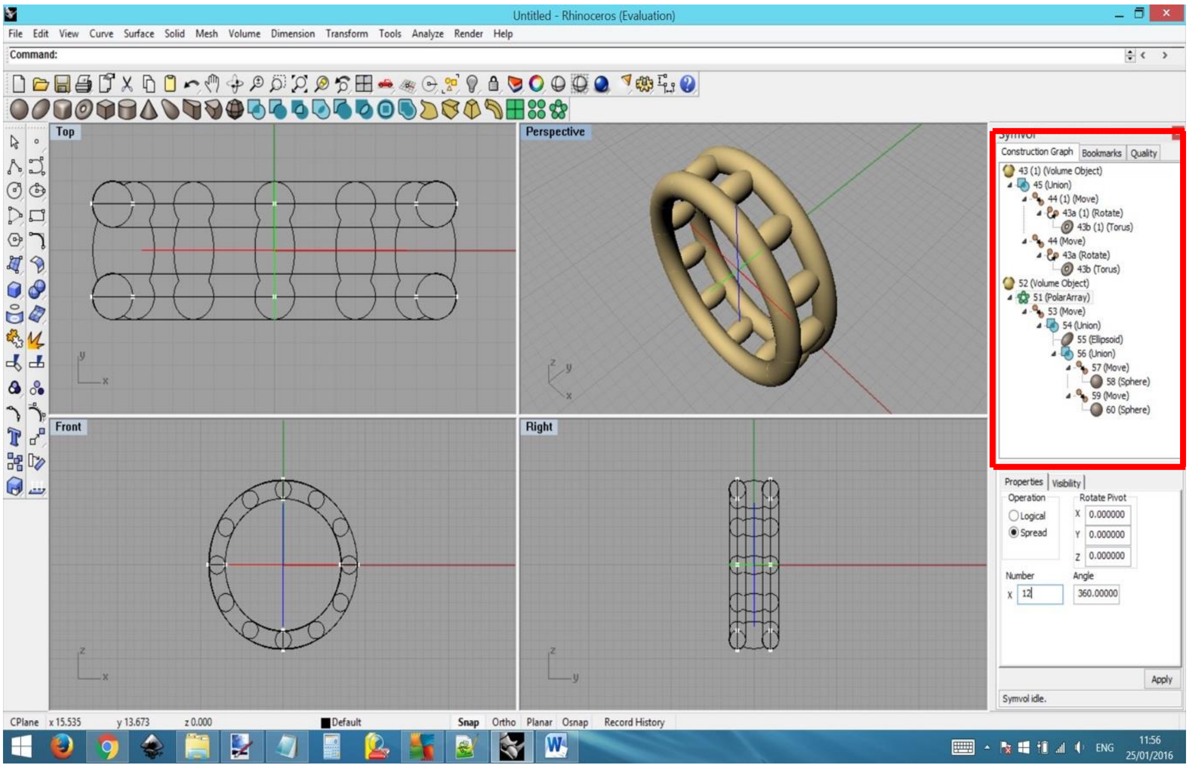

Figure 14 © Dinusha Mendis (as published in Dinusha Mendis, 'In Pursuit of Clarity: The Conundrum of CAD – Seeking Clarity Through Case Law' [2018] 40(11) European Intellectual Property Review, 694).

The picture above reflects a simple design – questioning whether the 'utilitarian' argument above, could apply here. Yet it is possible that a digital 3D model could entail a complex, beautifully designed pendant, ready for 3D printing. Moving one step further, the designer may even increase the complexity by providing mass customisation options (as illustrated in Figure 2, Chapter 1) for an end user to customise the pendant. Notwithstanding issues of co-creation which may arise, it is submitted these creative steps indicate an author's own intellectual creation and goes beyond functionality involving words, figures instructions or mathematical concepts considered in isolation. For these reasons, it is suggested that the digital 3D model can attract separate copyright protection distinct from the 3D printed physical product for the reasons presented below.

First, the AG's opinion in the case of *Cofemel*[127] concluded that originality cannot be extended to applied art, industrial designs and works of design without satisfying the requirement of the author's own intellectual creation. AG Szpunar reasoned that these types of works often enjoy double protection (copyright and design), leading to issues of competition, requiring some Member States to adopt a higher level of originality. As Derclaye states, the decision is not completely surprising following cases such as

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127 C683-17/, *Cofemel – Socieadade de Vestuário SA v G-Star Raw CV*. *See also*, Estelle Derclaye, Member States Can No Longer Require a Higher Level of Originality for Works of Applied Art/Designs says AG Szpunar in Cofemel (3 May 2019) Kluwer Copyright Blog at http://copyrightblog.kluweriplaw.com/2019/05/03/member-states-can-no-longer-require-a-higher-level-of-originality-for-works-of-applied-artdesigns-says-ag-szpunar-in-cofemel/

Infopaq, Painer, Football Dataco, SAS, Flos, BSA.[128] However, the recent CJEU judgement in *Cofemel* clarified that in terms of industrial designs, no other requirement is mandated for copyright protection to arise, under the InfoSoc Directive, but the sufficient originality of the relevant design. Applying this reasoning to the present context, it can be concluded that the 3D model can attract separate copyright protection distinct from the 3D printed physical product as long as it meets the threshold of originality (i.e. author's own intellectual creation). This argument is elaborated below.

Furthermore, based on the example of the pendant above, which reflects the complexities and choices which a designer makes, it can be argued that in such cases, a designer is using his/her own intellectual creation and therefore a digital model is not limited to a utilitarian work.

Second, 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. For example, in the UK case of *Abraham Moon & Sons Ltd v Andrew Thornber and Others*[129] involving a loom document, 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'.*[130] This is quite different to an analogy drawn from music, where a piece of music – whether in MP3 format or a CD – will be exactly the same. Not so with a CAD file and resulting physical product as illustrated above. The 3D model and the resulting physical product will be very different.

Furthermore, in the CJEU case of *Art and Allposters International BV v Stichting Pictoright*[131] the image from a paper poster was transferred to canvas by way of a chemical process (referred to as the 'canvas transfer process'). After the canvas transfer process was completed, the ink disappeared from the paper – leading to the question of whether the canvas constituted an 'adaptation' or 'reproduction' of the original work (paper poster). The CJEU held that a canvas transfer process of a poster 'results in the creation of a new object incorporating the image of the protected work'[132] – thereby also distinguishing between the *corpus mechanicum* (the tangible object) and the *corpus mysticum* (the intangible creation).

Third, as explained in Chapter 1, there is a distinction between the CAD file and STL file. The CAD file, carrying the digital 3D model, incorporates the designer's IP, identifying how the 3D model was designed. However, when the file is prepared for printing, it is saved and transferred into a neutral file format such as STL, which, importantly, represents the digital model which will be 3D printed, but does not include information, allowing a third party to edit the original CAD file. In turn, this reflects the importance of the 3D model, in its digital format, separate from the physical product, which may be 3D printed.

These arguments and cases point to the fact that a digital 3D model reflecting an author's own intellectual creation can arguably attract artistic copyright protection,

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[128] ibid.

[129] *Abraham Moon & Sons Ltd v Andrew Thornber and Others* [2012] EWPCC, 37. See also, *Brigid Foley Ltd v Ellott and Others* [1982] RPC 433. For a detailed discussion, see, Dinusha Mendis, 'In Pursuit of Clarity: The Conundrum of CAD – Seeking Clarity Through Case Law' [2018] 40(11) *European Intellectual Property Review,* 694.

[130] [2012] EWPCC 37 at para 46, per Judge Birss.

[131] *Art and Allposters International BV v Stichting Pictoright* C-419/13, EU:C:2015:27.

[132] *Art and Allposters International BV v Stichting Pictoright* C-419/13, EU:C:2015:27, para 40.

separate from the later conceived tangible product. The importance of this point can be further captured by the fact that the intangible 3D model, encompassed within the CAD file, can be used, shared and hosted on online platforms – and may never be 3D printed. In such circumstances, having a clear distinction between the intangible 3D model and tangible physical product is essential.

Furthermore, as illustrated below, there also appears to be uncertainty amongst industry stakeholders. For these reasons, clarifying the law in the context of CAD files, digital 3D models and the resulting physical product, will be welcome.

Industry Opinion: Multiple Authors in the 3D Printing Process

Interviewees were asked to indicate their level of agreement with the following statement: *'A ready-to-print [STL] file can contain multiple people's IP (e.g. customers', third-party manufacturers and potentially the AM software providers), is there is an issue with this?'*

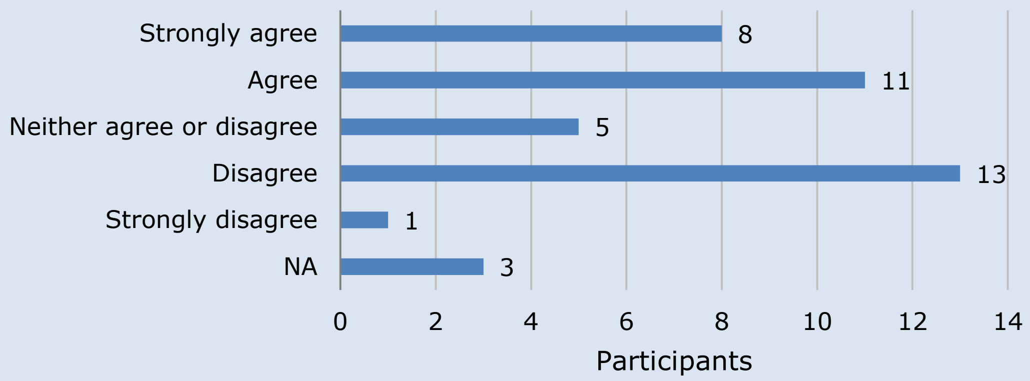

Figure 15 Interviewees' assessment on whether there is an issue with multiple individuals contributing IP to a ready-to-print file

In responding to the above statement, interviewees expressed a clear division of opinion. More than half of the participants identified the challenges and importance of maintaining an overview of the involvement of different parties in the development and modification of a digital representation of a physical object as illustrated in Figure 15. Moreover, this issue is present in digital manufacturing in general and also in different sectors. However, the interviewees noted that this issue might be more critical for specific kinds of companies. For example, plastic objects might be more susceptible to such complications in comparison with other materials that are used mostly in industrial settings rather than by hobbyists.

The complexity of this issue may increase when changes to a CAD file or a ready-to-print [STL] file are not only conducted manually by a human but also automatically by a software program without any human interaction (the changes are decided and executed by the program). One participant working for a company that manufactures 3D printers gave the example of the changes conducted by the machines they produce: '*the machine we sell to our customers includes our software, which defines how the build process operates. This means that our software – developed by us – determines how the laser beam is moved to melt the powder, but it only works in* *combination with the design data of customers. …. What comes out [of] the machine is always a combination of our IP and the IP of the designer; if the user of the machine has modified any parameters, then also his/her IP can go into this… so it's quite complicated' (Int.26).*

Conversely, 14 interviewees did not see multiple authors' IP in a single CAD or ready-to-print [STL] file as a problem. Six interviewees stated that in a commercial setting this issue can be avoided by means of a conversation upfront with the customer which is then confirmed in a contract. Issues arise when there is an absence of a clear contract and parties attempt to identify each person's copyright and IP late in the process. According to one of the interviewees, this is a common approach not only in 3D printing but also in other manufacturing techniques.

Four of the participants disagreeing with this statement elaborated about conducting changes to the CAD or ready-to-print files of a client as a part of the manufacturing service. Examples of such changes would be the adjustment of parameters, such as modification of wall-thickness to optimise the printing processes. Two of them suggested that attitudes to the ownership of IP may be changing in this context. Both mentioned that in the past they perceived modifications to a CAD file as belonging to them, however now '*helping people with their CAD file is a part of the service'* that is paid for and often stipulated in the service contract. On the other hand, a third interviewee explained that there was never a reason to consider the modification as new IP being added to the CAD file. Instead, this interviewee compared this situation with the design and assembly of other products, where the design is the idea to be protected and the assembly is the manufacturing process (including the selection of parameters and small adjustments) *(Int.31).*

Industry Opinion 8 Copyright and multiple authors in the 3D Printing process

2.3.2. Protecting Design Data

Article 10(2) of TRIPS 1994, states that 'compilations of data or other material, whether in machine readable or other form, which by reason of the selection or arrangement of their contents constitute intellectual creations shall be protected as such. Such protection, which shall not extend to the data or material itself, shall be without prejudice to any copyright subsisting in the data or material itself.' The same wording is reflected in Article 5, WCT 1996.

Therefore, whilst subject matter such as texts, art, music and films amongst others included within data sets can be copyright protected, data *per se* does not fall under the domain of copyright protection.

There are some reasons for this. Firstly, it is not possible for data *per se* to attract copyright protection, based on the fact that copyright extends to the expression of the idea, but, not the idea itself.[133] Therefore data alone cannot attract copyright protection; however, data incorporated and expressed within books, drawings, films etc., can be eligible for protection. Secondly, most datasets are generated by machines and not by creative humans. In this context, it leaves open the interesting

[133] See, Guide to the Berne Convention for Protection of Literary and Artistic Works (Paris Act,1971), (WIPO, 1978) at https://www.wipo.int/edocs/pubdocs/en/copyright/615/wipo_pub_615.pdf

question of whether the requirement of 'author's own intellectual creation' (where author has been traditionally understood as a natural person) might apply to data. Moreover, even in cases where data production can be linked to a legitimate author, it might be challenging to identify the person responsible for the arrangement and creation of the work. For instance, authorship and ownership of the right could be dispersed amongst *inter alia* (a) the designer(s) of the smart system, (b) the data provider(s), and (c) the user(s) of the system. Indeed, ultimately, the most challenging assessment lies in defining whether the human contribution in the development of the machine-generated data is sufficient for the purpose of demonstrating the existence of a human's own intellectual creation or contribution to the creative work – and therefore originality.

2.3.2.1. Protecting Design Data: Application of the Database Directive

The EU legal regime for database protection provides for a two-tier system: copyright protection for databases which, by reason of the selection or arrangement of their contents, constitute the 'author's own intellectual creation' as discussed above and *sui generis* protection for databases where the criteria of 'substantial investment' is met. This analysis will focus on the latter – *sui generis* database protection – which provides greater possibilities for protecting data or datasets in the data economy, particularly in the context of information contained within CAD files. As such the *sui generis* database right protection could be offered as a possible mechanism of protection in the current context.

This is particularly relevant in the context of 3D scanning. When a tangible physical product is scanned, it generates 'data' which needs to be cleaned, before it can be 3D printed. Whilst the scanned data, *per se,* cannot gain copyright protection, a data set, containing multiple scanned files, which have been cleaned and arranged into various categories (toy, hobby, art, miniature, spare parts etc.) ready for 3D printing, may attract *sui generis* database protection. This aspect is explored below whilst, highlighting some limitations it presents.

The first limitation is that the *sui generis* protection applies only to databases as a 'collection of data', and therefore does not extend to data *per se* as mentioned above.[134]

In addition, the *sui generis* protection extends only to certain forms of digital databases namely, databases defined as a 'collection of independent works, data or other materials arranged in a systematic or methodical way and individually accessible by electronic or other means' (Database directive, Article 1.2). In such cases, the collection or arrangement of the work is considered as valuable. In other words, this type of protection does not cover collection of masses of data, which, although possibly of economic value, do not qualify under the definition of digital databases. The CJEU has further developed the criteria mentioned in the Directive by stating that 'independent works' refer to the fact that 'a database consisting of any collection of works, data or other materials are separable from one another without the value of their contents being affected'.[135] Specifically, 'systematic or methodical way of arrangement' and 'individual accessibility' means that the collection of data should be

[134] Article 7(2)(a) Database Directive forbids the acts of 'extraction' and 're-utilisation' of individual data included in the databases only as far as such data form a 'permanent or temporary transfer of all or a substantial part of the contents of a database to another medium'.

[135] ECJ´s ruling Fixtures Marketing Ltd v. Organismos prognostikon agonon podosfairou AE (OPAP), C-444/02.

contained in a 'fixed base'.[136] For this purpose, a method or a technical system for the retrieval of each of its constituent materials must be included in the database.

Bearing these points in mind, it can be concluded that, although data contained within a series of categorised CAD files might lead to 'databases' that fall under the scope of protection of the Directive, in most cases it seems unlikely that the requirements of systematic or methodological arrangement and individual accessibility would be fulfilled. This is because data is usually captured, analysed and utilised immediately, without using any fixed base.[137] Therefore a database containing a series of scanned CAD files categorised according to particular themes, may be protected under the *sui generis* database right. However, data *per se*, contained within each CAD file will not attract protection for the reasons given above.

Secondly, the Database Directive (Article 7.1) states that the *sui-generis* protection is reserved only for databases for which there has been 'qualitatively and/or quantitatively a substantial investment' in the 'obtaining, verification or presentation' of their contents. The CJEU stated in the *British Horseracing Board* case that the notion of 'investment' refers to the resources used, with a view to ensuring the reliability of the information contained in that database, to monitor the accuracy of the materials collected when the database was created and during its operation. The resources used for verification during the stage of creation of data or other materials which are subsequently collected within a database, on the other hand, are resources used in creating materials and *cannot* be taken into account in order to assess whether there was substantial investment in relation to Article 7(1) of the Directive. The CJEU argued that the rationale for database protection is to promote the creation of storage and processing systems for existing information and not for the creation of materials capable of being collected subsequently in a database. 'Substantial' investment can consist of monetary investments or time or labour requiring efforts. It is evident that substantial investments are necessary for developing smart systems, but capturing and collecting the data, in today's digital world, are based on automated means. However, 3D scanning is still in its development stage and falls short of being completely automated – thereby requiring a 'substantial investment' to be made in the creation of databases which, for example, encompass a series of scanned CAD files categorised according to specific themes. In such a scenario, where an extensive collection of data has been carried out, and the 'obtaining, verification or presentation' of the collecting mechanism has resulted in a large investment, leading to the creation of data sets reflecting a series of themed CAD files, it will most likely satisfy the requirement of substantial investment in accordance with the *sui generis* database right.

An additional problem in terms of applying database protection arises from the perspective of the maker of the database. Recital 41 of the directive, states that the maker of a database is the person who takes the initiative and the risk of investing. Naturally, there might be joint authorship of a database if it is created in co-operation with several actors. It is possible that, for instance, the one who collects the material, the one who takes care of the technical implementation of the database and the one who finances the project, are all considered as creators of the database. In a 3D printing context, this could entail different actors such as the party hosting the database, party providing the scanning devices and those who are involved in the

[136] ibid.

[137] Taina Pihlajarinne & Rosa Ballardini, 'Owning Data via Intellectual Property Rights: Reality or Chimera?', in R. Ballardini, O. Pitkänen & P. Kuoppamäki, Regulating Industrial Internet through IPR, Data Protection and Competition Law, (Kluwer Law Int. 2019).

technical implementation of it. In such a scenario, involving several such entities, there might be a case of joint authorship and ownership (see also Case Study 4).

2.3.3. Protecting Materials and Hardware

The protection of materials and hardware does not come within the realm of copyright law as copyright relates to creative works. However, user manuals that are associated with hardware such as 3D printers and scanners, will be protected by copyright as literary works.

Summary

CAD file: A CAD file may be considered a 'literary work', more specifically, a computer program, although at the moment, a defintion to this effect does not exist under EU copyright law. It is suggested that the defintion provided by the European Commission in the Explanatory Memorandum relating to the proposal for the 'legal protection of computer programs' (Software Directive) be considered for clarifying the position.

A digital 3D model can be seen as a distinct 'work' separate from the resulting physical product. This is based on the fact that the (a) creation of a digital 3D model reflects an author's own intellectual creation, especially in the case of complex designs providing mass customisation options; (b) the digital 3D model and resulting physical product are distinctly different (in texture, material etc.) and on this point case law suggests the distinction between *corpus mechanicum* (the tangible object) and the *corpus mysticum* (the intangible creation); and (c) a CAD file, as a vessel for carrying the 3D model is different to the STL file, which contains ready-to-print 3D model without the designer's information showing how it was designed (which is contained in the CAD file).

The above reasoning reflects the existence of the digital 3D model, reflecting the author's own intellectual creation, separate from the physical product, which may be 3D printed. For example, taking into account the recent CJEU judgement in the case of *Cofemel*, it is clear that in terms of a design no other requirement is mandated for copyright protection to arise, under the InfoSoc Directive, but the sufficient originality of the relevant design including industrial designs. This reasoning can be extended to 3D models (in the 3D printing context) for clarifying this position.

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

However, data sets may be protected under the *sui generis* database directive as long as the criteria of 'substantial investment' is met. Yet, although data contained within a series of categorised CAD files might lead to 'databases' that falls under the scope of protection of the Database Directive, in most cases it seems unlikely that the requirements of systematic or methodological arrangement and individual accessibility would be fulfilled. It will very much depend on a case-by-case basis.

The maker of a database is the person who takes the initiative and the risk of investing. This could involve multiple persons such as the party hosting the database, party providing the scanning devices and those who are involved in the technical implementation of it. In such a scenario, involving several such entities, there might be a case of joint authorship and ownership.

The protection of **materials and hardware** does not come within the realm of copyright law as copyright relates to creative works. However, user manuals that are associated with hardware such as 3D printers and scanners, will be protected by copyright as literary works.

2.4. Protecting the Elements of the 3D Printing Process via Design Law

The European Union design law framework is a 'two-tier'[138] system which has its legal base in the *Community*[139] Acts, namely the Design Directive[140] which harmonises national laws as to registered designs, and the Design Regulation[141] which establishes a unitary union-wide law of registered designs and of unregistered designs, additional to the protection for designs that is available under existing national laws.

The Design Regulation establishes two distinct design rights.[142] One is the Registered Community Design ('RCD'), obtained through registration at the EUIPO. The other is the unregistered Community design ('UCD'), which arises by virtue of being disclosed within the European Union. These two rights ('Community designs') have a unitary character and territorial effect throughout the union.[143] Otherwise, much of the law relating to the design rights applies not only to the Community Designs,[144] but also to national registered designs by virtue of the Design Directive.[145] Therefore, the following statements made for the provisions examined are valid for all three different rights if not explicitly stated otherwise.

European Union design law protects 'the appearance of the whole or a part of a product' to the extent that it is 'new' and has 'individual character'.[146]

Article 3(a) of the Design Regulation and Article 1(a) of the Design Directive provide a non-exhaustive list of elements on the basis of which such appearance may be assessed.[147] This list includes the lines, contours, colours, shape, texture and/or materials of the product itself and/or its ornamentation. Moreover, the definition of 'appearance' does not consider any evaluation of an aesthetic, creative[148] or functional nature. The result is a very broad[149] definition of `appearance´ without a certain threshold of artistic value that must be reached in order to gain protection.[150] Moreover, it is clear that `appearance´ requires the design to take visible form in order to be protected.[151]

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[138] Annette Kur and Thomas Dreier, *European Intellectual Property Law* (Edward Elgar, 2013) p. 354.

[139] The Treaty of Lisbon [2009] changed the traditional wording from then being *Community* to now being *EU*. However, the provisions of the Regulation and the Directive still refer to the Community and therefore this term will be used in this paper when referring to the provisions.

[140] Council Directive 98/71/EC of 13 October 1998 on the legal protection of designs [1998] OJ L289/28.

[141] Council Regulation (EC) No 6/2002 of 12 December 2001 on Community designs [2002] OJ L3/1. It has since been amended by Annex II to the Act of Accession [2003] OJ L236/344, Annex III to the Act of Accession [2005] OJ L157/233 and Council Regulation (EC) No 1891/2006 of 18 December 2006 amending Regulations (EC) No 40/94 to give effect to the accession of the European Community to the Geneva Act of the Hague Agreement concerning the international registration of designs [2006] OJ L386/14.

[142] Article 1(2) of the Design Regulation.

[143] Article 1(3) of the Design Regulation.

[144] Article 1(1) of the Design Regulation.

[145] Article 2(1) of the Design Regulation.

[146] Article 1 (a) of the Design Directive and Article 3 of the Design Regulation.

[147] Mario Franzosi, Marc-Roger Hirsch, Willem A. Hoyng et al., *European Design Protection - Commentary to Directive and Regulation Proposals*, (Wolters Kluwer, 1996), p. 41.

[148] Case I ZR 89/08 *Verlängerte Limousinen* (Bundesgerichtshof, 22 April 2010), para. 41.

[149] Lionel Bently, Brad Sherman, Dev Gangjee and Philipp Johnson, *Intellectual Property Law*, (5*th* ed), (OUP, 2018), p. 742.

[150] Mario Franzosi, Marc-Roger Hirsch, Willem A. Hoyng et al., *European Design Protection - Commentary to Directive and Regulation Proposals*, (Wolters Kluwer, 1996), p. 41.

[151] Case XXII GWwp 19/10 *Opakowania do Artykulów spozywczych* (Sad Okregowy w Warszawie Wydzial XXII, 4 April 2011); see also recital 14 of the Design Regulation which mentions the informed user `viewing the design´.

Articles 5 of the Design Regulation and 4 of the Design Directive define the concept of novelty. Novelty is an objective criterion[152] that is identified with the absence of identical designs made available to the public before the date of reference (i.e. the date of filing the application for registration or the date of priority, if a priority is claimed, or the date from which the protection of a non-registered design begins to run).[153]

Paragraph 1 of Article 6 of the Design Regulation and Article 5 of the Design Directive defines the second requirement for protection, namely the 'individual character'. A design has an 'individual character' insofar as it produces an impression of overall dissimilarity compared with previously existing designs.

Paragraph 2 of the Articles stipulates that the degree of freedom of the designer shall be taken into consideration when determining the overall dissimilarity.

The person on whom the overall impression of dissimilarity must be made is an `informed user'. The 'informed user' is not further defined but Recital 13 of the Directive gives some interpretational assistance as to what the 'informed user' might know. The 'informed user' is a fictional character capable of viewing whether the 'design clearly differs from that produced on him by the existing design corpus, taking into consideration the nature of the product to which the design is applied or in which it is incorporated, and in particular the industrial sector to which it belongs and the degree of freedom of the designer in developing the design.'[154]

It is important to consider that generally design protection shall not subsist in features of appearance of a product which are solely dictated by its technical function (i.e. Article 8 of the Design Regulation and Article 7 of the Design Directive). In order to prevent technological innovation from being hampered by granting design protection to features dictated solely by a technical function of a product design, protection is denied even if alternative designs would be fulfilling the same function.[155]

Article 3(b) of the Design Regulation and Article 1(b) of the Design Directive define the term 'product. This definition of 'product', specifies that only industrial and handicraft items are protected and it contains a non-exhaustive, but indicative[156] list of objects that qualify as products by right. These include parts intended to be assembled into a complex product, packaging, get-up, graphic symbols and typographic typefaces. 'Complex products' are defined as products which are composed of multiple components that can be replaced permitting disassembly and reassembly of the product.[157]

Computer programs are *expressis verbis* excepted from protection under European Union Design law as they are deemed not be a 'product'.[158] However, the computer program exception does not cover the 'results of running a computer program', i.e. the displays on the computer screen or the graphic user interface, but only the programs themselves, i.e. the code lines and the functionality.[159] Basically, the 'results

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152 *Proposal for a European Parliament and Council Regulation on the Community Design. COM (93) 342 final, (3 December 1993),* Article 5.

153 Article 5(1) of the Regulation and Article 4(1) of the Directive.

154 Recital 13 of the Directive.

155 Case C 365/16 *Doceram GmbH v CeraTec Gmbh* (8 March 2011).

156 Additional Opinion of the Economic and Social Committee para 5.3.

157 Article 1 (c) of the Directive and Article 3 of the Regulation.

158 Article 1 (b) of the Directive and Article 3 of the Regulation.

159 *Legal Protection of Designs: A Consultation Paper on the Implementation in the United Kingdom of EC Directive 98/71/EC* (UK Patent Office, 12 February 2001).

of running a computer program' in this context are the displays on a computer screen including the so-called graphic user interface (the 'GUI').[160] Accordingly, the definition does not generally include every result of running a computer program but evolves around 'graphic symbols' as also categorised in Article 1(b) of the Design Directive and Article 3(b) of the Design Regulation. And, indeed, EUIPO has already registered a number of such `graphic symbols´ that are the result of running a computer program.[161]

2.4.1. Protecting the CAD File

As already explained above, the legal status of the CAD file needs addressing, separate from the 3D model. As mentioned in Chapter 1,[162] a CAD file is akin to *Microsoft Word*, *Excel or PowerPoint* which is the 'basis' for creating a design and what is 'fed' into a printer – either a 2D or 3D printer. In the case of a CAD file, however, the design arises from the CAD software itself – unless it is scanned – in which case it is dependent on a physical object. On the other hand, a digital 3D model can be realised as a physical product and in such cases, will exist independently of the CAD file.

2.4.1.1. Does the CAD File fulfil the 'product' requirement?

In order for the the CAD file to be protected within EU Design law it will have to qualify as a 'product' within the meaning of Article 3 (b) of the Design Directive and Article 1 of the Design Regulation.

As mentioned above, computer programs are by virtue of Articles 3(b) of the Design Regulation and 1(b) of the Design Directive explicitly excluded from protection as they cannot be regarded as 'products'. The Official Commentary to the Regulation refers to the Directive on the legal protection of computer programs[163] in order to define the term 'computer program'.[164] This poses a problem since this Directive does not provide any definition of computer programs in order to keep the protection open for embracing further developments in information science and technology.[165] However, it is agreed upon that computer programs have to be defined broadly and generally 'consist of all kinds of instructions or sequences of instructions intended to operate with a data-processing machine (computer) to perform certain functions or fulfil certain tasks, for whatever purpose and by whatever means, or by means of whatever programming languages'.[166] Nordberg and Schovsbo submit that at least the underlying source and object code of a CAD file has to be considered a 'computer program' within the meaning of this definition and therefore it does not qualify as a 'product' and hence not as a 'design'.

However, the computer program exception does not cover the 'results of running a computer program', but only the programs themselves, i.e. the code lines and the

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[160] The GUI allows "the user to instruct the computer what is wanted of the programs being run" *see* William Cornish, David Llewelyn and Tanya Aplin, *Intellectual Property: Patents, Copyrights, Trade Marks & Allied Rights*, (8*th* ed), (Sweet & Maxwell, 2013), para. 20–23.

[161] For example, RCD 930367-0002 for an icon for a portion of a display screen.

[162] See Chapter 1, Section 1.3, Designing a CAD File.

[163] Council Directive (EC) 91/250 on legal protection of computer programs [1991] OJ L122/42.

[164] *Proposal for a European Parliament and Council Regulation on the Community Design. COM (93) 342 final, (3 December 1993),* Article 3.

[165] Michel M Walter and Silke von Lewinski, *European Copyright Law: A Commentary*, (OUP, 2010) para 5.1.26.

[166] Michel M Walter and Silke von Lewinski, *European Copyright Law: A Commentary*, (OUP, 2010) para 5.1.26.

functionality.[167] This becomes relevant when considering that the CAD file is not merely a source and object code but also encompasses a digital representation of the design along with instructions on how to print it.

In line with this notion, *Nordberg* and *Schovsbo*[168] submit that a CAD file can be considered a 'product' within the meaning of Articles 1(b) of the Design Directive and 3(b) of the Design Regulation. The authors argue that CAD files resemble blueprints and these may be considered as 'products' according to the EUIPO guidelines of examination of registered Community Design.[169]

Moreover, *Caddy* argues that 'it is possible that a court would find that a CAD file constituted a 'product' in which a design was incorporated'.[170] Unfortunately, *Caddy* gives no explanation why she is of that opinion.

Nordemann, Rüberg and *Schaefer,*[171] *Wiedemann* and *Engbrink*[172] as well as *Schmoll, Graf Ballestrem, Hellenbrand* and *Soppe*[173] argue that the CAD file has to be considered a 'product' as the CAD file incorporates the design in its entirety.

Elam[174] argues that even the design as such encompassed by the CAD file may not be eligible for design protection as the definition of 'product' does not cover digital items.

It is submitted that the CAD file *per se* may not be considered a 'product' within the meaning of the EU Design Law framework. Rather, the CAD file serves as a mere representation of a design 'product'. The reason for this is that Articles 1(a) and (b) of the Design Directive and 3 (a) and (b) of the Design Regulation define a 'product' as an 'industrial or handicraft item' which possesses 'lines, contours, shape, texture etc.'. Clearly, a CAD file as such is not an item that possesses these features. Nevertheless, the design encompassed by the CAD file may be an item that has the features described above.

Therefore, in conclusion, a design of an item encompassed by a CAD file may be considered a 'product' whilst the CAD file *per se* is not eligible for design protection. This means that for actually examining whether a 'product' is existent it is only relevant to assess the item as such, regardless that it is only of digital existence. If interpreted in this purposive way, the design encompassed in the CAD file may gain protection if it also fulfils the other requirements necessary for protection. This view is supported by *Franzosi* when stating that 'what is eligible for protection is the design

[167] *Legal Protection of Designs: A Consultation Paper on the Implementation in the United Kingdom of EC Directive 98/71/EC*, (UK Patent Office, 12 February 2001).

[168] Ana Nordberg and Jens Schovsbo, in Rosa M. Ballardini, Marcus Norrgård and Jouni Partanen (eds), *3D Printing, Intellectual Property and Innovation – Insights from Law and Technology* (Wolters Kluwer, 2017) chapter 13, para. 13.2.

[169] EUIPO, *Guidelines for Examination of registered Community Designs*, (1 October 2018), p. 23.

[170] Lorna Caddy, *Challenging CAD file sharing*, (*Taylor Wessing*, April 2013)

[171] Jan B. Nordemann, Michael Rüberg and Martin Schaefer, 3D-Druck als Herausforderung für die Immaterialgüterrechte [2015] 68(18) *Neue Juristische Wochenschau* 1267.

[172] Markus Wiedemann and Dennis Engbrink, Rechtliche Auswirkungen des 3D-Drucks auf Immaterialgüterrechte und gewerbliche Schutzrechte [2017] *Zeitschrift zum Innovations- und Technikrecht* 77.

[173] Andrea Schmoll, Johannes Graf Ballestrem, Jan Hellenbrand and Martin Soppe, Dreidimensionales Drucken und die vier Dimensionen des Immaterialgüterrechts [2015] 111(17) Gewerblicher Rechtsschutz und Urheberrecht 1045.

[174] Viola Elam, CAD Files and European Design Law [2016] 7(2) *Journal of Intellectual Property, Information Technology and Electronic Commerce Law* para. 39.

per se no matter how, or through which means it will be realised'.[175] It is submitted that this definition of 'product' results in a practicable way of treating designs encompassed in CAD files.

The following discussion about 'computer generated designs' does not evolve around another issue in regard to the 'computer program' exception but rather concerns the requirement of designs actually being a creation of human activity instead of a strictly computer-generated creation. Hence, the term 'computer generated design' means the 'generation of a design by computer'[176] where the designer 'chooses the design generated among the possible multiplicity of solutions given by the computer'[177] or the design is created with the help of artificial intelligence.[178] This discussion is of relevance when assessing the protection of CAD files as the designs encompassed may be designed solely with the means of software tools.

When drafting EU design law in the early nineties the Commission regarded it as being an 'untraditional method of operating'[179] when creating a design by computer but albeit considered it appropriate for protecting as long as the other requirements were fulfilled. Therefore, most designs contained in CAD files are not *per se* excluded from protection. It has to be lauded that the legislators had enough foresight and did not choose a too formalistic approach in that respect.

2.4.1.2. Designs being solely encompassed by CAD Files meeting the 'Appearance' Requirement?

As already described above, design rights only protect the appearance of a product or of a part of a product.[180] Moreover, it is clear that appearance requires the design to take visible form in order to be protected.[181] However, the definition requiring the design to be visible could pose a problem with the rise of 3D printing. If one assumes that it will be possible to create and distribute the design on a solely digital basis, it is necessary that the requirement of 'visible' must be interpreted as also including being visible on computer screens. Otherwise, designs being solely contained in CAD files could not be included in the general definition 'designs' as this would otherwise result in the design lacking protection.

Furthermore, *Stone* suggests as a further requirement for 'appearance' that the 'design must take a *physical form* in order to be protected'.[182] This suggestion is based on the fact that concepts of designs[183] and methods of use or operation[184] are not

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[175] Mario Franzosi, Marc-Roger Hirsch, Willem A. Hoyng et al., *European Design Protection – Commentary to Directive and Regulation Proposals*, (Wolters Kluwer, 1996), p. 43 footnote 25.

[176] *Green Paper on the Legal Protection of Industrial Design. Working document of the services of the Commission, III/F/5131/91-EN (June 1991),* para. 5.6.2.

[177] *Green Paper on the Legal Protection of Industrial Design. Working document of the services of the Commission, III/F/5131/91-EN (June 1991),* para. 5.6.2.

[178] Joy Tan, *Artificial Intelligence Turns Design Into A Collaborative Undertaking*, (Forbes, 2018) https://www.forbes.com/sites/joytan/2018/06/22/artificial-intelligence-turns-design-into-a-collaborative-undertaking/

[179] *Green Paper on the Legal Protection of Industrial Design. Working document of the services of the Commission, III/F/5131/91-EN, (June 1991),* para 5.6.2.

[180] Article 1(a) of the Design Directive and Article 3(a) of the Design Regulation.

[181] Case XXII GWwp 19/10 *Opakowania do Artykulów spozywczych* (Sad Okregowy w Warszawie Wydzial XXII, 4 April 2011); see also recital 14 of the Regulation which mentions the informed user 'viewing the design'; David Stone, *European Union Design Law – A Practitioners' Guide*, (2*nd* ed), (OUP, 2016), para. 4.09.

[182] David Stone, *European Union Design Law – A Practitioners' Guide*, (2*nd* ed), (OUP, 2016), para 4.08.

[183] *Green Paper on the Legal Protection of Industrial Design. Working document of the services of the Commission, III/F/5131/91-EN, (June 1991),* p. 58.

eligible for design protection. In regard to 3D Printing this is a controversial suggestion as this could have crucial consequences for the protection of designs contained solely in the CAD file. A design contained merely in a CAD file obviously lacks a *physical form* in the traditional sense since it is merely displayed on a screen before being printed for the first time. Unfortunately, *Stone* does not explain further why the *physical form* of a design is a requirement for protection.

It is submitted that the design having a *physical form* is no requirement for the 'appearance' and hence designs being solely contained in a CAD file can have an 'appearance' within the meaning of Articles 1(a) of the Design Directive and 3(a) of the Design Regulation. The first reason for non-physical designs having the possibility of possessing an 'appearance' is an *a fortiori* approach. As shown above, graphic symbols that are solely displayed on computer screens are recognised as 'products' within the meaning of EU design law and have already been successfully registered at the EUIPO. This indicates that even 'products' can have a *non-physical* form and hence their 'appearance' must *a fortiori* be able to be *non-physical*.

Furthermore, a historic interpretation of the travaux préparatoires reveals that the Commission considered it an 'untraditional method of operating'[185] when creating a design by computer but albeit considered it appropriate of protecting as long as the other requirements were fulfilled (see above 'Computer generated designs' as a product). This indicates that the legislators of EU design law were not generally against protecting designs that were made with the help of a computer and therefore non-physical. Hence, a *physical form* requirement for qualifying as 'appearance' is also not covered by a historic interpretation considering that generating designs with the help of computers is now a technique very commonplace.

Moreover, EU design law does not have any requirement of permanence for gaining protection as e.g. UK copyright has[186] (registration does require such permanence, but not protection as such). This also indicates that a *physical form* for having 'appearance' is not necessary for gaining protection.

It is therefore submitted that a design contained solely in a CAD file can fulfil the requirement of having 'appearance' and thereby being protected by EU design law.

2.4.1.3. Designs encompassed in CAD files meeting the 'Individual Character' Requirement?

As described above, paragraph 1 of Article 6 of the Design Regulation and Article 5 of the Design Directive define the second requirement for protection, namely the 'individual character'. A design has an 'individual character' if it produces an impression of overall dissimilarity compared to previously existing designs.

The question is, however, how this system would react to the emergence of consumer 3D printing. It is assumed that a relevant difference between the state at present and such a scenario future would be that a rise of 'new' designs would occur. The reason for this is that it is simpler to create designs with the help of consumer friendly

[184] Case T-337/12 *El Hogar Perfecto del Siglo XXI SL v OHIM—Wenf International Advisers Limited* ECLI:EU:T:2013:601 (General Court, 21 November 2013).
[185] Case T-337/12 *El Hogar Perfecto del Siglo XXI SL v OHIM—Wenf International Advisers Limited* ECLI:EU:T:2013:601 (General Court, 21 November 2013).
[186] *See* William Cornish, David Llewelyn and Tanya Aplin, *Intellectual Property: Patents, Copyrights, Trade Marks & Allied Rights*, (8th ed), (Sweet & Maxwell, 2013), para. 11–33.

software and with the help of AI.[187] Moreover, it is also cheaper for companies to create new designs as these are created within a much shorter time only on a computer as opposed to the costly craftsmanship required in the traditional distribution. Furthermore, the 3D printing industry itself may create a new market for designs. It is further assumed that the designer will have an increased degree of freedom, which is the result of the new technique providing new possibilities of production methods.[188]

Thus, the specific question to be asked is whether the individual character test will still work if there is a rise in new designs and substantially more freedom of the designer.

Hypothetically, the dissimilarities of new products within the same sector of industry and of the same nature would vanish if the creation of such products rose enormously.[189] The reason for this is that a 'product' may physically only vary to a certain degree in its 'appearance' until it ceases qualifying as a product. For example, this could be the lines, contours, colours, and the shape of a product may only vary to a limited degree if produced in enough versions. In theory, this would result in the 'informed user' not being able to 'clearly' differentiate between the corpora of the designs any longer.

On top of that, the new mechanical and physical freedom of the designer caused by the new manufacturing technique would only add to this theoretical problem. As already explained above, the more freedom a designer has, all the harder it will be for small differences to create a different overall expression.

This leads us to the hypothetical result that the emergence of 3D printing will challenge the 'individual character' requirement in that the already only small differences caused by the flood of new designs will not be taken into account as the wide open freedom of the designer provided by the new technique prohibits this.[190] The consequence would be that the 'informed user' would not be able to see the clear difference between the new product and the prior design and hence the new designs could not gain protection due to not fulfilling the 'individual character' requirement.

One solution to this 'imbalance' would be that the `informed user´ is more 'picky' when determining that a product clearly differs in its overall impression in respect to any prior design. In first instance, this would result in less designs gaining protection. However, the designs gaining protection would be major innovations. This 'balance' of the system is favourable as it more likely incentivises creativity and innovation compared with the first solution and rather gives 'input to further the development of the modern, European market economy'.[191]

[187] Joy Tan, *Artificial Intelligence Turns Design Into A Collaborative Undertaking*, (Forbes, 2018) http://www.forbes.com/sites/joytan/2018/06/22/artificial-intelligence-turns-design-into-a-collaborative-undertaking

[188] Critical to this notion Viola Elam, CAD Files and European Design Law [2016] 7(2) *Journal of Intellectual Property, Information Technology and Electronic Commerce Law*, para. 96.

[189] Similar Viola Elam, CAD Files and European Design Law [2016] 7(2) *Journal of Intellectual Property, Information Technology and Electronic Commerce Law*, para. 97.

[190] Again critical to this notion Viola Elam, CAD Files and European Design Law [2016] 7(2) *Journal of Intellectual Property, Information Technology and Electronic Commerce Law*, para. 95.

[191] Mario Franzosi, Marc-Roger Hirsch, Willem A. Hoyng et al., *European Design Protection – Commentary to Directive and Regulation Proposals*, (Wolters Kluwer, 1996), p. 76.

2.4.2. Protection of Design Data

It is submitted that the raw data derived from scanning as for example (digital) strings of letters or numerals may not be considered an 'appearance' of a product in accordance with Article 3 (a) of the Design Regulation and Article 1 (a) of the Design Directive. The reason for this is that for 'Appearance' to subsist the sense of sight is relevant.[192] Accordingly, the EUIPO Guidelines for Examination of registered Community Designs 'strings of letters or numerals' are explicitly excluded from protection.[193] It is however recommended that the law should not be changed to include design data as the protection of this would be alien to the current framework. In addition, other areas of law are better equipped to provide adequate protection in this area.

2.4.3. Protection of Materials and Hardware

2.4.3.1. Protection of Materials

It is submitted that the materials of a design are protected only to the extent that they are a feature of appearance of a product or part of a product.[194] The mere raw and unprocessed materials will not be subject to any protection by EU Design law.

2.4.3.2. Protection of Hardware

There is no reason why a 3D printer should not be eligible for design protection if it fulfils the general requirements for protection under EU Design Law. In fact, a 3D printer has already been the subject of a Registered Community Design.[195]

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Design protection was perceived as difficult as designs are not static, but can change in terms of the shape, form and size according to each application. This difficulty was best expressed by a start-up in the construction industry: '*Because we are working on a parametric design … every time you change a parameter, the shape is changing. … it's not exactly the same. … you can't protect the design because it is always changing so you can't put protection on 1,000 designs.'* In the case of this particular company their designs are not created with CAD software, but with mathematical expressions, such as formulas – in other words, instead of specifing the surface points of the object, they predefine a family of shapes that are determined by a finite amount of parameters. Therefore, the source code of this mathematical expression is valuable IP that they try to protect *'it's quite hard to explain that it [the different shapes] is coming from the same design model [the mathematical expression]. Right now, we look at protecting the code.' (Int.16).*

Similarly, a large company in the biotech sector explained the effective use of design law in their company: *'the other mechanism that we use is by registering designs, so the use of a particular device may not be patentable because it may already be out in the field, people are doing similar things, be it with 3D printer parts of manufacture wise. What we would do is that we would look to register the*

[192] Case XXII GWwp 19/10 ZIMBO Fleisch- und Wurstwaren GmbH & Co KG v Wanda Szczupak (Sąd Okręgowy w Warszawie Wydział XXII (4 April 2011).
[193] EUIPO, *Guidelines for Examination of registered Community Designs*, (1 October 2018), para. 4.1.4.
[194] David Stone, *European Union Design Law – A Practitioners' Guide*, (2nd ed), (OUP, 2016), para 4.23.
[195] RCD file information 002432104-0001.

design and protect the design, rather than any novel applications/uses for it.' (Int.11)

These industry views were interesting to note – both in terms of noting the challenges as well as the opportunities which design law brings to the 3D printing sector.

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2.4.4. Creating awareness

It has been suggested that designers depend on the complexity or time needed for producing a duplicate as a mean of protection.[196] As 3D printing would allow complex designs to be reproduced more easily, policymakers should focus on making designers more aware of the possibility of design protection via registration.[197] Such measures could include regulatory authorities resourcing design-applications and design-enforcement agencies in the future.[198]

Summary

The **CAD file** is not eligible for protection under EU Design Law. However, the design encompassed by a CAD file may fulfil the requirements of protection. This is the case even if the design was created only with the help of software tools.

With a hypothetical rise of 3D printing the current 'individual character' test will have to be reassessed. The 'informed user'-'designer´s freedom' dichotomy may be under scrutiny as there might be a flood of new designs whilst the freedom of the designer may rise with new technical possibilities.

The raw **design data** cannot and should not be subject to protection under EU Design Law.

Materials and hardware: Whilst materials may only be protected by EU Design Law to the extent that they are a feature of appearance of a product or a part of a product, hardware may be subject to EU Design Law protection.

The lawmaker should also focus on creating awareness with regard to the possibility of protection via design registration, moreso than depending on creating duplicates as means of protection.

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[196] *Economic Review of Industrial Design in Europe* (MARKT2013/064/D2/ST/OP) (Europe Economics; 2015), p. 134.

[197] *Economic Review of Industrial Design in Europe* (MARKT2013/064/D2/ST/OP) (Europe Economics; 2015), p. 134.

[198] *Economic Review of Industrial Design in Europe* (MARKT2013/064/D2/ST/OP) (Europe Economics; 2015), p. 134.

2.5. Protecting the Elements of the 3D Printing Process via Trade Mark Law

European law provides for a union-wide trade mark right based on registration, the so-called EU trade mark, which is codified as 'Regulation (EU) 2017/1001 of the European Parliament and of the Council of 14 June 2017 on the European Union trade mark' ('EUTMR').[199]

In parallel to the protection of trade marks available at the level of the European Union through the EUTMR, there are national trade mark registration systems in every EU member state.[200] These national trade mark systems based on registrations were harmonised by several Directives, the most recent Directives being Directive (EU) 2015/2436 of the European Parliament and of the Council of 16 December 2015 to approximate the laws of the Member States relating to trade marks (Recast), which entered into force on 15 January 2019 ('TM Directive').[201] Within this harmonised field for trade marks, registrations may be filed through the European Union Intellectual Property Office (EUIPO) or the respective national trade mark offices. Under the Madrid System, there is also an option to file for Union-wide and national trade marks as part of an International Registration through the World Intellectual Property Organization (WIPO).

For protecting the CAD file as a trade mark, one can use the aforementioned parallel and co-existing regimes of registered trade marks on the EU and national level. But there are also – at the national level – protection systems for signs used in the course of trade. This includes specific regimes of protection for (electronic) publications, e.g. the German title right. But as such regimes are not harmonised at the EU level, this report will not deal with them further.

The discussion below will separately explore trade mark protection for the elements of the 3D printing process, which are (i) CAD file,[202] (ii) design data[203] and (iii) materials and hardware used for the 3D printing process.[204] For the protection of 3D printing CAD files under EU trade mark law, there seem to exist only very limited sources.[205] Generally speaking, the focus of legal discussions is more on the trade mark protection for the design data than on the trade mark protection of the CAD file as such.

2.5.1. Protecting the CAD file

The following part is about trade mark protection of the CAD file. As explained above in the 'Introduction',[206] the CAD file is understood as the 'vessel' which carries the 3D model. It is different from the design data, which is included in the CAD file; trade mark protection of design data is explained separately below.[207]

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[199] OJ L 154, 16.6.2017, p. 1–99.
[200] The BENELUX countries have one joint trade mark system.
[201] OJ L 336, 23.12.2015, p. 1–260
[202] See 2.5.1.
[203] See 2.5.2.
[204] See 2.5.3.
[205] See for a discussion of trade mark protection of CAD files: Jan Bernd Nordemann/Michael Rueberg/Martin Schaefer, '3D-Druck als Herausforderung für die Immaterialguetterrechte', (2015) *Neue Juristische Wochenschrift (NJW),* 1265 at 1268.
[206] See 1.3.
[207] See 2.5.2.

The EU trade mark is subject to registration (Art. 6 EUTMR). The national trade mark systems, as far as harmonised at the EU level, also rely on registration of the trade mark (Art. 10 (1) TM Directive).

But to protect a CAD file, not every sign is registrable as a trade mark. A registered EU trade mark or a national trade mark may (only) consist of any signs, provided that such signs are capable of (see Art. 4 EUTMR and Art. 3 TM Directive):

a) Distinguishing the goods or services of one undertaking from those of other undertakings; and

b) Being represented on the Register of European Union trade marks ('the Register'), in a manner which enables the competent authorities and the public to determine the clear and precise subject matter of the protection afforded to its proprietor.[208]

Furthermore, a trade mark registration will only be possible, in case no absolute grounds for refusal apply (Art. 7 EUTMR, Art. 4 TM Directive). In particular, trade marks without any distinctive character or which consist exclusively of signs or indications which may serve, in trade, to designate characteristics of the goods or services do not qualify for trade mark protection.

As such, any sign for the protection of CAD files must meet these requirements in particular to distinguish the good of a CAD file from other CAD files; also no absolute grounds for refusal of the sign used for the CAD files should apply.

Word name, logo (design), letter, numeral, and/or colour: If these requirements are met, it is in theory possible to protect and in particular register for example words (including personal names), or designs, letters, numerals, colours, the shape of goods or of the packaging of goods, or sounds. That said, for CAD files, only some trade mark forms will be relevant.

One way to protect CAD files as trade marks will be to protect the word(s) used to distinguish the CAD file as word mark and additionally also a possible figurative mark for the logo used to distinguish the CAD file from other CAD files. But – as shown above (Art. 7 EUTMR, Art. 4 TM Directive) – in particular for word marks, there is the limitation that only words are protectable, which have a distinctive character and do not merely describe the CAD file.The example below is taken from the platform 'shapeways'.[209] To name the CAD file which shows a screwdriver, a generic term is used ('screwdriver'), which is not protectable as a word mark pursuant Art. 7 EUTMR, Art. 4 TM Directive. It does not justify registrability that the CAD file as such is not a screwdriver (but just the electronic vessel to print a screwdriver). According to Art. 7 (1) lit. c EUTMR, Art. 4 (1) lit. c TM Directive, trade marks which consist exclusively of signs which may serve, in trade, to designate the intended purpose of the product are excluded from registration. This is true for the term 'screwdriver', if it is used to indicate the purpose of the CAD file, i.e. to 3D print a screwdriver. In other words: a word 'screwdriver' is not capable of distinguishing the CAD file from another CAD file which also is meant to 3D print a screwdriver.[210]

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208 Art. 4 EUTR, Art. 3 TM Directive.

209 Shapeways. Marketplace – Rose. https://www.shapeways.com/product/N2WUN6T6X/rose?optionId=15036402&li=marketplace

210 Additionally, using such an obviously descriptive term like 'screwdriver' for a CAD file which is meant to 3D print a screwdriver may not be seen as a sufficient trade mark use, which would be necessary to be relevant for trade mark law infringements, see below 4.4.

But the name (origin) of the CAD file designer 'jacky' would be protectable as a word mark. The specific indication of origin 'Made by jacky' is also used to describe brands outside the the 3D printing world.

Figure 16 (Source: Shapeways)

Trade mark protection is also advisable in mere licensing scenarios. Registration of a trade mark is necessary if the right to use a trade mark for a CAD file is envisaged to be licensed to a licensee. There is in principle no trademark licensing without trade mark protection for CAD files, as otherwise there would be no licensable IP in the form of a trademark. Against this background, trade mark protection also makes sense for companies, who use their brand for certain different goods, but where this product would be additionally fit to be made available in electronic form in the form of a CAD file. One example would be *Ford* motor cars. While the car manufacturer *Ford* does not seem to offer CAD files with *Ford* cars itself, *Ford* licenses its *Ford* and other trade marks for use, for CAD files offered on the Internet platform www.turbosquid.com:[211]

[211] Available at https://www.turbosquid.com/3d-models/3d-model-mustang-2018/1132944

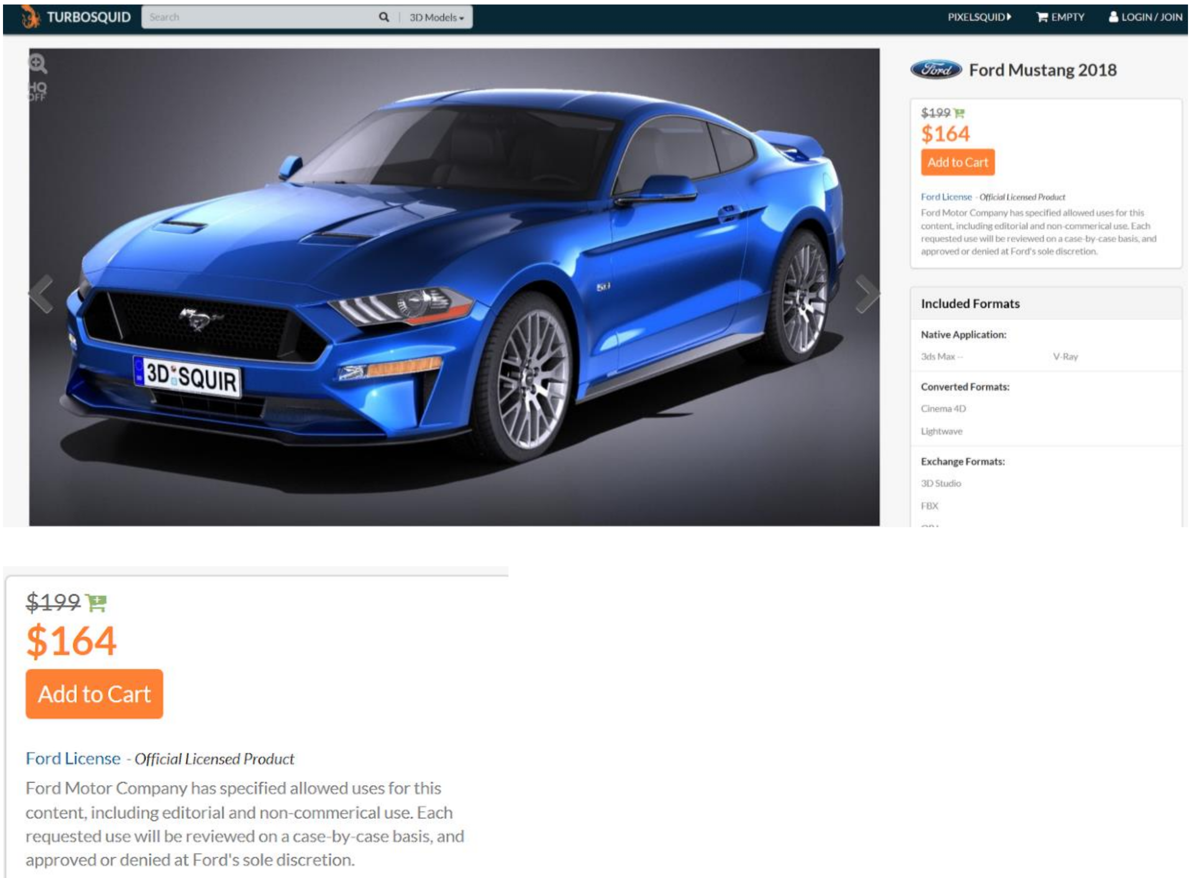

Figure 17 (Source: Turbosquid.com)

In the example, in order to grant a trade mark license, the licensor (*Ford* Motor Company) could register a trade mark word: 'Ford' and/or figurative and/or word: 'Ford Mustang 2018'.

It should also be noted that the *design data* used for 3D printing may also qualify for protection as a three-dimensional trade mark; this will be investigated below.[212]

There is no registration without a description of goods and services in the relevant trade mark classes. These descriptions determine the scope of trade mark protection. The descriptions are usually grouped in so-called trade mark classes. Such class structures are internationally harmonised.[213] The EUIPO, which administers EU trade mark registrations, provides for a 'Harmonised Database' of the language to be used for the description of goods and services. This is through 'TMclass'.[214]

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[212] See Section 2.5.2. below.

[213] The Nice Classification, established by the Nice Agreement (1957), is an international classification of goods and services applied for the registration of marks. The 2018 version of the eleventh ed. of the NCL came into force on January 1, 2018. Available at http://www.wipo.int/classifications/nice/en/

[214] TMclass is an international database that includes the terms of the Harmonised Database, as well as terms accepted in other countries around the world and by international organisations such as the World Intellectual Property Organization; available at http://tmclass.tmdn.org/ec2/

From a trade mark perspective, a CAD file has to be seen as a good – and not as a service. The CAD file may be grouped as (the good of) an electronic publication. Electronic publications of all kinds already enjoy trade mark protection under the EU (registration) system and under the (vastly) harmonised national trade mark (registration) systems. For CAD files (as electronic publications), the following classification could be envisaged:

- 'CAD software' in international classes 9 and 42: The current version of TMclass does not provide for any language to describe 'CAD files' '3D printing files' or '3D design files'. '3D printing' is not listed for classes 9 and 42. Only 'CAD software' is proposed in class 9 as a good and the development of CAD software in class 42 as a service. But as it is to date unclear if a CAD file can be seen as CAD software (see above),[215] it is advisable to file for trade mark protection beyond 'CAD software'.

- 'Electronic publications' in international classes 9 and 41: CAD files belong to the larger group of electronic publications. Pursuant TMclass, 'electronic publications' should be described in class 9 as a good. This however, requires that they are either made available for download or are distributed via a haptic data carrier. Otherwise, the file could not be classified as a 'good'. In the case of making publications available via mere streaming, this is considered a mere service, which needs to be classified into class 41. Accordingly, the following description for trade mark registrations of CAD files would be possible:

    - Class 9: 'Electronic publications in the form of CAD files (downloadable)';

    - If also offline distribution should be protected, it should read in class 9: 'Electronic publications in the form of CAD files (downloadable and on data carriers of every kind');

    - In case the CAD is made available online as a service without the option to download the CAD file to a storage medium, a description in class 41 should be added. Such language could be for example: 'Electronic publications in the form of CAD file (non-downloadable)'.

It should be noted that a trade mark registration specifically for CAD files as shown above in class 9 is also necessary if the trade mark rights are solely licensed. In the *Ford* example above, the car manufacturer Ford will have trade mark registrations for cars (class 12). But as *Ford* licenses offers of CAD files bearing the *Ford* trade marks, *Ford* could also register a trade mark word: '*Ford*' and/or figurative and/or word: 'Ford Mustang 2018' in international class class 9 for 'electronic publications in the form of CAD files (downloadable)'.

2.5.2. Protecting Design Data

The creation of design data making up the CAD file can also have relevance for trade mark law. This is in particular, the case if the printable object contains protected trade marks.

[215] See above 2.3.1.2. CAD File as a Computer Program?

The most relevant forms of trade marks to protect the printable objects will be the three-dimensional trade mark, as set out below. Furthermore, also a word trade mark and a figurative trade mark protection may become relevant. This will also be discussed below.

2.5.2.1. Three-Dimensional Trade Mark Protection

In legal literature, trade mark protection of design data is intensively discussed regarding three-dimensional trade marks.[216]

This is no surprise, as 3D trade marks seem to be particularly relevant to protect the design data (i.e. the object to be printed) as a trade mark. Three-dimensional trade marks are trade marks which are protected through registration in the shape of the good itself.

That said three-dimensional trade mark protection in the shape of the good is only awarded under exceptional circumstances. The requirements for the registration of three-dimensional trade marks are very strict.

First, trade mark protection is impossible for signs which consist exclusively of:

a) the shape which results from the nature of the goods themselves;

b) the shape of goods which is necessary to obtain a technical result;

c) The shape which gives substantial value to the goods.[217]

The rational of these grounds for refusal of registration of 3D trade marks is to prevent trade mark protection from granting its proprietor a monopoly on technical solutions or functional characteristics of goods which a user is likely to seek in the goods of competitors.[218] The exclusion from protection may not be overcome by acquiring a distinctive character.[219]

One example, where three-dimensional trade mark can be ruled out, is design data as a printable object in the form of a screwdriver. The shape of a screwdriver results from the nature of the goods themselves (screwdriver) and can thus be excluded from three-dimensional trade mark protection under Art. 7 (1) lit. e EUTR, Art. 4 (1) lit. e TM Directive.

Secondly, three-dimensional trade mark protection may be ruled out due to lack of distinctive character.[220] The criteria for the assessment of the distinctive character of three-dimensional trade marks consisting of the shape of the product itself are not different from those for other categories of trade marks (e.g. word marks). Through its distinctive character, a trade mark must serve to identify the goods or services

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[216] Nina Natalia Baranowska, 'The Intersection of 3D Printing and Trademark Law', (2018) 9 *JIPITEC* 251 para. 20; Andreas Schmoll/Johannes Graf Ballestrem/ Jan Hellenbrand/Martin Soppe, 'Dreidimensionales Drucken und die vier Dimensionen des Immaterialgüterrechts', (2015) *Gewerblicher Rechtsschutz und Urheberrecht (GRUR)* 2015, 1041 at 1047 et seq; Dominik Göbel, 'Personal 3D Printing from a Perspective of European IP Law', (2016) *Medien und Recht International (MR-Int)*, 155, at 156.

[217] See Art. 7 (1) lit. e EUTR; Art. 4 (1) lit. e TM Directive.

[218] CJEU of 16.09.2015, C-215/14 para. 44 – *Nestlé/Cadbury "Kit Kat"*; CJEU of 18.6. 2002, C-299/99 para. 78 – *Philips*; CJEU of 18.9. 2014, C-205/13 para. 18 – *Hauck*.

[219] Art. 7 (3) EUTR; Art. 4 (4) TM Directive.

[220] Art. 7 (1) lit. b EUTR; Art. 4 (1) lit. b TM Directive.

covered by that mark as originating from a particular undertaking, and thus to distinguish the goods or services in question from those of other undertakings.[221]

But this standard to find a sufficiently distinctive character usually excludes three-dimensional trade marks from registrability. It is standing case law of the CJEU that the perception of the relevant public in relation to a 3-dimensional trade mark consisting of the appearance of the product itself is not necessarily the same as it is in relation to word marks or figurative marks (logo). Average consumers are not in the habit of making assumptions as to the origin of products on the basis of their shape. Consequently, it will be more difficult to show the distinctive character of a three-dimensional mark compared with a word mark.[222] In those circumstances, only a mark which departs significantly from the norm or costumes of the sector and thereby fulfils its essential function of indicating origin is not devoid of any distinctive character.[223] As a result, the standard is very strict and excludes usually three-dimensional trade marks from registrability. Not even a watch in the form of a stamp had distinctive character in the eyes of the CJEU, as it does not depart significantly from the norm or costumes in the sector of jewellery or horological instruments.[224]

The same is true for packaging, which does not depart significantly from the norm.[225] The design data in the example below[226] from 3DEXPORT allowing printing a 'bottle of wine collection' could not be trade marked as a three-dimensional trade mark:

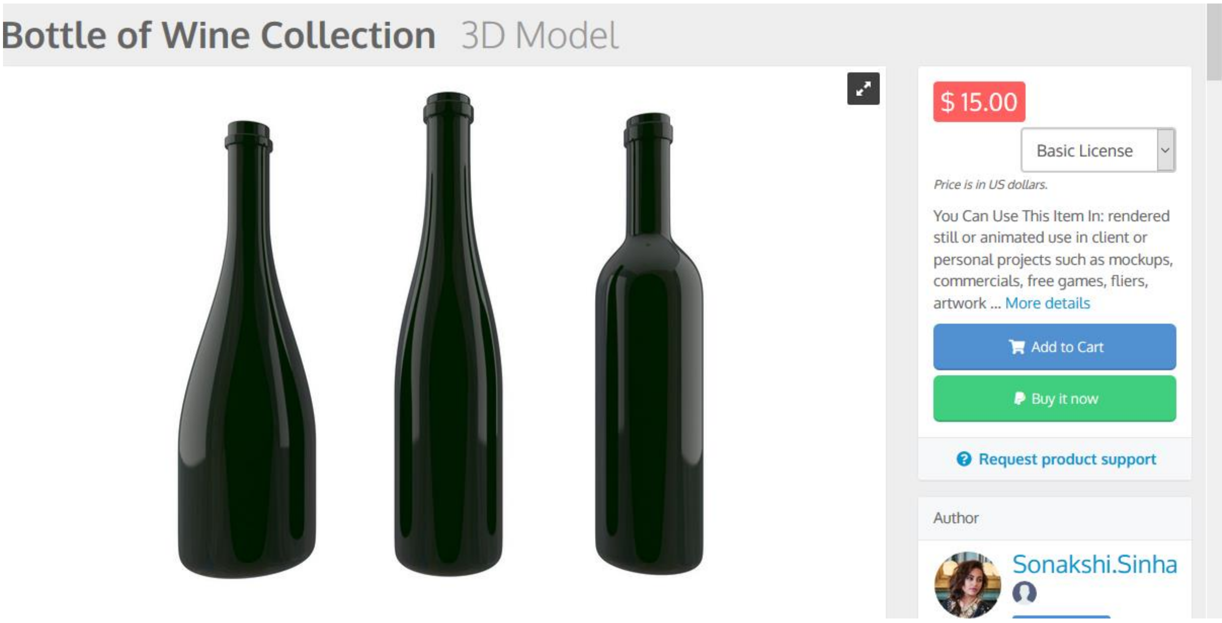


Figure 18 (Source: 3DEXPORT)

[221] CJEU of 16.09.2015, C-215/14 para. 60 – *Nestlé/Cadbury "Kit Kat"*; CJEU of 18.6. 2002, C-299/99 para. 35 – *Philips.*

[222] CJEU of 22.06.2006, C-25/05 para. 18 – *Storck/HABM*; CJEU of 7.10. 2004, C-136/02 para. 38 – *Henkel/OHIM*.

[223] CJEU of 22.06.2006, C-25/02 para. 28 – *Storck/OHIM* with further references from the CJEU case law.

[224] CJEU of 14.05.2012, C-453/11 para. 21 – *Time House/OHIM*.

[225] See for example CFI, judgment of 24 February 2016, T-411/14, denying three-dimensional trade mark protection for a Coca Cola bottle.

[226] https://3dexport.com/3dmodel-bottle-of-wine-collection-245837.htm

The lack of initial distinctiveness may be overcome if the mark acquired a distinctive character through use. Here, the requirement is that, as a consequence of that use, the sign for which registration as a trade mark is sought may serve to identify, in the minds of the relevant class of persons, the goods to which it relates as originating from a particular undertaking.[227] Insofar, the trade mark applicant must prove that the shape of the good alone identifies a particular undertaking from which the goods originate.[228] This proof (that the shape alone identifies the origin of the product) is possible e.g. through polls or statements from the Chambers of Commerce and Industry or other trade and professional organisations.[229] The distinctive character acquired through use must be shown throughout the EU, and not only in a substantial part or the majority of the territory of the EU.[230]

As a result, it can be said that only a very small number of objects arising from the design data for purposes of 3D printing, will qualify for a protection as a registered three-dimensional trade mark.[231]

In the exceptional case that a design data qualifies for three-dimensional trade mark protection, the description of goods and services would be the same as for the CAD file:

- Class 9: 'Electronic publications in the form of CAD files (downloadable)';
- If also offline distribution should be protected, it should read in class 9: 'Electronic publications in the form of CAD files (downloadable and on data carriers of every kind');
- In case the CAD is also made available online without download as a service, a description in class 41 should be added: 'Electronic publications in the form of CAD file (non-downloadable)'.

See in more detail above.[232] Furthermore, trade mark protection should include the relevant good for the printed object the respective international class.[233]

For example, a bottle used as packaging for soft drinks, whose shape is registerable as a three-dimensional trade mark (because the shape of the bottle has distinctive character for soft drinks), could – besides the protection in international class 32 for soft drinks – also be registered for the relevant electronic goods in class 9 and the relevant electronic services in international class 41 as shown above.

[227] CJEU of 16.09.2015, C-215/14 para. 65 – *Nestlé/Cadbury "Kit Kat"*; CJEU of 18.4.2013, C-12/12 para. 28 – *Colloseum Holding*.
[228] See again CJEU of 16.09.2015, C-215/14 para. 66 – *Nestlé/Cadbury "Kit Kat"*.
[229] Gordian Hasselblatt in *Hasselblatt, Community Trade Mark Regulation*, (Munich, C.H. Beck/Hart Publishing/Nomos; 2015), Art.7 CTMR note 326.
[230] CJEU of 25.07.1965, C. 84/17, C.85/17, C-95/17 para. 87 – *Nestlé and Mondelez (KitKat 4 Finger).*
[231] Same opinion: Andreas Schmoll/Johannes Graf Ballestrem/ Jan Hellenbrand/Martin Soppe, 'Dreidimensionales Drucken und die vier Dimensionen des Immaterialgüterrechts', (2015) *Gewerblicher Rechtsschutz und Urheberrecht (GRUR)* 2015, 1041 at 1047 et seq; Dominik Göbel, ‚Personal 3D Printing from a Perspective of European IP Law', (2016) *Medien und Recht International (MR-Int)*, 155, at 156. See also in general for the registrability of 3D trade marks Gordian Hasselblatt in *Hasselblatt, Community Trade Mark Regulation*, (Munich, C.H. Beck/Hart Publishing/Nomos; 2015), Art.7 CTMR note 269: "extremely difficult".
[232] See 2.5.1.
[233] For the requirement of genuine use, see below 2.5.2.3.

Such extended trade mark protection seems necessary in a 3D printing world. Where the owner of the trade mark for the 3D printed product (in our example: a bottle) wishes to protect the business through trade marks, it will also be with regards to the trade mark use in CAD files, which serve as a 'vessel' for the 3D printed product. This seems to be particularly relevant where the CAD file is traded independently from the 3D printed product. Such commercial separation – offering the CAD file with its design data, while leaving the 3D printing e.g. to the purchaser of the downloaded CAD file – is a key characteristic of 3D printing. 3D printing is sometimes characterised as a 'liberalisation' of the production process.[234]

One example would be the sale of licences for CAD files allowing 3D printing by the licensee. The example below of licences to print cars bearing trade marks illustrates this point.[235]

2.5.2.2. Word Trade Mark Protection, Figurative Trade Mark Protection

It is possible that the design data contains a word mark or a figurative mark. This could be a word mark or a figurative mark on the object to be printed. In this case, a word mark and/or a figurative mark could be registered. The description of goods and services would be the same as for the CAD file:

- Class 9: 'Electronic publications in the form of CAD files (downloadable)';
- If also offline distribution should be protected, it should read in class 9: 'Electronic publications in the form of CAD files (downloadable and on data carriers of every kind');
- In case the CAD is also made available online without download as a service, a description in class 41 should be added: 'Electronic publications in the form of CAD file (non-downloadable)'.

See in more detail above.[236] Furthermore, trade mark protection should include the relevant good for the printed object the respective international class.[237]

One example, in such a scenario, would be a file consisting of design data to print a LEGO brick, which bears the LEGO word trade mark. The LEGO trade mark could also include – besides the protection for toys in international class 28 – the relevant electronic goods in class 9 and the relevant electronic services in international class 41 as shown above. Another example is the *Ford* Mustang licensed by *Ford* Motor Company, where the Mustang car (as the design data) bears the 'Mustang logo' trade mark (figurative mark), see below at the grill:

[234] Nina Natalia Baranowska, 'The Intersection of 3D Printing and Trade Mark Law', 9 (2018) *JIPITEC* 251 para. 24 et seq.

[235] See below 2.5.2.2. and for the requirement of genuine use see section 2.5.2.3.

[236] See 2.5.1.

[237] For the requirement of genuine use, see below 2.5.2.3.

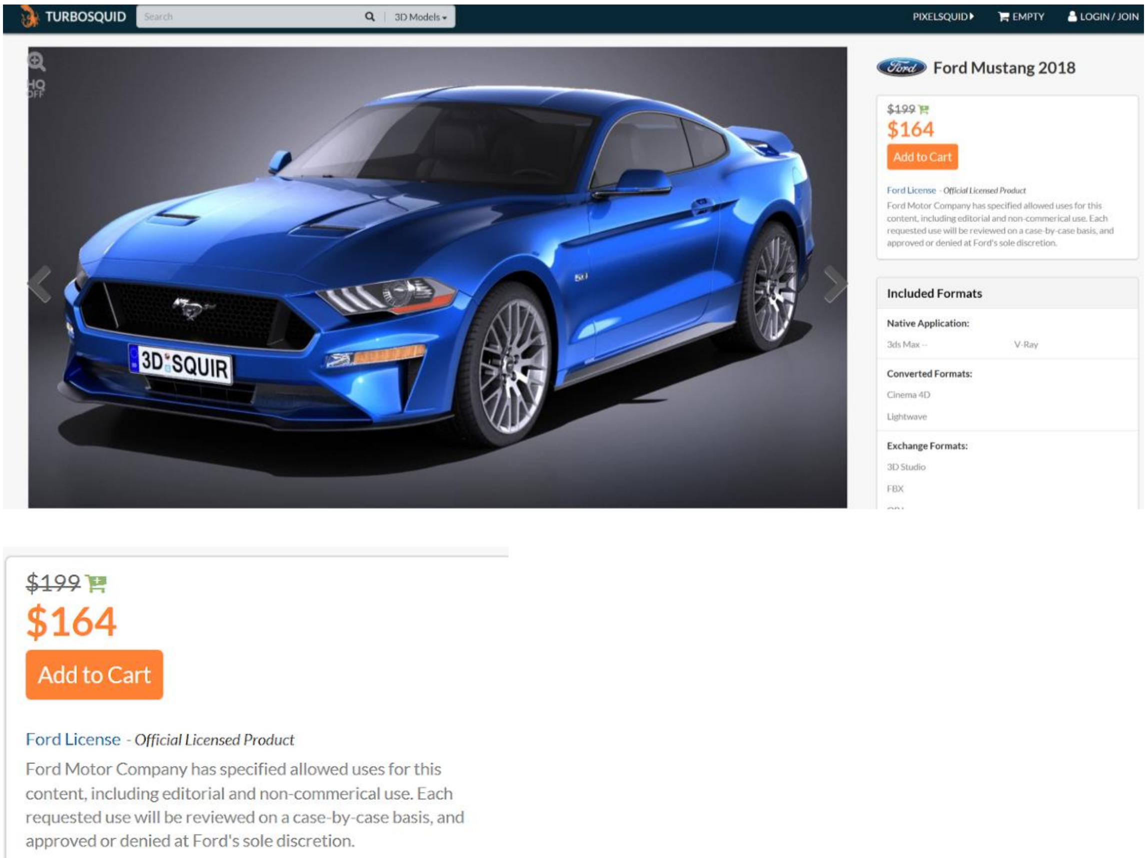


Figure 19 (Source: Turbosquid.com)

Here, trade mark protection – beyond in international class 12 for cars and/or in international class 28 for toys – could include the electronic goods listed in class 9 and the relevant electronic services in international class 41.

2.5.2.3. Requirement of Genuine Use

Another issue which comes up is the requirement of genuine use of a registered trade mark to protect the object to be printed. Art. 18 EUTMR and Art. 16 TM Directive require genuine use within five years after the completion of the registration procedure. Without such a genuine use, any registered trade mark will no longer serve to protect the owner against infringements.

For the requirement of genuine use, two scenarios have to be differentiated as to the goods the use needs to be shown for:

1) Genuine use of the trade mark for the good of the product to be printed and;

2) Genuine use for the good (or service) of a CAD file.

Genuine use of the trade mark for the (hard) good printed, using the design data:

In the 3D world, there may be trade marks which are only used by the owner to offer CAD files with design data for 3D printing, but the owner does not itself print (and sell) the products itself. 3D printing technology allows to separate the provision of (printing) data from the production of the good. This is also called 'liberalisation' of the production process.[238] The production process is disseminated and allows the trade mark owner to merely provide the CAD file with the design data, but leave the printing e.g. to the purchaser of the downloaded CAD file. In case the trade mark owner does not itself offer the object as a print-out, sufficient genuine use of the trade mark in the relevant product class for the printable object as such (e.g. toys in international class 28) may be questionable:

- **3D printing not under the control of the trade mark owner – no genuine use:** If only third parties print the object (after purchasing the CAD file), this use will not be attributed to the trade mark owner as an own use, as long as the printing is not under the trade mark owner's control. In this case, the trade mark is not in a position to guarantee the origin and the quality of the printed product set by the trade mark owner. The mere electronic origin and quality will not suffice. It is one of the most striking features of 3D printing that the origin function of trade marks used for the design file data will be blurred, when the printing is done without the control of the trade mark owner.[239] A genuine use of the trade mark for the printed product in such scenarios cannot be recognised.

- **3D printing under the control of the trade mark owner – genuine use:** There are, however certain scenarios, which would produce a sufficient own use. The printing process needs to be under the control of the trade mark owner. In this case, the trade mark owner can guarantee the origin and also the quality of the print-out. One example would be the print of the object which can be made only through 3D printing shops authorised by the trade mark owner, which fulfil the quality requirements of the trade mark owner for the print.

Licensing of 3D printing – genuine use if commercial printer is licensed: Another option to show genuine use of the trade mark would be to show use by licensees. Pursuant to Art. 18 (2) EUTMR and Art. 16 (6) TM Directive 'the use of the trade mark with the consent of the proprietor shall be deemed to constitute use by the proprietor. In other words, if the trade mark owner grants a print licence to the user, this should result in genuine use. However, this will only be true in scenarios, where the print is made in the course of trade, i.e. commercially. A mere private print-out will not be considered a sufficient use, as it is outside the scope of trade mark relevance.[240]

Genuine use for the good (or service) of a CAD file: Furthermore, to protect the product in electronic form (CAD file), it may also be advisable to register the trade mark in international class 9 and 41.[241] For the genuine use of such a trade mark registration in class 9 for electronic files (or for the respective services in class 41), the inclusion of the trade marks into the CAD file should be sufficient, but this is contested and remains an open issue to a certain extent same as the (infringing) use

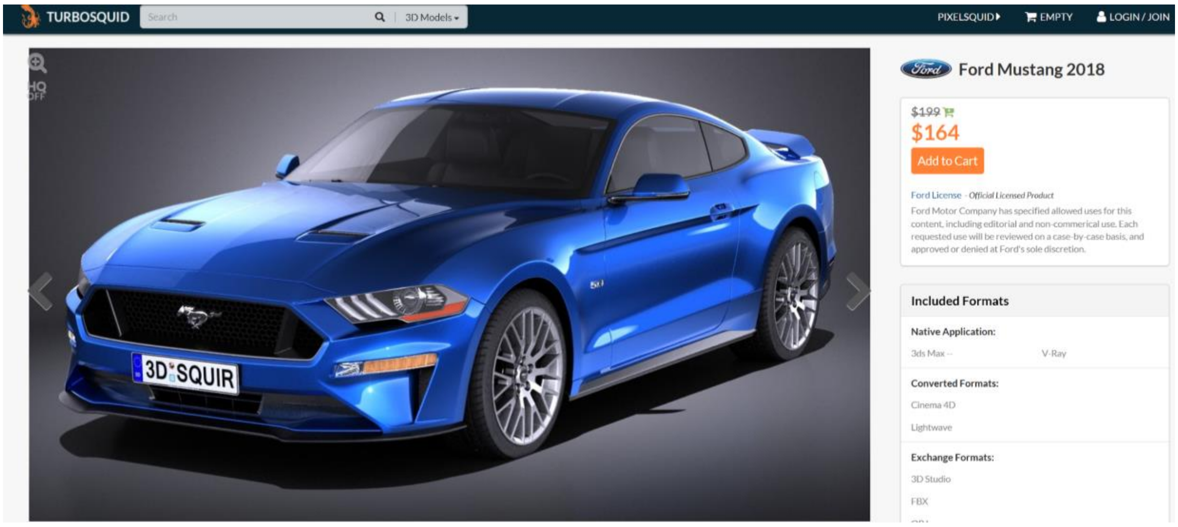
[238] Nina Natalia Baranowska, 'The Intersection of 3D Printing and Trademark Law', 9 (2018) *JIPITEC* 251 para. 24 et seq.

[239] Taina Pihlajarinne in Rosa Maria Ballardini/Markus Norrgard/Jouni Partanen*, 3D printing, Intellectual Property and Innovation* (Alphen aan de Rijn; Wolters Kluwer; 2017), p. 311.

[240] Nina Natalia Baranowska, 'The Intersection of 3D Printing and Trade mark Law', 9 (2018) *JIPITEC* 251 para. 31 et seq.

[241] See above 2.5.1. Protecting the CAD File.

of a trade mark, which is merely included into a CAD file.[242] Please see below for an example:



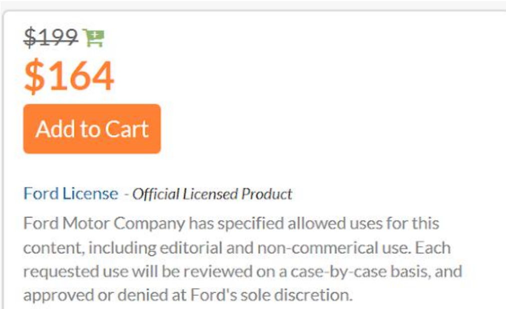


Figure 20 (Source: Turbosquid.com)

In the example of the *Ford* Mustang above the use of the 'Mustang logo' within the object (at the grill) is – according to our view above - a genuine use for electronic files in class 9.

In case the trade mark is also used to advertise the CAD file, e.g. on the internet when making the file available and advertising it for download, this will additionally constitute a genuine use of the trade mark.

In the example of the *Ford* Mustang above, the use of the trade mark 'Ford' to advertise the CAD file should constitute use for electronic files in class 9.

2.5.3. Protecting Materials, Hardware and 3D printing services

2.5.3.1. Protection of Materials

The materials of the 3D printing process may be trade mark protected just like any other material used in the production process. There is nothing specific under EU trade mark law for materials used for 3D printing.[243]

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[242] See below, Chapter 4, Trade Mark Infringement through Sharing the CAD file.

[243] See 2.5. and 2.5.1. for the requirements of trade mark protection under the EUTMR and under the national trade mark systems of the EU member states harmonised by the TM Directive.

For example, 'TMclass' [244] suggests 'metals in powder form for 3D printers' to be registered as an EU or as national trade mark in international class 6. The same is true for 'metals in foil form for 3D printers'.

2.5.3.2. Protection of Hardware and 3D printing services

3D printing hardware is eligible for trade mark protection like any other hardware. There is nothing specific under EU trade mark law for 3D printing hardware.

3D scanners may be registered as a national trade mark according to the EU or the national systems – suggested by 'TMclass' in international class 9 as '3D scanners', while '3D printers' can be registered in international class 7 as '3D printers' or 'three dimensional printers'. The service of 'repair and maintenance of 3D printers' may be protected in international class 37 and 'renting of 3D printers' or the service of '3D printing' (for others) in international class 40.

Summary

This section explores trade mark protection for the CAD file, design data and the materials, hardware and 3D printing services.

CAD file: The CAD file may be trade mark protected as a good, if it is downloadable (and as a service, if it is not downloadable, but provided as a service). The trade mark used for the CAD file may be registered as an EU trade mark and as a national trade mark under the harmonised systems in the Member States. Due to the electronic form of the CAD file, the mark used to indicate the origin and thus distinguish the CAD file from other files may be the object of trade mark protection. This could e.g. be the word name, but also a logo (design).

Concerning the description of goods and services, the following description for trade mark registrations of CAD files seems advisable: Class 9 'Electronic publications in the form of CAD files (downloadable)'; In case the CAD is also made available online without download as a service, a description in class 41 should be added: 'Electronic publications in the form of CAD file (non-downloadable)'.

Trade mark protection through registrations makes sense in case CAD files are offered in the course of trade. Trade mark protection is also necessary, if the right to use a trade mark for a CAD file is envisaged to be licensed to a licensee.

Design data: In the context of trade mark law, the design data to print the object may be in particular protected by word, figurative and three-dimensional trade marks. But only a very small number of objects which the design data enables to be printed will qualify for a protection as a registered three-dimensional trade mark. As for CAD files, the registration should be done classes 9 (if downloadable) and in class 41 (if not downloadable).

A sufficient genuine use in the relevant product class for the printed (hard) good may be questionable in case the trade mark owner does not itself print and offer the object as a print-out. To establish genuine use, the trade mark owner will need to either control the printing process or will need to license the printing to the user (the latter only possible in case of commercial users licensed). For the use of trade marks registered in class 9 for electronic CAD files (or for non-downloadable CAD files in

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[244] TMclass is an international database that includes the terms of the Harmonised Database, as well as terms accepted in other countries around the world and by international organisations such as the World Intellectual Property Organization; available at http://tmclass.tmdn.org/ec2/

class 41), genuine use may be shown through the use of the marks when advertising the CAD files. We also think that the mere inclusion of a trade mark into the CAD file constitutes a genuine use; but this is contested and remains to a certain extent an open issue.

Materials, hardware and 3D printing services: Materials, hardware for the 3D printing process (e.g. printers or scanners) and services linked to the 3D printing process such as 3D printing for others may be trade mark protected. No specific issues will arise insofar under EU trade mark law.

Industry Opinion: Does 3D Printing Add Value to Brands?

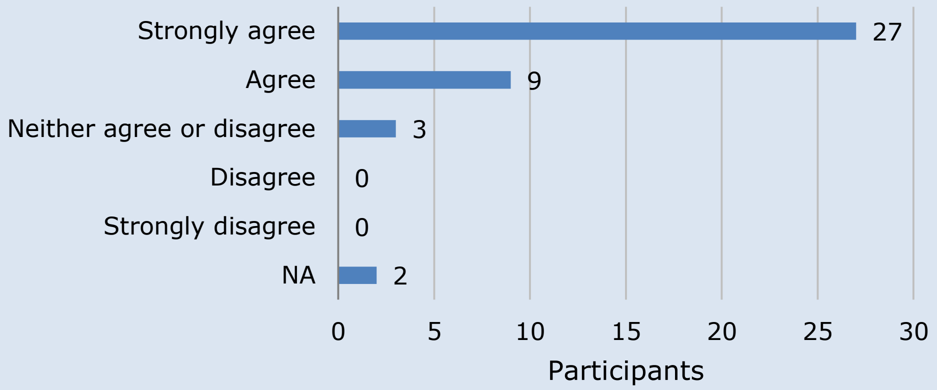

Figure 21 Interviewees' assessment on whether 3D printing creates additional value for brand owners and consumers

In a 3D printing context, trade marks can also apply to the protection of the CAD file. However, do they add value to brands? This question was put to the interviewees who were asked whether they agreed with the statement: '*3D printing enables the economic manufacture of personalised and customised parts. This creates additional value for brand owners and consumers. As such embracing 3D printing can add value to such brands.'*

This statement generated the strongest level of agreement with almost all participants strongly agreeing that embracing 3D printing can add value to brands. None disagreed.

From an economic perspective, the benefits of 3D printing depend on the volume of objects to be created. When producing a small series of products (prototyping, creating individualised products, etc.) industries' will '*save on tooling … time … [and] manpower that goes into all kinds of things' (Int.25)*. This was the sentiment of one interviewee. However, as another interviewee explained, doing so on a large scale, reduces costs per fabricated object: '*My rule is that if you can cast it, you should cast it. If you can mill it, you should mill it – this is seen from an economic perspective. Otherwise (with 3D printing), it would be, I would say 9 out of ten times, too expensive. … You are of course able to manufacture advanced geometries but it's expensive and the quality is not as you are used to.' (Int.27).*

As such the interviewees agreed on the suitability of 3D printing technology for modification and customisation purposes. The interviewees also noted three aspects of 3D printing that add value to brand owners and consumers. These included:

- In prototyping processes, 3D printing shortens innovation clicks because it makes possible the rapid manufacture of modifications and customisations.
- Customised products are more valuable in terms of client relationship.
- Customised products are more attractive for consumers seeking high-value luxury items

The interviewees also suggested that the potential value which 3D printing adds to companies is still not fully exploited; it can also be difficult to get customers to engage. The suggestion was that this is likely to be very different in the future – potentially as soon as companies, for example, find '*their niche in the high-value stuff*' (*Int.8)*. Similarly, an interviewee from a company that develops 3D printers and materials mentioned that the additional value for individual consumers will be more evident in the future with individual mass production.

Industry Opinion 10 Does 3D Printing Add Value to Brands?

2.6. Summary of 3D Printing and Protection of IPR: At-A-Glance Table and Two Case Studies

PATENT LAW		
CAD FILE	**DESIGN DATA**	**MATERIALS AND HARDWARE**
The major challenge to applying patent law to protect CAD files relates to the extent to which patents can be used to protect CAD design files *per se*. New strategies to file 'CAD-types' of claims are on the raise, but it remains unclear whether Patent Offices will accept such claims. On the other hand, the application of patent law to software inventions relating to the 3D printing process does not seem to raise any *ad hoc* issue, while general rules and principles as for CII patents will apply.	When it comes to protection of the data (e.g. design data contained in the CAD files) patent law seems to be applicable only in limited form. For e.g. data could potentially attract patent protection should it be conceived as a 'product' obtained by using a process patent (Article 25(c) of the Unified Patent Court (UPC) Agreement). At the same time, however, not only is this hypothesis very realistic, but also some national decisions in the EU lean towards an interpretation that indicates that patent protection should not extend to information as the product of a process patent (e.g. *Hunde-Gentest* case from Germany).	While the application of patent law to hardware and materials relating to the 3D printing processes does not seem to raise any specific concern on a general level, the possibility to apply patent protection to bio-printing related innovations might be challenged due to the possible morality and ethical claims that these inventions may carry.
COPYRIGHT LAW		
CAD FILE	**DESIGN DATA**	**MATERIALS AND HARDWARE**
A definition of a 'computer	Subject matter such as	The protection of

program' is not provided in international treaties nor EU Directives; however, the proposal by the European Commission in relation to the Software Directive and CJEU jurisprudence provides a definition which could be applicable in the current context for CAD files providing mass customisation options, in particular.

Applying the definition and CJEU case law, it can be concluded that a CAD file is a a computer program under the subject matter of literary works.

A *digital 3D model* represented through design data can be seen as a distinct 'work' separate from the resulting physical product. This is based on the fact that the (a) creation of a digital 3D model, particularly complex designs with mass customisation options, can reflect an author's own intellectual creation; (b) the 3D model and resulting physical product are distinctly different as suggested in case law*;* and (c) a CAD file, as a vessel for carrying the 3D model is different to the STL format, which contains the ready-to-print 3D model without the designer's IP showing how it was designed (which is contained in the CAD file).

The recent CJEU judgement on *Cofemel* clarifies that in terms of a design, no other requirement is mandated for copyright protection to arise, but the sufficient originality of the relevant design. This ruling can also be applicable to a digital 3D model in the 3D printing texts, art, music and films amongst others included within data sets can be copyright protected, but data *per se* cannot be copyright protected.

Data sets can be protected under the *sui generis* database directive as long as the criteria of 'substantial investment' is met. This will very much depend on a case-by-case basis.

The maker of a database is the person who takes the initiative and the risk of investing. This could involve multiple persons such as the party hosting the database, party providing the scanning devices and those who are involved in the technical implementation of it. In such a scenario, involving several such entities, there might be a case of joint authorship and ownership.

materials and hardware do not come within the realm of copyright law as copyright relates to creative works. However, text and user manuals that relate to hardware such as 3D printers and scanners, will be protected as literary copyright works.

context.		
DESIGN LAW		
CAD FILE	**DESIGN DATA**	**MATERIALS AND HARDWARE**
The CAD file is not eligible for protection under EU Design law. However, the design encompassed in a CAD file may fulfil the requirements of protection. This is the case even if the design was created only with the help of software tools.	The raw Design Data cannot be subject to protection under EU Design Law.	Whilst materials may only be protected by EU Design Law to the extent that they are a feature of appearance of a product or a part of a product, hardware may be subject to EU Design Law protection.
TRADE MARK LAW		
CAD FILE	**DESIGN DATA**	**MATERIALS AND HARDWARE**
Yes, trade mark protection for the CAD file is available. EU trade mark and/or under the harmonised systems in the EU Member States. Registration in class 9 (e.g. 'Electronic publications in the form of CAD files (downloadable)'). Or if mere provision as a service not downloadable in class 41 (e.g. 'Electronic publications in the form of CAD file (non-downloadable)' Trade mark protection is advisable if CAD files are offered in the course of trade or licensed to be used in trade.	Yes, the design data to print the object may be trade mark protected. Protection available e.g. by word, figurative and three-dimensional trade marks. But only very small number of objects included in the design data will qualify for a protection as a three-dimensional trade mark. Sufficient genuine use: a) In the relevant product class for the printed (hard) good: use may be questionable in case the trade mark owner does not itself print and offer the object as a print-out. Necessary to either control printing process or license for commercial printing. b) In class 9 for electronic CAD files: use through advertising the CAD files. Open, if mere inclusion of trade mark into the design data constitutes genuine use.	

2.7. Case Study 2: The Legal Status of CAD Files

Case Study and Overview

This case study considers the status of CAD files on the one hand and the legal position where there are multiple authors in the creation of a CAD file. The legal status of CAD files, as discussed above, appears to be clear from the perspective of the type of work it entails (a computer program); however, it raises questions in terms of the author's own intellectual creation. At the same time, the true potential of 3D printing lies in customisation and personalisation of objects – which feeds into the concept of an intellectual creation by an author. This case study considers the legal status of CAD files and issues relating to ownership and authorship. Whilst CAD files are used in computer numerical control (CNC) machines, CAD files also play an integral role in 3D printing – as without it, a 3D printer will not work.

Issues and Relevant IPRs

In the context of patents, copyright, design and trade marks, the protection of CAD files raises a number of questions. As discussed in the legal review, some aspects are addressed through the current law, whilst others remain unclear. The questions which require clarity include the type of work it is; whether it is capable of encompassing an invention, can it be considered a product and whether is it capable of carrying a trade mark. Furthermore, an interesting question which requires further exploration is whether a CAD file can be considered a computer program under copyright and whether the modelling which an author carries out in designing a 3D model, amounts to an author's own intellectual creation or can it be considered utilitarian? Yet, complex design drawings or creating a design with customisation options for the end user, involves making creative choices. Furthermore, CAD files carry information which is not transferred to the ready-to-print STL file – thereby making a CAD file an IP-rich source from the perspective of a designer. Moreover, where there are multiple authors, or where an end user sends a CAD or STL file for printing to a bureau service, how is ownership or potential infringement considered? These issues concerning the legal status of a CAD file and ownership raises a number of questions. Some of these issues drawn from industry, are captured through the quotes below.

Examples

'For example, when a client sends you information about a piece, the model (CAD file) is owned by the client. From that point of view, unless otherwise agreed, the intellectual property of the project is always owned by the client … Our doubt, in this case, is: to what extent is this sufficient legal protection in case of infringement [by client]? Do we need to investigate who is the owner of the IP?' (Int.20)

'Unless the file indicates that it has a certain kind of licence, you might violate a designer's right when you modify the file that the client passes to you.' (Int.20).

'I use kind of a mix of, I guess I would say programming with 3D modelling to create … complex shapes that you couldn't otherwise create, and so I've had issues with contracts where the … company I'm working for, they'd like to own not only the deliverable, i.e. the design [but also] the … design files, … for me the design files are more than just a 3D model, it's also kind of a program I have written to create the geometry' (Int.24).

Solutions and Recommendations

Whilst the law is clear in the area of trade mark law, it needs to be clarified in certain other aspects such as patent, copyright and design laws.

In terms of looking ahead to the future, the following recommendations are suggested. in the context of patent law, determine (ideally via EPO case law) whether 'CAD file types' of claim are acceptable for patent protection and under what conditions. Under copyright law, define whether a CAD file can be considered a 'computer program' in accordance with EU copyright law. In this context, policy makers may wish to adopt the European Commission definition suggested in the Software Directive.

Clear contractual terms and awareness of its need and training to this effect can further address issues of ownership.

Case Study 2 The Legal Status of CAD Files

2.8. Case Study 3: 3D Printing of Spare Parts

Case Study and Overview

As 3D printing became more mainstream, its impact on the spare parts market, particularly in the supply of aftermarket parts to the consumer, was highly anticipated. The idea of low prices for essential parts, a shorter waiting-time for the delivery of critical and specialist parts and being less dependent upon manufacturers to support ageing products is attractive for the consumer. As such, this case study explores the potential of 3D printing in the automotive aftermarket and the implications, particularly for design law.

Issues and Relevant IPRs

In the context of design law, *only the visible features of a component within a complex product* will be considered for design protection requiring the need to display the necessary novelty of design and individuality of character if it is to benefit from design protection. This is known as 'under the bonnet'. It should also be noted that features of appearance of a product which are solely dictated by its technical function, will not attract protection.

From a 3D printing perspective, there are many benefits that can be identified in the context of spare parts. For example, vehicle manufacturers will benefit from not having to hold stock at the end of a vehicle's life, whilst for a third party manufacturer it will reduce the need to invest in fixed assets such as bespoke tooling, reducing cost and risk.

However, a key feature in this market is the role played by the Original Equipment Manufacturer (OEMs) manufacturers who produce original spare parts. Interestingly, a Study on 3D printing and implications for IP published in 2015 highlighted that, at the time, OEMs had a very low level of concern about the control of data and subsequent IP implications, should 3D printing of spare parts become widespread (Mendis, Secchi and Reeves, 2015).

As such, at the moment, beyond a small number of exceptional cases where 3D printing is being used in the manufacture of luxury vehicle components, 3D printing has made limited impact on the overall automotive market. The apparent reasons for this lack of traction seems to be for two reasons: (a) higher costs – '*3D printed parts amounted to almost five-times as much as available classic spare parts'* and (b) not being fit-for-purpose – *'whilst parts were of the correct dimensions, they did* *not conform structurally to the original design and were not fit-for-purpose'.*

Examples

'A similar economic picture is seen for other automotive components such as water pumps, exhaust pipes, silencers and radiators. All these parts could conceptually be made using additive manufacturing, but the production costs would be of a greater magnitude than the current aftermarket value, thereby restricting the value proposition of the additive manufacturing printed aftermarket' (previous published research).

'The adoption of 3D printing for producing aftermarket parts will be driven primarily by OEMs, not by consumers or by supply chain-led initiatives; consequently, the production data will be generated by the OEM and this can be controlled in the same way that it is at present, thus protecting their intellectual property' (previous published research).

Solutions and Recommendations

As 3D printing continues to improve providing more precision, while costs continue to decrease, the adoption of the technology for production parts is something which is being considered by car manufacturers. As such, the 3D printing of spare parts, appears to be a more long-term solution.

Due to the current high costs, the use of the technology for *prototyping* could be more viable for wider adoption in the shorter term.

Case Study 3 3D Printing of Spare Parts

2.9. Protecting the 3D Printing Process Through Trade Secrets

The above section provided an in-depth discussion of the application of IPR to the various elements of the 3D printing process. In particular, it included a consideration of the four main IPR of patents, trade marks, copyright and design. However, our research revealed that trade secrets plays a significant role in this industry.

Taking into consideration the findings from our interaction with industry stakeholders, the section below sets out a legal overview of trade secrets and confidential information before integrating it with the empirical analysis.

2.9.1. Protecting Design Data: Application of Trade Secrets and Contractual Mechanisms

Trade secrets and contractual mechanisms, as well as technical protection measures are often used to protect data. In the context of 3D printing, this applies particularly to design data.[245] It is an area that has garnered much attention in recent times. Recently, Professor Orly Lobel highlighted the tensions between the culture of open innovation in Silicon Valley and the increasing use of trade secrets and contract law in the course of employment.[246] Legislative developments such as the new EU Trade Secrets Directive[247] (which gives more teeth to trade secrecy as a protection mechanism), as well as cases like the *Waymo and Uber* disputed in the US (in respect of trade secrets relating to autonomous vehicles) highlight the importance of trade secrets in emerging fields of technology.[248]

In the EU context, trade secret protection is required by the Trade Secret Directive and EU Member States are also allowed far-reaching protection provided certain requirements are met. Trade secret protection is also regulated in the TRIPs Agreement. Pursuant to the Trade Secret Directive, using trade secrets without the consent of the trade secret holder constituted infringement. This led to situations where the trade secret had been acquired unlawfully or happened in violation of a contractual or other kind of duty as well as situations where another person had done so and the person using the trade secret ought to have known this to be the case.

The EU Trade Secrets Directive increases possibilities for protection against unlawful acquisition, use and disclosure of trade secrets. As such, these mechanisms are often used to provide protection for elements, such as data, that might not typically attract IPR protection. However, this protection applies only to information not 'generally known among or readily accessible to persons within the circles that normally deal

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245 See for e.g. R.M. Ballardini, J. Lindman, & I. Flores-Ituarte, 'Co-Creation, Commercialization and Intellectual Property Management – Challenges with 3D Printing Technology', *European Journal of Law and Technology* (2016), Vol 7, Issue 3

246 Orly Lobel, *Talent Wants to be Free: Why We Should Learn to Love Leaks, Raids, and Free Riding* (Yale University Press, 2013).

247 Directive 2016/943 on the protection of undisclosed know-how and business information (trade secrets) against unlawful acquisition, use and disclosure, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32016L0943

248 *Waymo LLC v Uber Technologies Inc.* 17-cv-00939, U.S. District Court, Northern District of California (San Francisco); Sarah Jeong, 'Who Blinked First in Waymo v. Uber? Why Uber and Waymo Settled its High-Stakes Case', *The Verge* (9 February 2018) https://www.theverge.com/2018/2/9/16997394/waymo-v-uber-trial-settlement-explained; and Joel Rosenblatt and Eric Newcomer, 'Uber Agrees to Pay Waymo $245 Million Equity To Settle Suit', *Bloomberg* (10 February 2018), https://www.bloomberg.com/news/articles/2018-02-09/uber-settles-waymo-driverless-car-lawsuit-averts-jury-verdict-jdg486do

See also, Dinusha Mendis, Mark Lemley and Matthew Rimmer, 'The future of printcrime: intellectual property, innovation law, and 3D printing' in Dinusha Mendis, Mark Lemley and Matthew Rimmer, *3D Printing and Beyond: Intellectual Property and Regulation* (Edward Elgar, 2019).

with the kind of information in question' (Art 2.1(a)). In other words, if data is shared with other parties or somehow made publicly available (e.g. in websites), protection does not apply.[249]

Beyond the EU Trade Secrets Directive, national (not harmonised) unfair competition law may provide for further remedies in the case of data. For example, German law recognises an unfair 'passing-off' also in scenarios, where the competitor 'dishonestly obtained the knowledge or documents needed for the replicas'.[250] Further unfair competition law scenarios, in particular on passing-off and misappropriation, can also apply.

Generally, in the context of 3D printing trade secrets are considered as an attractive tool of protection not only for the data contained in the CAD files, but for the CAD files *per se*. As explained above, one clear reason can be drawn from the existing controversy in respect to whether IPR mechanisms, like copyright, trade marks, designs or patents, apply to CAD files. For example, to date, it is highly questionable whether and to what extent patent law is applicable to inventions arising from the CAD file *per se* or even in relation the valuable data included within the file. Thus trade secrets and contracts become an important protection mechanism (as for e.g. copyright, design or trade marks fail to provide protection to the technical inventions at stake). For instance, the relevance and importance of trade secret protection in 3D printing became apparent in a recent US case concerning two 3D printing companies. In 2018, Desktop Metal Inc. launched litigation against Markforged Inc. and Matiu Parangi in relation to IP and metal 3D printing.[251] As well as complaints of patent infringement, Desktop Metal Inc. alleged that the defendants had engaged in acts of trade secret misappropriation, unfair and deceptive business practices, and breach of contract. There was a trial regarding the matters relating to trade secrets, consumer law, and contract law in September 2018. Mid-trial, there was a confidential settlement reached between Desktop Metal Inc. and Markforged Inc. Nonetheless, the case highlighted the role and function of trade secrets protection in respect of 3D printing.

Despite the importance of Non-Disclosure Agreements (NDAs) and contractual agreements, sometimes they are not fully implemented even in highly developed industries. For instance, a medium-sized company with a focus on the aerospace sector shared with us a situation they encountered as a result of a poor management of trade secrets. The company occasionally offered customers the opportunity to license their IP and also provided training. This was viewed by the company as a secondary source of income as it '*allowed us, if you like, not to make money from printing things but make money from our IP, so we put in place a training programme for the customer … and, you know, show them some of our quality processes'.* The issue was that the customer took the know-how from the training and set-up their own facility. This saved the customers '*2 years of trying to work it out themselves' (Int. 2).* As a result of the incident the interviewee's company is more wary of such situations occurring again. A possible strategy could be to include an exclusivity clause for trained customers for a specified number of years in protecting one's trade secrets.

[249] Tanya Aplin, Lionel Bently, Phillip Johnson and Simon Malynicz, *Gurry on Breach of Confidence: The Protection of Confidential Information*, 2nd edn (Oxford University Press, 2014).
[250] See § 4 No. 3 lit. c) UWG.
[251] *Desktop Metal, Inc. v Markforged, Inc. and Matiu Parangi* (2018) Case Number 1:18-CV-10524.

2.9.2. Case Study 4: Design Data and Creation of Design Data Sets

Case Study and Overview

3D scanning has become more prevalent over the past few years, with improved technology and increased applications. This case study considers the ownership of scanned design data, whilst questioning the types of rights which exist for protecting it. Drawing on the discussion above, the case study further questions whether the current mechanisms for protecting such data is adequate in light of practices in industry.

Issues and Relevant IPRs

A consideration of the current IP regime establishes that data *per se* is ineligible for protection under patent, copyright and design laws. Under trade mark law, design data utilised as a trade mark on the object to be 3D printed, may be protected as a word, figurative (e.g. logo) and three-dimensional trade mark. However, only a very small number of objects will qualify to be registered as a three-dimensional trade mark. On the other hand, whilst data *per se* cannot be protected, the current law does afford protection for 'data sets' under the *sui generis* database rights. Also, although generally patent law is not applicable here, data could potentially attract patent protection if it can be considered a 'product' obtained by using a process patent. Therefore, in terms of related rights, data sets can attract the protection of database rights whilst laws such as trade secrets and conract apply to the protection of both data *and* data sets.

Whilst 3D scanning conjures up the image of a physical object being scanned, it is not limited to replicating physical products. For example, it is interesting to note the use of 3D scanning for visualisation applications, where the design data is typically optimised to be on-screen, in a digital environment rather than being re-transferred into a physical environment through 3D printing (or other means). One of the interviewees from a micro company (Int.39) spoke of their business model involving an upfront fee for the use of 3D scanning devices (rental fee) and a monthly service fee for customers utilising their cloud based infrastructure, where scanned design data is available for enterprise applications (rather than consumer applications). This involves clearing IP rights with the content-owners before it can be scanned. As indicated above, there are some rights which can protect the data, but, under which circumstances, is an open question – and this has led to some confusion amongst industries as reflected through the views of the participants engaged in this Study.

Examples

'If there is a sufficient market place where people just want to buy and trade generic digital content, then actually we might be able to give scanners away for free in principle if the people who were using them were willing to assign [to] us either the full rights or a share of the rights of the digital content' (Int.39)

'Game of Thrones are producing series 9 and I want to have a bunch of digital stuff like some old looking clothes that are going to get into the CG for production. If they can download that from a digital store and that goes straight into that production process, then that can have a lot of value because otherwise they have to go out and digitise that themselves or pay a digital modeller a lot of money to create it' (Int.39).

'The creation of a global database for scanned objects is "very unlikely"… I think …. people have already tried to do this … and tried to monetise on that itself, unless you're providing the full service of here's the files and we can print it for you and

we can ship it to you. Other than that then it's just like … the music industry, I think people will be less likely to want to pay almost like an Apple Store kind of fee, unless it was some platform. But I don't think there will be a one unified database' (Int.24)

Solutions and Recommendations

The creation of a single, one-stop-shop for scanned design data/printable objects (such as istock for images or iTunes for music) was suggested as a solution by Int.39, however other interviewees (Int.24) as well as Int. 21 and 31 representing small and large companies disagreed. It is suggested that other areas of laws, such as trade secrets and contracts, are better equipped to provide adequate protection for design data and data sets whilst the *sui generis* database rights can be applied to data sets under certain conditions. To address the distinction between the lack of protection for data *per se* under IPRs and protection for 'data sets' under the database rights where certain conditions are satisfied, greater awareness amongst industries is needed. In this context, the applicability of trade secrets, contractual agreements and database rights for protecting *both data and data sets* should form part of the awareness campaign.

Case Study 4 Design Data and Creation of Design Data Sets

2.9.3. Trade Secrets in Technology Companies

Trade secrets policies and agreements are usual strategies for companies developing and working with 3D printing technology to protect valuable information, data and know-how. For instance, all interviewed technology companies confirmed that they use trade secrets. Small, medium and large companies used them often, one of them even referred to trade secret agreements as part of the 'daily business'. They are used in order to keep knowledge confidential within the company (i.e. with employees) as well as with external partners (i.e. clients, partners, suppliers, distributors). An example of its utility was given by an interviewee who had written an article for a trade magazine and had used a series of photographs which they had taken at a trade fair displaying components that they had printed for an aerospace company on their stand. The aerospace company saw the images in the magazine and realised that those parts where actually their parts. The interviewee explained '*the issue actually was that the owner of the design [the aerospace company] had never .. given them [the vendor] the right to show those parts in public .. they were displaying parts which I believe were actually covered by a NDA'* – once the situation was clarified, the vendor backed down.

Knowledge confidentiality within the company can be temporary (i.e. until the introduction of a product into the market) or long-term if the secret applies to research, development or manufacturing activities. In the latter case, trade secrets are used to secure knowledge that is not patented or not patentable: *'[we] have a few trade secrets in house here, … just a few people know [about it] and all the employees that come in here are signing a non-disclosure agreement with the company. ... The software that operates our machines is stored on our in-house software repositories. There we store data which we consider to be confidential and very few people have access to those files' (Int.25).* Another two companies (Int.2 and Int.3) explained that trade secrets are mostly used to protect knowledge on how to run a certain process (while patents are typically used to protect commercially relevant innovations). However, when patents are deemed difficult to get or to enforce, the invention is then protected as a trade secret. Although not indicated by the interviewees, it is also possible that trade secrets are used when it is clear to a company that their invention cannot be reverse engineered.

Patent applications are published 18 months after the first filing. This was alluded to by a few interviewees (Int.2, Int.3, Int.18, Int.21) who stated that trade secrets are also chosen over patents, when the company prefers not to disclose their know-how. Two companies (Int.18, Int.21) were clear in that trade secrets formed part of their IP strategy as well as part of their 'business philosophy': *'retaining knowledge and experience within the business, rather than formally protecting and disclosing with patents' (Int.21).*

Trade secrets are also often regularly used in projects and communications with other partners and clients. All technology companies interviewed confirmed that they use confidentiality agreements to share or receive confidential material, knowledge or information for certain purposes with external actors. Given that such agreements are used in a broad spectrum of situations (i.e. R&D, industrial collaboration, service provision) different terms and conditions apply to each contract, as explained by a company: *'we have a lot of collaborative partnerships, and a number of those are covered by NDAs and collaboration agreements which are focused on specific applications. I believe our competitors operate the same strategy to secure preferential commercial opportunities. Obviously, the whole IP management and IP ownership is done on a more or less case by case [basis] [and], a project by project basis' (Int.21).*

The need to protect the know-how (software and hardware processes and 3D printing techniques) connected to printing the physical 3D object was very much a concern for companies falling within the production stage of 3D printing. This issue was identified for two different customer segments by interviewee 4. First, those who under-estimated the know-how involved in the production process: *'In terms of protecting our IP I think as long as we, yeah keep the trade secrets confidential that's fine. Some of our problem is that the customers don't recognise our IP, they kind of say why do you need a non-disclosure agreement, all you're doing is pressing a button to print the parts, they don't realise that 3D printing is more complex than they imagine and it's not simply pressing a button. So … sometimes I struggle to persuade customers that we do actually …have valuable IP that we need to protect and get the confidentiality agreement etc. But that's changing really because people, you know, it's becoming a better known area, and the other extreme of course is customers who … are completely alive to all the IP that sits in how to 3D print and they want to set up their own 3D printing facilities and start asking us lots of questions, which we don't answer (Int.4).*

Production companies were also cognisant of the potential damage their own employees could do in disclosing, inadvertently or otherwise, their IP – as also highlighted above in the *Markforged Inc. and Matiu Parangi* case. The following quote explains how these companies go about protecting information held by their employees: '*Trade secrets is also quite crucial and we have within our company a lot of know-how … our people have a lot of know-how and there is a lot of techniques that are known in house in how to use those printers, how to make a good product so we have a lot of process parameters … that we have learnt as a result of our activities for years and I am sure that is what we try to keep this in-house …. these type of things we try to protect them. We have to underline that they (employees) will come in contact with all kinds of trade secrets and the law about how that is confidential and that they cannot disclose those trade secrets after their employment with XX so we really try to focus on that and we try to avoid that when an employee is leaving XX they do not run away with our trade secrets and our know-how as a regard to 3D printing' (Int.2 and 3).*

Industry Opinion: Contractual Agreements as Measures to Protect the IP of Industrial 3D Printing Manufacturers

Interviewees were asked to indicate their level of agreement with the following inquiring statement: *'The industrial 3D printing manufacturers have protective measures in place to protect their IP, based on their contractual agreements with OEMs.'* Companies discussed the protective measures between 3D printing manufacturers and Original Equipment Manufacturers (OEMs)

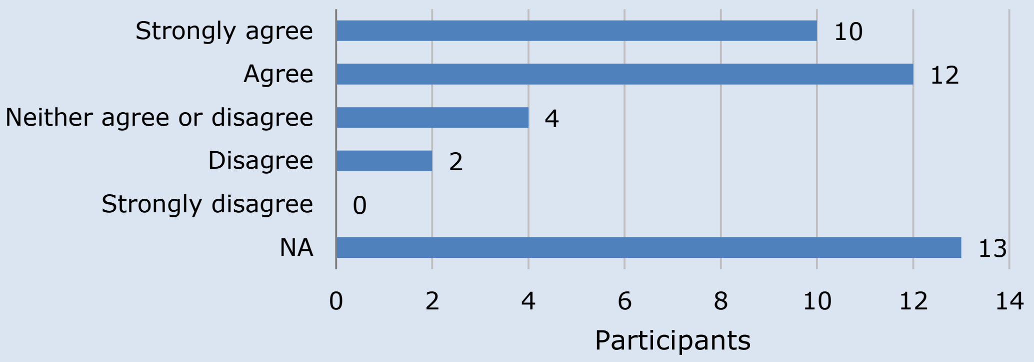


Figure 22 Interviewees' assessment of inquiring statement

Overall, participants agreed that the commercial relationships between 3D printing manufacturers and Original Equipment Manufacturers (OEMs) have the necessary mechanisms to protect IP. This is also the case for the relationships with component and connectors and other contract manufacturers. In the view of the interviewees, these relationships are a normal part of the contract and have been extensively 'tried and tested' over many years in other kinds of manufacturing processes and therefore do not pose a problem.

Four interviewees neither agreed nor disagreed with this statement. One of them explained that such relationships are mostly controlled by those that create the hardware technology (i.e. manufacturers of 3D printers), as they usually provide product services such as maintenance and support. At the industrial level, for complex machines, machine manufacturers also supply the material used in their machines. Opting for a different provider of such services or materials implies assuming risks (e.g. losing warranty or support). According to this interviewee, this situation is the consequence of the low number of standardised technologies in 3D printing. It is a field that has not yet been liberalised because there are many valid patents, and three actors within the manufacturing part of the value chain have expressed their hopes of further standardisation in the future.

Disagreement with the statement was only raised by two participants. The first is a manufacturer of 3D printers who stated that such types of agreements are not common. The second produces equipment for the biotech sector and this particular interviewee indicated that such practice varied greatly within the sector: *'some of them do and some of them don't'* (Int.11), with the bigger companies doing it well but overall the interviewee considered the market to be not very well protected. It should also be noted that almost a quarter of the participants did not answer due to their lack of knowledge on the relationship between hardware manufacturers and OEMs.

Industry Opinion 11 Contractual agreements as protective measures to protect IP of industrial 3D printing manufacturers

2.9.4. Other Informal Protection Mechanisms

Companies also reflected on additional informal and unregulated protections mechanisms that act as a complementary layer of protection. Such strategies comprised a broad range of initiatives, such as internal company policies, external communication plans, or technical means of protection (i.e. encryption, confidentiality of source code), among others. These were used by both SMEs and large companies. For instance, one SME discussed the importance of retaining expertise in order to protect the company's know-how: *'in order to build a team, you need to find experts in different disciplines. However, expertise in additive manufacturing is very rare in the industry at the moment, so protecting the team is maybe one of the key issues and not losing the team to the US or to China. I would say that this is one of the key issues for Europe at the moment. Not losing people. The community is rather small, so the experts are very much searched' (Int.33).* Other companies invested resources into training employees in IP procedures as a strategy to combat the loss or violation of IP rights.

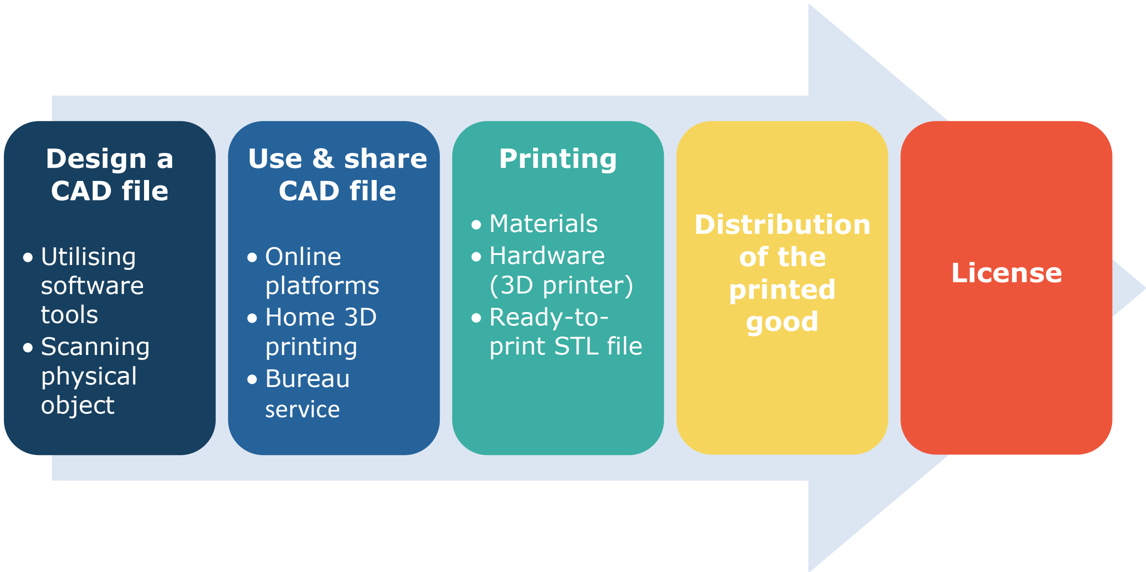
Another SME shared a different strategy relating to the management of why they decided not to patent. Its representative explained that if they do not plan to patent an innovation, they consider means for protecting it from being patented by competitors: *'we attend conferences and all that and sometimes you speak about ideas that could be patented but you'd rather … publish it because you cannot afford to patent it. As you know once it's published it cannot be patented. There are a lot of things we do, and we try to put an ownership tag on it by publishing it.' (Int.25).*

A third example relates to continuous innovation and increasing product complexity. Having relentless innovation cycles adds a second level of protection against competitors, as it keeps them constantly catching up. Furthermore, the development of ever more complex systems and processes makes copying or reverse engineering more laborious. This approach was mentioned by two companies, one SME (Int.25) and a large firm (Int.21). The CEO of the SME argued that this strategy also helped to increase the company's visibility in the market. Similarly, the representative of the large firm explained that this policy also helped to differentiate themselves from other companies in the market.

Finally, the use of technical means of protection were also widespread among the technology companies. Depending on the type of information to be protected, different solutions could be applied, such as strong access control, encryption of sensitive information, and an in-house repository of source code, etc.

In many ways this scenario is not peculiar to the 3D printing sector and can happen in any sector, where training is needed for the operation of complex technological devices and mechanisms. The example, is however, illustrative of this common issue happening in the 3D printing industry also.

CHAPTER THREE:
3D PRINTING AND
EXCEPTIONS AND LIMITATIONS



3. Introduction

This chapter will focus on exceptions and limitations relating to 3D printing. In doing so, the chapter refers to the various elements in the 3D printing process – which in this case includes designing a CAD file *(step 1),* using and sharing the CAD file *(step 2),* printing the 3D model *(step 3)* and distributing the printed good *(step 4)* – as demonstrated in the diagram above.

Exceptions and limitations are particularly important in the 3D printing sphere. This is because in order to maintain an appropriate balance between the interests of rights holders and users of protected works, IP laws allow certain limitations on economic rights, which permits protected items to be used without the authorisation of the rights holder and with or without payment of compensation in certain circumstances.[252] Exceptions and limitations can vary from country to country and according to each IP right.

Within the context of 3D printing, the most discussed types of exceptions and limitations to IP rights in the literature are private and non-commercial use and copying, as well as issues of repair, re-use and recycle of protected products in relation to the interpretation of the doctrine of exhaustion. The sections below discuss the implications of both private and non-commercial use and the principle of exhaustion in the context of 3D printing from the perspective of each IPR.

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[252] World Intellectual Property Organisation, 'Exceptions and Limitations' at https://www.wipo.int/copyright/en/limitations/

3.1. Implications of the Private and Non-Commercial Use Exception for 3D Printing Processes

It is common practice for most European jurisdictions to include an exception for private use and private copying under patent, copyright, as well as trade mark and design laws.

In the context of 3D printing, the application of the private and non-commercial use exception might differ according to the purpose of printing. For IPR protected items, 3D printing raises at least the following three possible scenarios for private and non-commercial use:

- **Home 3D printing**: users may create a CAD file of a protected object and print it out at home (or in private) for themselves (or, in some cases, for their friends and families) for non-commercial purposes.
- **Printing at a 3D service bureau or at other public spaces**: Due to the costs of printing machines and materials, 3D printing is likely to take place not only 'at home' or in private spaces, but also in other 'public' spaces such as public libraries, schools[253] and public research institutions, commercial establishments such as 3D printing cafes[254] and finally in 3D printing service bureaux (i.e. facilities that own 3D printing machinery and sell services such as subcontracted manufacturing using 3D printing machines). Users may create a CAD file for a protected object and print it out through 3D printing service bureaux or other public spaces and then use it for themselves (or, in some cases, for their friends and families) for non-commercial purposes.
- **Sharing of CAD Files:** users may create a CAD file for a protected object and then share the file over the Internet with other users (who can potentially then print it out).

The first two scenarios will result in a physical object and thus, at least to some extent, would enable physical tracing of objects. In contrast, the third type would occur in the digital environment where only the design files are traded (although the object can potentially also be printed out).

Whilst scenarios (1) and (2) may be more relevant from a consumer perspective, scenario (3) lends itself to both consumer and industrial implications.

In the discussion below, we apply these scenarios to the various IP rights in order to provide a concrete basis for the analysis of the legal issues related to 3D printing and the private and non-commercial use exception.

3.1.1. Private Use Implications for Patent Law

In contrast to other exceptions, such as the research or experimental use exception (including its applicability to reverse engineering), that have received more attention due to the advent of technologies such as software, biotechnology, nanotechnology and gene-related patents, discussion over the private and non-commercial use exception in European patent law has been relatively scarce, both in the literature and in jurisprudence. The main justification for this is that the use by private persons for non-commercial purposes (excluding research and experimental purposes) has been rare for both technological and economic reasons. Similarly, hobbyists' and DIYers'

[253] For instance, there have already been several projects to purchase 3D printers for schools in the UK and Finland.

[254] For instance, 3D Crush cafe in Finland, *see* http://www.3dcrush.fi/

activities have traditionally attracted little attention from patent holders, because these uses of patented inventions are usually a 'one-time use' only and, as such, do not fall within the targeted market of patent owners in the value chain. Indeed, the majority of patent litigation involves businesses, research institutions or universities, rather than activities by private individuals or end users. 3D printing technology, however, is expected to change this scenario, especially because it calls for a re-evaluation of the role of users in the value chain. Even though consumer 3D printing will play a major role, industrial 3D printing will be clearly relevant. For instance, the private use exception in the context of industrial 3D printing could be especially relevant in relation to printing spare parts.

The private and non-commercial use exception in patent law is not found in all jurisdictions in the world, nor is it part of any harmonised international minimum standards. Notably, for instance, the exception does not exist in the US patent statute. However, most EU countries contemplate the exception in their patent acts. Notwithstanding the fact that in many instances the patent laws of the EU Member States resemble each other, however, some practices may diverge in the context of exceptions and limitations, such as the private and non-commercial use exception.[255]

In general, all EU countries agree that private use refers to the type of use carried out solely for the individual's personal use[256] or, sometimes, for friends or family, but not for the benefit of the public at large. Non-commercial use, on the other hand, refers to use devoid of economic benefit for the user. [257] Both international treaties and the literal understanding of national statutes seem to indicate that the conditions should be cumulative, i.e. the use should be both 'private' and 'non-commercial' in order for the exception to apply.[258] Where the 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.[259]

It is also important to note that in most jurisdictions, the nature of the private use exception in patent law is a personal privilege or a 'defence', not a 'licence'. For instance, the Unitary Patent Court Agreement (UPCA) Article 26 states that 'persons performing the acts referred to in Article 27(a) to (e) shall not be considered to be parties entitled to exploit the invention within the meaning of paragraph 1'. In other words, under the UPCA (as well as under most EU patent statutes), the private use exception is a personal privilege and, thus, it may not be further licensed. Following this reasoning, it appears that those who knowingly supply to third parties who are benefiting from the private use exception may still be liable for indirect patent infringement, even though the infringing act might ultimately be excused (as private use applies).[260]

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[255] For more info see R. M. Ballardini and N. Lee, "Limitations and Exceptions in European Patent law – Challenges from 3D Printing Technology" in Rosa Ballardini, M. Norrgård & J. Partanen (eds), *3D Printing, Intellectual Property and Innovation – Insights from Law and Technology*, (Kluwer Law Int, (2017).

[256] *Smith, Kline & French Laboratories Ltd v. Evans Medical Ltd* [1989] FSR 513, 518; *McDonald v. Graham* [1994] RPC 407. See also *District Court Alkmaar*, 2 December 1991, BIE1992/12.

[257] For details of difference in interpreting the concept of 'private' and 'non-commercial' in patent law in various EU countries see: WIPO survey, http://www.wipo.int/scp/en/exceptions/replies/netherlands.html

[258] *See* Lionel Bently & Brad Sherman, *Intellectual Property*, 543 2nd ed. (Sweet & Maxwell 2014).

[259] ibid.

[260] For more details on this see R. M. Ballardini and N. Lee (2017).

We now move the discussion to the application of these interpretations of the private and non-commercial use exception to the three scenarios identified below in the context of 3D printing.

Home 3D Printing. Home desktop printing is likely to meet the requirement of 'private', as opposed to 'public', and not necessarily 'secret', use. However, if a printed object is further shared with others, then the question may arise as to whether such sharing was compensated or not (i.e. whether it was done for 'commercial' purposes or not). Additionally, the target of such sharing activity might be a relevant point to consider in regard to whether such an act was done for private purposes (i.e. for the enjoyment of either a private person or their family or friends) or not. Finally, questions may arise concerning a person who engages in 'home printing' and routinely uses it, for instance, as part of their professional activity. Other than these specific cases, however, home 3D printing usually is excused from infringement.

Printing at a 3D Service Bureau or other Public Spaces. This scenario brings some additional complexities. On the one hand, whether the 3D printer is located in a public space or in a commercial establishment should not be of relevance in this discourse, as the condition of 'private' use should relate only to the actual purpose of the activities undertaken with the protected object. Moreover, if a person uses a service to print out the protected object for their own personal enjoyment, the fact that compensation has been paid for the printing service may not be relevant for the purpose of applying the exception. *However, the fact that a service is supplied by a service provider on behalf of a private user would be highly relevant.* This is because the private user is not actually the one engaging in the 'making' or 'using' of the protected object – the service provider is. As previously explained, under the current understanding of the private and non-commercial use exception in Europe, using a third party to engage in conduct permitted under the exception would not be allowed. Considering the justification and objective of the private use exception, which is to allow a private person to engage in activity for their own personal enjoyment where these activities would otherwise be prohibited, it is highly doubtful that the exception would extend to a case when the conduct is performed by a person other than the one who would personally enjoy the result of such conduct.

Another question relates to whether the private use defence can be invoked when commercial or educational services provide the required equipment and materials to enable private users to print out (infringing) objects themselves. These services may be found liable for facilitating infringement and thus for contributory liability.[261] Even though they may try to find 'safeguards' by requiring indemnification clauses in their terms of service or even by ensuring that private users do not use their services to print out protected objects (e.g. by using specific scanning technologies or by including contract clauses), under indirect patent infringement doctrines in Europe those who knowingly supply third parties who are benefiting from the private use exception may still be liable for indirect patent infringement. Thus, such indemnification clauses will only give rise to actions for contractual breach for service providers to seek remedies from private users, but, will not avoid liability.

Sharing of CAD files. This is more complex, yet it is the most important scenario, especially in the context of industrial 3D printing. Indeed, for the purpose of analysing the applicability of the private and non-commercial use exception in the context of sharing digital design files, the relationship between the protected physical object and the related CAD file is highly relevant. As previously mentioned, there are several

[261] Marc Mimler, '3D Printing, the Internet, and Patent Law – A History Repeating?' (2013) 62(6) *La Rivista di Diritto Industriale* 352.

open questions in this regard. For instance, if CAD files were to be considered a digital representation of an invention in the same way as the textual description of a claim, then, at least theoretically, it is possible to argue that commercial CAD-file sharing may be viewed as an act of 'offering' or 'offering for sale' of an invention, thereby leading to an infringement.[262] Moreover, if, after construing the claims, the CAD file could be considered the essence of the claimed invention, then sharing the file (either by uploading it to or downloading it from a platform or by sending it by email) would constitute direct infringement as the user would be 'making' or 'using' the patented invention.[263] In cases where the CAD file is considered part of a patented object then the question would revolve around whether the act of sharing the CAD file would be considered making the claimed invention or 'repairing' the embodiment of the patented invention, which might be allowed under the doctrine of exhaustion.

In cases where the CAD file *per se* is neither the invention nor an 'essential' component of it, but, is instead only the digital representation of the invention or component, then the act of sending the file could potentially give rise to contributory liability. This could apply if it is proved that the person knew (or should have known) that the CAD file (as far as it qualifies for the purpose of 'means' to an 'essential element' of the invention) was suitable and intended for putting that invention into effect (unless the file is considered a staple product, when special rules apply).[264] As previously mentioned, at least under the UPCA, it appears that those who knowingly supply third parties who are benefiting from the private use exception may still be liable for indirect patent infringement.[265] Therefore, in these cases, there seems to be no room for claiming the private use defence under current rules.

3.1.2. Private use Implications for Copyright Law

In accordance with Recital 14 of the InfoSoc Directive 2001,[266] the Directive aims to 'promote learning and culture by protecting works and other subject-matter while permitting exceptions or limitations in the public interest for the purpose of education and teaching'. Accordingly, the Directive 'provides for an exhaustive enumeration of exceptions and limitations to the reproduction right and the right of communication to the public.[267] These exceptions and limitations are set out in Article 5.

Article 5(2)(b) of the 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'.

The reference to 'fair compensation' also known as 'levies' was first introduced in Germany in 1966, replacing the exclusive reproduction right with a right to equitable remuneration.[268] In other jurisdictions, levies were attached to long-standing private use exceptions when modern technological developments made it difficult to deny that

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[262] *See,* e.g. arguing for that interpretation of US patent law, Timothy R. Holbrook and Lucas Osborn, *Digital Patent Infringement In An Era Of 3D Printing*, (2015) 48 U.C. Davis L. Rev. 1319.

[263] ibid. 1355–1370.

[264] See e.g. UPCA, Art. 26.

[265] See UPCA, Art. 27.

[266] 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.

[267] ibid. Recital 32.

[268] World Intellectual Property Organisation, International Survey on Private Copying: Law and Practice (WIPO, 2015), 5.

private copying was affecting the income potential of rights holders.[269] In general, the exception only applies when the source is legal. Downloads from a peer-to-peer network, newsgroups, torrent sites and the like, where music and films have been uploaded without consent from the rights holders, are usually not within the scope of the exception. In the context of 3D printing, the law will now be applied to the three scenarios in assessing the application of exceptions and limitations.

Home 3D printing. If an end user prints a CAD file at home for his/her consumption and does not share it nor disseminate it through online platforms, torrent sites etc., then such an activity will not amount to copyright infringement and will qualify for the private use exception under Article 5(2)(b) of the InfoSoc Directive. However, if an end user directly or indirectly engages in any commercial activity such as sharing a printed object in return for a remuneration or shares the printed product widely through a platform owned by the user, which generates income through advertising, the exception will be defeated.[270]

Printing at a 3D service bureau or at other public spaces. It should be pointed out that the difference between an online platform and a bureau service is that online platforms mainly involve themselves in facilitating the dissemination and sharing of files whereas a bureau service provides 3D printing and delivery services.[271] However, bureau services can also 'double-up' as online platforms in some cases.[272]

In the context of bureau services, once again, if the bureau service or other public places, mentioned above, are engaged in commercial activities then the private use exception cannot apply. This can be further clarified by making a distinction between the 'commissioner' and the 'commissioned' of the act of 3D printing and /or 3D scanning. For example, if a commissioner (an end-user) engages in 3D printing activities in a public place such as a university library, public library or research institution (i.e. 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.[273] Similarly, they could also benefit from the research or private study exception[274] 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.[275]

However, based on the above law, it is also clear that, in certain circumstances, the 'commissioner' will not fall within the private use exception or any of the other exceptions listed above. For example, where a 3D printing start-up or SME (as the 'commissioner') requests a bureau service to 3D print a specific part – in exchange for financial remnuneration – the commissioner will be carrying out a commercial activity

[269] ibid.

[270] Article 5(2)(b) InfoSoc Directive. *Also see,* Jan Bernd Nordemann/Michael Rueberg/Martin Schaefer, 3D-Druck als Herausforderung für die Immaterialguetterrechte', (2015) *Neue Juristische Wochenschrift (NJW),* 1265 at 1266.

[271] Dinusha Mendis and David Secchi, *A Legal and Empirical Study of Online Platforms and an Analysis of User Behaviour* (London: UK Intellectual Property Office; 2015).

[272] Bureau services have expanded over the years from companies such as Stratasys, which were early adopters, to the more recent services as listed above. Stratasys provides a bureau service and provides an online platform – Thingiverse – for facilitating the dissemination and sharing of 3D files. See also https://www.stratasysdirect.com/manufacturing-services/3d-printing/3d-printing-service-bureau-reasons-to-use-one

[273] Jos Dumortier et al., *Legal Review on Industrial Design Protection in Europe*, Annex 3 'Overview of 3D Printing and Intellectual Property Law' (MARKT2014/083/D) (European Commission, 2016). See also, C-435/12 *ACI Adam BV and Others*, ECLI:EU:C: 2014: 254

[274] Article 5(3)(n) InfoSoc Directive 2001.

[275] Article 5(3)(a) InfoSoc Directive 2001.

and will not be able to rely on the above exceptions. As such, it will depend on the nature of the commissioner and nature of the activity.

In terms of 3D printing bureau services, acting as the 'commissioned', whilst they offer their services in terms of 3D scanning and 3D printing objects, they will need to actively exert their control to avoid copyright infringement and liability – as the private use exception will not apply to them. Also, where there is knowledge of such infringing activity taking place either on online platforms or within bureau services, intermediaries will have to take note of them.[276] Such concerns are generally addressed by the bureau services' user agreements at the point of registration/sign-up. A review of such end-user agreements was carried out by Mendis and Secchi in 2015 and concluded that all 3D printing platforms (much like other online platforms offering content) absolve themselves of all liability, thereby passing the liability to the end user. Therefore, in the context of exceptions and limitations, unless an end-user is able to rely on the private use exception, the research or private study exception or the illustration for teaching or scientific research exception as outlined in the InfoSoc Directive, the user can be held liable in such circumstances.[277]

In terms of the bureau service itself, which are mainly commercial entities delivering a service in exchange for financial remuneration, it will mean that these exceptions will not apply to them in any case. Furthermore, much like other commercial entities which pay a licence fee for the privilege of enaging in reproduction of copyright works (libraries, higher education institutions etc.), these bureau services may also be subject to a 'blanket licensing scheme' which would enable them to legally reproduce and 3D print protected objects, in the future. This could be made possible by collective management organisations and their licensing schemes.

Sharing of CAD Files: This is probably the most problematic of the three and yet the most significant in the context of industrial 3D printing. File-sharing in the entertainment sector has given rise to many legal issues and without the proper policy and legislative response, the same could also be true of sharing CAD files. Cases such as *Pirate Bay*[278] revealed the extent of copyright infringement which can arise from file-sharing even if the end-user is not making a commercial gain. Ultimately in the copyright field, the issue has been addressed through notice and takedown (NTD) measures.

In exploring the issues in the 3D printing sector, the section below will make a distinction between 'uploading' and 'downloading' and its significance from a copyright context.

In terms of uploading a CAD file to an online platform, if it is done by the rights holder himself/herself, it will not infringe copyright laws. However, if the CAD file is being uploaded to an online platform by a third party (not the rights holder), then the purpose of the activity has to be questioned. If the intention includes sharing with thousands if not millions of users, it is submitted that such an activity – sharing a protected CAD file on an online platform – without the copyright owner's consent will amount to an act of communication to the public. This right, set out in Article 3 of the

[276] Dinusha Mendis, 'Back to the Future?': From Engravings to 3D Printing – Implications for UK Copyright law in Dinusha Mendis, Mark Lemley and Matthew Rimmer *3D Printing and Beyond: Intellectual Property and Regulation* (Edward Elgar, 2019).

[277] Dinusha Mendis and Davide Secchi, *A Legal and Empirical Study of 3D Printing Online Platforms and an Analysis of User Behaviour* (UK Intellectual Property Office, 2015), pp. 17-20 and 42.

[278] *Dramatico Entertainment Ltd & Ors v British Sky Broadcasting Ltd & Ors* [2012] EWHC 268 (Ch) (20 February 2012). See also, S Larsson, Metaphors, Law and Digital Phenomena: The Swedish Pirate Bay Court Case (2013) 21(4) *International Journal of Law, Information and Technology,* 354.

InfoSoc Directive is explored in detal in Chapter 4 under 'Infringement'. Article 3 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'.

There are two aspects to this discussion. First, there has to be an 'act of communication' and second, the communication should be made to a 'public'.

Recent CJEU case law has clarified that the 'act of communication' can be made in such a way that those who comprise the public can access it, from wherever and whenever they individually choose, irrespective of whether they choose to do it or not.[279] Furthermore, in the context of the 'public' the CJEU has clarified that it refers to an indeterminate number of potential users and implies a fairly large number of people.[280] In that regard the concept of 'public' involves a certain *de minimis* threshold, which excludes from that concept groups of persons concerned which are too small, or insignificant.[281] As such, uploading a CAD file to a small group of friends via a private account or to a password-protected intranet site accessible by a determinate number of people, will not infringe the communication to the public right. Therefore, if the uploading is for private use purposes in accordance with Article 5(2)(b), or for research or private study, the illustration for teaching or scientific research and is carried out in accordance with the conditions set out in Aticle 5(3)(a) and (n) of the InfoSoc Directive, these exceptions can apply in such a scenario.[282]

Where a CAD file is 'downloaded' by an individual, the question is whether it involves reproduction of a protected CAD file – or indeed an infringing CAD file, uploaded without the right holder's consent. In such a scenario, if the downloader is involved in reproducing a CAD file and it is not for their private use, they will be acting contrary to Article 2 of the InfoSoc Directive.[283] Equally, if an already infringing CAD file is downloaded in contravention of copyright laws, the person downloading it will not be able to rely on the private use exception nor on any of the other relevant exceptions discussed above.

However, if the downloading meets the relevant criteria as set out in the InfoSoc Directive, Article 5, for private use or research or private study, then it is possible that the individual will be able to rely on the relevant exceptions. In such a scenario, the platform from which it is being downloaded should also be acting lawfully and should be a lawful organisation (i.e. a library, university etc).[284]

Exceptions are important in an online world to strike a balance between the fundamental rights laid down in the Charter of Fundamental Rights of the European Union in recognising the freedom of expression and the freedom of the arts, and the right to property, including IPR. However, their use should not prejudice the lawful rights of the copyright owner, as discussed above.

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[279] Case C-161/17 *Land Nordrhein-Westfalen v Dirk Renckhoff* ECLI:EU:C:2018:634.

[280] Case C-527/15 *Stichting Brein v Ziggo BV et al* ECLI:EU:C:2017:465; [2017] E.C.D.R. 19, para 25.

[281] Case C-527/15 *Stichting Brein v Ziggo BV et al* ECLI:EU:C:2017:465; [2017] E.C.D.R. 19, para 41.

[282] See also, Jos Dumortier et al., *Legal Review on Industrial Design Protection in Europe*, Annex 3 'Overview of 3D Printing and Intellectual Property Law' (MARKT2014/083/D) (European Commission, 2016).

[283] Article 2, Reproduction Right: 'Member States shall provide for 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: (a) for authors, of their works; …'.

[284] Phil Reeves and Dinusha Mendis, *The Current Status and Impact of 3D Printing within the Industrial Sector: An Analysis of Six Case Studies* (UK Intellectual Property Office 2015).

3.1.3. Private Use Implications for Design Law

Generally, Articles 20 of the Design Regulation and 13 of the Design Directive provide that the design right cannot be exercised against certain uses. Within the scope of 3D printing the focus will be on the limitation of private and non-commercial use within the meaning of Articles 20(1)(a) of the Design Regulation and 13(1)(a) of the Design Directive and how they apply to the described infringing acts of Home 3D printing, printing at a 3D Service Bureau or other Public Spaces and Sharing.

For the exception of private and non-commercial use to apply the allegedly infringing act must be done privately and it must be done for non-commercial purposes.[285] In respect to private use, it has been suggested that 'the exception likely only applies to private individuals in their personal, non-commercial capacities, doing acts privately'[286] and that only private persons can rely on this provision.[287] The non-commercial requirement rules out all acts by corporations and other commercial entities and also all acts done privately but for commercial reasons.[288]

Home 3D printing: Generally, Home 3D Printing will fall into the private and non-commercial use exception within the meaning of Articles 20(1)(a) of the Design Regulation and 13(1)(a) of the Design Directive as home 3D printing will be carried out by private individuals in their personal, non-commercial capacities. Hence, an anticipated rise in home 3D printing extending to millions of homes would virtually leave the protection by design law circumvented if the private and non-commercial use exception would be left unchanged.[289] Or as *Stone* puts it: 'A plastic toy which would otherwise infringe will escape if it is only ever used privately and for non-commercial purposes'.[290]

Historically, the reason for including this limitation in EU design law was that private non-commercial uses were not perceived as posing much of a threat to the design monopoly.[291] As this might not be the case for the future with consumer 3D printing and the resulting ubiquitous possibility to 'consume' designs it has been suggested that the limitation in question would potentially fail the three-step-test as provided by Article 26 of the TRIPS agreement.[292]

Consequently, it has been suggested to restrict the limitation in question to only cover 'acts which do not unduly prejudice the normal exploitation of the design, or something aligned to the three step test under the TRIPS agreement'.[293] In spite of some guidance from the WTO Dispute Settlement Body this notion would lead to much confusion in interpretation and diminish legal certainty. Therefore, it is not recommended to change the statutes in question.

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[285] David Stone, *European Union Design Law – A Practitioners' Guide*, (2nd ed), (OUP, 2016), para 20.60.

[286] David Stone, *European Union Design Law – A Practitioners' Guide*, (2nd ed), (OUP, 2016), para 20.61.

[287] Mario Franzosi, Marc-Roger Hirsch, Willem A. Hoyng et al., *European Design Protection – Commentary to Directive and Regulation Proposals*, (Wolters Kluwer, 1996), p.143.

[288] David Stone, *European Union Design Law – A Practitioners' Guide*, (2nd ed), (OUP, 2016), para 20.61–20.62.

[289] See also *Legal review on industrial design protection in Europe (MARKT2014/083/D)* (15 April 2016), p. 129.

[290] David Stone, *European Union Design Law – A Practitioners' Guide*, (2nd ed), (OUP, 2016), para 20.61–20.61.

[291] Lionel Bently, Brad Sherman, Dev Gangjee and Philipp Johnson, *Intellectual Property Law*, (5th ed), (OUP, 2018), p. 797.

[292] *Legal review on industrial design protection in Europe (MARKT2014/083/D)* (15 April 2016), p. 132.

[293] *Legal review on industrial design protection in Europe (MARKT2014/083/D)* (15 April 2016), p. 132.

In line with the reasoning of the settled CJEU case law[294] on 'private use' in copyright it is suggested to differentiate between lawful and unlawful sources.[295] The reason for this is that such `use´ 'made from an unlawful source would encourage the circulation of counterfeited or pirated works, thus inevitably reducing the volume of sales or of other lawful transactions relating to the protected works, with the result that a normal exploitation of those works would be adversely affected'.[296] This reasoning in respect to copyright is similar to the possible impact from 3D printing on designs in that it also requires an enhanced protection through fighting counterfeiting in order to strengthen the exploitation of the protected good.

The approach above would certainly narrow the otherwise very broad limitation in European Design Law leading to the legality of mass copying of designs by consumers. However, another approach to reduce the scope of legal mass copying would be to provide legal protection against the circumvention of technological measures preventing certain uses not authorised by the rightholder as also provided for in European Copyright Law.[297] This would give rightholders the possibility to protect the construction of CAD files in a way that would automatically limit e.g. the number of times a design is printed from a single CAD file. Evidently, such protection would also have to be subject to restrictions in order to guarantee the beneficiary of (private and commercial use) limitations the benefit of such limitation.[298]

After all, however, the courts would have to define more specifically what falls under the limitation of 'private and commercial use'. Taken into consideration that one of the main goals of European Design Law is to promote 'the contribution of individual designers to the sum of Community excellence in the field [and encourage] innovation and development of new products and investment in their production'[299] it would be reasonable to narrow the scope of the limitation by the means of a teleological interpretation. Similarly, national jurisdictions limited the 'private use' exception for the respective copyright regime.[300] This approach would also prevent the limitation to infringe the three step test under the TRIPS agreement (see above).

Printing at a 3D Service Bureau or other Public Spaces: It appears to be problematic whether printing in a 3D service bureau or other public spaces can be done privately and/or for a 'non-commercial' use.

Grosskopf suggests that in regard to 3D printing in a Service Bureau both the commissioner and the commissioned shop are acting within the private use limitation. He argues that if only the owners of 3D printers would fall within this limitation, they

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[294] See e.g. Case C-435/12 ACI Adam BV and Others v Stichting de Thuiskopie, Stichting Onderhandelingen Thuiskopie vergoeding (CJEU, 10 April 2014).

[295] See also Ana Nordberg and Jens Schovsbo, in Rosa M. Ballardini, Marcus Norrgård and Jouni Partanen (eds), *3D Printing, Intellectual Property and Innovation – Insights from Law and Technology* (Wolters Kluwer, 2017), para. 13.03[C][1].

[296] Case C-435/12 ACI Adam BV and Others v Stichting de Thuiskopie, Stichting Onderhandelingen Thuiskopie vergoeding (CJEU, 10 April 2014), recital 39.

[297] Art. 6 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.

[298] Art. 6 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.

[299] Recital 7 of the Design Regulation.

[300] E.g. the German jurisdiction acknowledges a case-to-case analysis when determining the limitation of the 'private use' exception in copyright law but recognises a limitation of seven copies as a guideline (*see* Case I ZR 111/76 *Vervielfältigungsstücke* (Bundesgerichtshof, 14 April 1978).

would be unfairly privileged in contrast to others who have to rely on third parties printing for them.[301]

Mengden differentiates between commissioner and commissioned. He is of the opinion that the commissioner is acting within the limitation whilst the commissioned is not.[302]

Wiedemann and *Engbrink* argue that the commissioner may not be acting within the limitation if explicitly commissioning for commercial purposes (i.e. resale).[303] Moreover, in line with *Malaquias* they submit that the commissioned is not liable as long as 'precautions' are taken in regard to the unlawfulness of the commission.[304]

Nordberg and *Schovsbo* are of the opinion that the commissioned is not acting within the limitations and see no room for the preclusion of liability according to the Enforcement directive.[305,306]

It is submitted that both commissioning and being commissioned with 3D printing in a 3D printing Service Bureau does not fall within the limitation of private and non-commercial use. The first reason for this is that the commissioned is not acting privately as a shop cannot be regarded as a natural person. Moreover, the commissioner is not acting non-commercially. As stated above, the requirement of non-commercial rules out the private acts done commercially. Regardless of the purpose, paying for a manufacturing process must be seen as a commercial action although an individual might commission it.

However, in the light of the controversial discussion and the missing precedence in this respect a clarification in this this area is strongly recommended.

Sharing of CAD Files: The answer to whether the act of a sharing a CAD file falls within the private use limitation is twofold. In regard to the case where a person non-commercially and privately shares the CAD file with family or friends the private use exception of the EU Design law framework will apply.

However, the answer is different to the case where one person uploads a CAD file to a publicly accessible website and another person from that public downloads the design. In regard to uploading the CAD file it has to be considered that the design contained in the CAD file might be uploaded by a private person for non-commercial reasons. However, it cannot be argued that the person sharing the design is doing this in his or her strict personal capacity when an unlimited number of users might have access to the design contained in the CAD file. Therefore, it is submitted that an uploader is not

301 Lambert Grosskopf, 3D-Druck Personal Manufacturing [2012] 28(9) Computer und Recht 620.

302 Martin Mengden, 3D-Druck – Droht eine „Urheberrechtskrise 2.0"? Schutzumfang und drohende Rechtsverletzungen auf dem Prüfstand [2014] 17(2) MultiMedia und Recht 82.

303 Markus Wiedemann and Dennis Engbrink, Rechtliche Auswirkungen des 3D-Drucks auf Immaterialgüterrechte und gewerbliche Schutzrechte [2017] Zeitschrift zum Innovations- und Technikrecht 78.

304 Pedro Malaquias, Consumer 3d Printing: Is the UK Copyright and Design Law Framework Fit for Purpose? [2016] 6(3) Queen Mary Journal of Intellectual Property para. III.B.3.

305 Art. 9 (a) and 11 of Directive 2004/48/EC of the European Parliament and of the Council of 29 April 2004 on the enforcement of intellectual property rights.

306 Ana Nordberg and Jens Schovsbo, in Rosa M. Ballardini, Marcus Norrgård and Jouni Partanen (eds), *3D Printing, Intellectual Property and Innovation – Insights from Law and Technology* (Wolters Kluwer, 2017), para. 13.03[3].

acting privately when uploading the design to a publicly accessible website and hence this act does not fall within the private use limitation.[307]

Another difficult question is whether a person downloading 'non-commercially' is acting privately. It has to be taken into account that in contrast to the uploader, the downloader only saves the design on his/her hard drive and the action does not result in third person's accessing it. As already explained above, it is suggested that lawful and unlawful sources will have to be treated differently with regards to the 'private and non-commercial use' limitation.

The 'Component Parts of Complex Products Exception' and 3D Printing: A 'component part of a complex product' cannot gain protection under European Union Design Law if it is not visible ('under the bonnet exclusion')[308] or – in case of the Community Design – the right is not enforceable if the spare part is used to repair in order to restore the original appearance of the complex product.[309] The intention behind the 'under the bonnet' exclusion is to 'subvert what could otherwise be a monopoly for invisible spare parts'.[310] The 'repair clause' 'prevents the original (car) manufacturer from inflating the price of spare parts, because it allows competition from third parties'.[311]

Basically, the result and aim of this *liberalisation* of the protection of spare parts should be that the independent distribution sector of spare parts will put on a normally cheaper and larger spectrum of parts on offer. It is expected that this will lead to 'a greater variety of makes of parts, giving (…) the final consumer a greater choice and basically a lower price for must-match parts'.[312]

The question is, however, if the aims of liberalising the spare part market would be reached in a market dominated by consumer 3D printing. In theory, instead of relying on factory made large scale component parts the consumers would be able to obtain individualised spare parts that they print themselves. Whether the historic economic justification for a liberalised spare part market would still be applicable is doubtful.

First, the advantage of liberalisation is based on an economy-of-scale production method. The idea is to open the market to other competitors in order to give them the opportunity to produce the spare part cheaper and therefore make the consumer profit from this cheaper production method. However, this cost benefit cannot be assumed for the design market dominated by 3D printing. Here, users would just download the CAD file containing the spare part and print it. This production method does not include any economy-of-scale production and, hence, no efficient production method and as a result no cheaper product. Therefore, one of the reasons for spare parts becoming cheaper through the means of liberalisation would not be valid any longer.

Moreover, it is argued that the *liberalisation* is justified in that traditionally there is no innovation to be made in manufacturing spare parts. It has been suggested that 'the argument that the expectation of gains to be made [with spare parts through] legal

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[307] Similar for the UK perspective Dinusha Mendis and Phil Reeves, *The Current Status and Impact of 3D Printing Within the Industrial Sector: An Analysis of Six Case* Studies, (Intellectual Property Office, 2015), p. 9.

[308] Article 3 (3) and (4) of the Design Directive and Article 4 (2) and (3) of the Design Regulation.

[309] Article 110(1) of the Design Regulation.

[310] David Stone, *European Union Design Law – A Practitioners' Guide*, (2*nd* ed), (OUP, 2016), para 4.120.

[311] David Stone, *European Union Design Law – A Practitioners' Guide*, (2*nd* ed), (OUP, 2016), para 20.40.

[312] *Commission Staff Working Document – Extended Impact Assessment of the Proposal for a Directive of the European Parliament and the Council Amending Directive 98/71/EC on the Legal Protection of Designs, COM (2004) 582*, (14 September 2004), p. 24.

protection of industrial designs constitutes an incentive for design innovation lacks all plausibility, as the original manufacturer, like any third party, must necessarily reproduce the same part in order to restore the original appearance';[313] it is arguable whether this suggestion can even be proven right in the present market.[314] However, this argument would clearly not be valid in the future market dominated by 3D printing. As already mentioned above, the 3D printing technique allows not only for the production of objects that cannot be produced with the traditional production method (e.g. with the help of AI). Moreover, it is simpler and cheaper to create new designs as no moulds have to be made or machines have to be purchased. Therefore, there will be a possibility for incentivising innovation in spare parts as well. As a result, another justification for liberalisation spare parts will not be valid in the future.

Additionally, a liberalisation of the protection of spare parts does not take into account the 'detachment' of design and manufacturing in this theoretical future distribution. As explained above, the design and the actual manufacturing of the product would be two separate markets. Hence, manufacturers would no longer be able to regain the investment made for creating the product by having the sole possibility to physically manufacturing it.[315] Therefore, the lack of protection of spare parts not only endangers the innovation for spare parts as such but also the innovation of the complex product as a whole.

In conclusion, it remains to be seen whether the avoidance of monopolies with regard to the original design of a spare part justifies liberalising the protection of spare parts in the future. As already explained above, the avoidance of monopolisation, ideally allows competition from third parties which in turn should restrict the inflation of the price of spare parts, and allow for a greater variety of parts.[316] Considering the new technical possibilities provided for by 3D printing a liberalisation of protection could potentially hamper the creation of newly designed spare parts and hence lead to constraining the diversity. It is therefore recommended to (economically) analyse the impact of the given liberalisation in the light of a future with 3D printing.

Notwithstanding the above, another justification would be that consumers apparently would feel they have the right to repair their property once they have bought it.[317]

The consumer or professional 3D printing of (uncertified) spare parts may, however, be hindered by safety regulations and/or insurance policies exclusions thereby contributing to 'lock in effects', as *Nordberg* and *Schovsbo* point out.[318] This potential effect, however, remains subject to safety regulations as well as insurance and competition law.

The 'Designs Dictated by their Technical Function' Exception: A feature of appearance of a product that is solely dictated by its technical function is according to

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[313] Josef Drexl, Reto M Hilty and Annette Kur, Design Protection for Spare Parts and the Commission's Proposal for a Repairs Clause [2005] 36(4) *International Review of Intellectual Property and Competition Law* 448.

[314] *Legal review on industrial design protection in Europe (MARKT2014/083/D)* (15 April 2016), p. 141.

[315] Josef Drexl, Reto M Hilty and Annette Kur, Design Protection for Spare Parts and the Commission's Proposal for a Repairs Clause [2005] 36(4) *International Review of Intellectual Property and Competition Law* 455.

[316] David Stone, *European Union Design Law – A Practitioners' Guide*, (2nd ed), (OUP, 2016), para 20.40.

[317] *Economic Review of Industrial Design in Europe* (MARKT2013/064/D2/ST/OP) (Europe Economics; 2015), p. 159.

[318] Ana Nordberg and Jens Schovsbo, in Rosa M. Ballardini, Marcus Norrgård and Jouni Partanen (eds), *3D Printing, Intellectual Property and Innovation – Insights from Law and Technology* (Wolters Kluwer, 2017), chapter 13, para. 13.4.

Articles 7(1) of the Design Directive and 8(1) of the Design Regulation not eligible for protection.

Nordemann, Rüberg and *Schaefer* point out that the CAD file contains control instructions in regard to how the 3D printer will print the design contained in the CAD file. The existence of the control instructions in the CAD file could according to these authors lead to the design being 'dictated by its technical function'.[319]

It is submitted, however, that the design contained in a CAD file is not 'dictated' by the control instructions of the CAD file. Especially, the CAD file is not the only factor determining the choice by the designer of a feature of appearance of the design contained in the CAD file.[320] Rather, the CAD file has to be regarded as a mere 'conduit' of the design and the file has no influence on the assessment of the design contained.

3.1.4. Private Use Implications for Trade Mark Law

For trade marks, an infringement requires the use 'in the course of trade' by the alleged infringer.[321] Generally speaking, a trade mark is used in the course of trade, if it is used in the context of the commercial activity with the view to economic advantage and not as a private matter. For example, selling football merchandise would be 'in the course of trade', if it is made for an economic advantage.[322] Also, selling on internet auction platforms is only relevant if is not for mere private reasons only. Auction platforms like eBay may also be used for mere private selling activity, e.g. to sell private property. A case-by-case analysis is usually necessary to determine, if the sales made according to their volume, their frequency or other characteristics can be assessed as not private, but in the course of trade.[323] The sale of property from the private household is in principle not 'in the course of trade', although it may be offered to a high number of potential buyers through the internet platform.[324]

Home 3D printing: If users create a CAD file and print it at home (or in private) for themselves for non-commercial purposes, a trade mark infringement will have to be ruled out.

Printing at a 3D service bureau or at other public spaces: It is a more complex question if users privately create a CAD file and print it for themselves for non-commercial purposes, but through 3D printing service bureaux or other public spaces, which act in the course of trade. The role of the service provider will be relevant here. If the service provider performs the printing under the instruction of the private owner of the CAD file, the scenario seems comparable to the change of a trade marked product by a commercial undertaking instructed by the private owner of the product. For such a scenario, the German Federal Supreme Court (BGH) had ruled before the

319 Jan B. Nordemann, Michael Rüberg and Martin Schaefer, 3D-Druck als Herausforderung für die Immaterialgüterrechte [2015] 68(18) *Neue Juristische Wochenschau* 1267.

320 Case C 365/16 *Doceram GmbH v CeraTec Gmbh* (8 March 2011) para. 26.

321 Art. 10 (2) EUTMR; Art. 9 (2) TM Directive.

322 CJEU of 12.11.2002, C- 206/01 paras. 39 et seq. – *Arsenal Fooball Club*; Ewa Skrzydlo-Tefelska/Mateusz Zuk in *Hasselblatt, Community Trade Mark Regulation*, (Munich, C.H. Beck/Hart Publishing/Nomos; 2015), Art. 9 CTMR note 41.

323 CJEU of 12.07.2011, C- 324/09 para. 55 – *L'Oréal/eBay*; Ewa Skrzydlo-Tefelska/Mateusz Zuk in *Hasselblatt, Community Trade Mark Regulation*, (Munich, C.H. Beck/Hart Publishing/Nomos; 2015), Art. 9 CTMR note 42.

324 German Federal Supreme Court (BGH) (2015), *Gewerblicher Rechtsschutz und Urheberrecht (GRUR)*, 577 para 25 – *Kinderhochstuehle im Internet III*.

TM Directive came into effect that the change (in the case: addition of diamonds to a Rolex watch) would not be in the course of trade, because it was under the instruction of a private customer.[325] Today, German legal commentators point out that this case law may not be in line any more with Art. 9 EUTMR and Art. 10 TM Directive. Such 'tuners' of trade marked product would act in the course of trade and thus relevant under EU trade mark law.[326] As a general rule, however, this does not seem entirely convincing, because commercial use may be ruled out if the act of using the trade mark is initiated and controlled by the (private) customer and not by service provider. The analysis if the trade mark use is commercial, should depend on a case-by-case assessment.

Sharing of CAD Files: Uses in the private sphere when offering the CAD file or when offering a 3D printed object are generally permitted under trade mark law. This could become a serious problem for IP rights holders, in case CAD files will be disseminated privately on the internet. It is a question of a case-by-case analysis if internet activity is private or for commercial purposes, as shown above for the offering on auction sites like eBay. The use in file sharing networks (such as Bittorrent) appears at first glance to be private, because the people sharing share on a non-remuneration basis. That said, it is possible that sharing under certain circumstances can be considered commercial, e.g. when the sharing within a file sharing network is for the purpose of advertising a commercial activity offered elsewhere.[327] The same could be true if any remuneration is for purposes of receiving the CAD file.

Nevertheless, a vast part of file sharing activity will remain outside the reach of trade mark law. Under trade mark law, it is – in contrast to e.g. copyright law – not sufficient for a commercial use that the use takes place in the open public. In order to be a relevant trade mark use, it needs to be a public use for commercial purposes.

It needs to be seen in the future if such allowed private activity produces protection gaps from the perspective of IP owners which need to be closed in order to provide for a sufficient IP protection against unauthorised CAD files or 3D prints. This may be the case, if private sharing and printing of consumer goods increases and if such activities begin to compete with original products of the trade mark owner. This may bring up a scenario where the trade mark owner is no longer able to use its trade mark to identify the origin associated with him, because too many privately made products circulate. In such scenarios, it seems justified to think about revising trade mark law to make it possible again for the trade mark owner to control the origin of products bearing his trade mark.

3.2. Principle of Exhaustion and Implications for 3D Printing

3D printing allows unprecedented possibilities for re-using, re-making and recycling (including for protected items) by enabling possibilities to produce on demand and by demand (i.e. customisation and servitisation of manufacturing). This holds enormous advantages not only for end users, but also for commercial entities operating, for example, in the spare parts business. In this regard, an important principle in IP law is

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[325] BGH (German Federal Supreme Court) (1998) *Gewerblicher Rechtsschutz und Urheberrecht (GRUR)* 696 – *Rolex-Uhr mit Diamanten.*

[326] Reinhard Ingerl/Christian Rohnke, *Markenrecht (German Trade Mark Law)*, 11th edition (Munich; C.H. Beck; 2010), § 14 MarkenG note 87; Karl-Heinz Fezer, *Markenrecht (German Trade Mark Law)*, 4th edition (Munich; C.H. Beck; 2009), § 14 MarkenG note 35.

[327] Dukki Hong and Simon Bradshaw, *"Digital trade mark infringement and 3D printing implications: What does the future hold?"* in Dinusha Mendis, Mark Lemley & Matthew Rimmer (eds.) (Cheltenham and Northampton; Edward Elgar; 2019), Chapter 4 at 4.1.

the principle of exhaustion, which exists in all EU countries, although in different forms (such as through statutory provisions or case law interpretations).

The following sections contextualise the implications of the doctrine of exhaustion in relation to the 3D printing process, in order to shed light on the areas where current IP rules in Europe are creating obstacles as for enabling re-use, re-make or even re-cycling of protected items.

3.2.1. Exhaustion and Implications for Patent law

In patent law, 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 right holder's consent.

In Europe, the patent exhaustion doctrine originated from the European Court of Justice (CJEU) ruling in *Centrafarm v Sterling Drug,*[328] which spelt out two key elements required for the exhaustion of patent rights to take place: (1) the placing of the patented product on the market in the European Economic Area (*EEA*), (2) by or with the consent of the patent holder. Putting the product on the market means that the patent holder transfers the right to dispose of the goods embodying the patented invention to a third party, allowing the patent holder to realise the economic value of the patent right. 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 the sold product. Consequently, purchasers of the sold product may use, resell and import the product in the (EEA) territories where the exhaustion principle applies without additional consent from the patentee.[329] The exhaustion principle in patent law also covers the loan and *ordinary repair* of the product. 'Ordinary repair' of a product sold is allowed only insofar as such repair does not equate to 'making' the invention. The distinction between 'making' versus 'repairing' in European patent law, however, is not straightforward as under current rules 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. 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 are not considered to have a monopoly on the right to repair their patented products.[330] On the other, however, some courts have specifically stated that there is no such right as the right to repair. Some courts have also affirmed that the question of whether an act constitutes 'repairing' or 'making' a patented invention is a matter of 'fact and degree'.[331] This is notwithstanding, however, the factors that are usually taken into consideration by European courts when deciding on issues of 'making' as opposed to 'repairing' patented products, which are:

[328] Centrafarm v Sterling Drug, Inc. (C-15/74) 1974 2 C.M.L.R. 480.

[329] Rosa Ballardini, Flores-Ituarte I & Eujin Pei "Spare Parts and Additive Manufacturing: Challenges Between Patent Law and Digital Business" 29(6) (2018) Journal of Manufacturing Technology Management.

[330] See, for instance, United Wire Ltd v Screen Repair Services (Scotland) Ltd [2001] F.S.R. 24 HL, Schütz (UK) Ltd v Werit (UK) Ltd (Rev 1) [2013] UKSC 16 (13 March 2013), BGH 14.07.1970, GRUR 1971, 78, 80 Diarähmchen V, BGH 17.07.2012, docket no. X ZR 97/11 Palettenbehälter II, available in German at: http://juris.bundesgerichtshof.de/cgi-bin/rechtsprechung/document.py?Gericht=bgh&Art=en&sid=3c6d49f845dcefd695bb195c4e4722bb&nr=61447&pos=0&anz=1. See the English translation in IIC, Pallet Container II (Palettenbehälter II) (2013) 44 at 351–360, 351, DOI 10.1007/s40319-013-0044-3.

[331] See, for instance the UK decision in the Schütz v Werit case.

1) Whether and to what extent the technical effects of the invention are embodied by the component replaced;

2) The *need* for repair of the product (estimated with respect to the working life of the device);

3) The *extent of the repair* compared with the manufacturing process of the original product;

4) The extent to which the repaired part competes with the original parts.

All of these factors must be considered while also balancing the interests of all parties involved, including patent holders, users and third parties.

In the context of 3D printing these issues are very important especially with regard to spare parts. Indeed, the possibilities that this technology enables especially for the production of spare parts is likely to throw much attention to this doctrine, pushing the legislator and the courts to further and more clearly clarify the limits between permissible repair and impermissible reconstruction. 3D printing, in fact, further complicates the already uncertain interpretation of the exhaustion doctrine in patent law, because CAD files allow data to be easily modified, making it more difficult to determine how much modification is allowed before it could be considered patent infringement, and thus further blurring the line between making and repairing.

3.2.2. Exhaustion and Implications for Copyright Law

Once a copy of work is placed on the market, the right holder’s control over further distribution of that copy is exhausted. This is made clear in Article 4(2) of the InfoSoc Directive. Traditionally, ‘the distribution right was limited to hard copies’,[332] however, in the ever-developing digital world, copyright works are easily accessible and downloadable.

The InfoSoc Directive Art 4(2) states that ‘the distribution right shall not be exhausted within the Community in respect of the original or copies of the work, except where the first sale or other transfer of ownership in the community of that object is made by the rights holder or with his consent’.[333] This is a significant legal doctrine as it strikes a balance between the IP right to a particular work ‘as opposed to the material property right to a copy of that work’.[334] It demonstrates that the law rewards the copyright holder by granting the distribution right but this is limited to the first sale of that copy of the work. Therefore, the rights holder enjoys the financial rewards of his work whilst ensuring the free movement of the protected work.

In relation to the exhaustion of software which is particularly relevant to the present discussion, Article 4(2) of the Infosoc Directive does not specifically mention whether this legal doctrine should be applied to tangible or digital copies. However, recital 28 of the Directive indicates that ‘protection under this directive includes the exclusive right to control distribution of the work incorporated in a tangible article’.[335] This suggests that a CAD file, created using software which is purchased and downloaded

[332] Aaron Perzanowski and Jason Schultz, The End of Ownership: Personal Property in the Digital Economy (Cambridge, MA: MIT; 2016).
[333] Information Society Directive 2001/29/EC Art 4(2).
[334] Mette Lindskoug, ‘The legal position of Sellers and Buyers of Used Licenses’ (2014) 36(5) *European Intellectual Property Review*, 293.
[335] Infosoc Directive Recital 28.

online, does not exhaust the distribution right of the rights holder as it is limited to tangible copies.

Article 4(2) of the Software Directive states that 'the first sale in the community of a copy of a program by the right holder shall exhaust the distribution right within the community of that copy'.[336] This issue was addressed in the case of *UsedSoft GmbH v Oracle International Corp.*[337] Accordingly, by removing the distinction between tangible and digital copies for purposes of exhaustion, the case was hailed for striking 'an appropriate balance between the interest of software copyright holders in extracting maximum financial profit and the public interest in ensuring the free circulation of software products'.[338]

The implications for 3D printing, from the perspective of the *UsedSoft* case is that even intangible copies which are downloaded (i.e. CAD files) will exhaust the right to distribution. This does mean that if CAD files are defined as 'computer programs' as discussed in Chapter 2, then the *UsedSoft* ruling will apply to CAD files and CAD file distributors. Moreover it also means that if CAD files are sold by a professional distribution network, through the execution of a perpetual license agreement, this decision will make it possible for consumers to resell their bought CAD files to others.

3.2.3. Exhaustion and Implications for Trade Mark Law

In trade mark law, Art. 15 EUTMR and Art. 15 TM Directive regulate the exhaustion of trade mark rights. An EU trade mark shall not entitle the proprietor to prohibit its use in relation to goods which have been put on the market in the European Economic Area under that trade mark by the proprietor or with his consent. This rule of exhaustion will apply to 3D print-outs which have been made with the consent of the trade mark owner.

Art. 15 (2) EUTMR and Art. 15 (2) TM Directive rule out exhaustion 'where there exist legitimate reasons for the proprietor to oppose further commercialisation of the goods, especially where the condition of the goods is changed or impaired after they have been put on the market'. Generally speaking, for 3D printed products, no specific issues arise.

This is, in particular true for spare parts produced via 3D printing to repair trade marked products. Rather it is a question for Art. 15 (2) EUTMR and Art. 15 (2) TM Directive, if there is a justified interest in case of a trade mark use concerning the spare parts. It is also clear after the CJEU decision *Ford/Wheeltrims* that the repair privilege of Art. 14 Design Directive 98/71/EC and Art. 110 Design Regulation 6/2002 does not apply to the question of trade mark infringement.[339] Also, the removal of trade marks for the printed product – usually done when creating the CAD file – will be a question to be solved pursuant Art. 15 (2) EUTMR and Art. 15 (2) TM Directive, bearing in mind the case law of the CJEU.[340]

[336] Software Directive 2009/24/EC Article 4(2).

[337] Case C-128/11 *UsedSoft GmbH v Oracle International Corp* [2012] ECDR 19.

[338] Yin Harn Lee, 'UsedSoft GmbH v Oracle International Corp (Case c-128/11) – Sales of "Used" Software and the principle of Exhaustion' (2012) 43(7) *International Review of Intellectual Property and Competition Law,* 846.

[339] CJEU of 06.10.2015, C-500/14 – *Ford/Wheeltrim*.

[340] Dukki Hong and Simon Bradshaw, *"Digital trade mark infringement and 3D printing implications: What does the future hold?"* in Dinusha Mendis, Mark Lemley & Matthew Rimmer, (eds.) (Cheltenham and Northampton; Edward Elgar; 2019), Chapter 4 at 3.3, referring to CJEU of 26 April 2007, C- 348/04 paras 43-44 - *Boehringer Ingelheim KG/Swingward Ltd*.

The rule of exhaustion will, however, not apply to the selling of the CAD file, even if the download was authorised by the trade mark owner. An exhaustion in the trade of files distributed online should not be recognised. Also in copyright law, the exhaustion doctrine does not relate to online distribution.[341] Against this background, it does not seem relevant to ask the question, if the modification of a product when creating the CAD file runs contrary to a justified interest of the trade mark owner pursuant Art. 15 (2) EUTMR and Art. 15 (2) TM Directive.[342] The rule of exhaustion will not apply to creating the CAD file anyway.

[341] See 3.2.2. Implications for Copyright Law.

[342] The question has been answered in a way that justified interests may not be invoked by the trade mark owner, as the CAD file has to be differentiated from the printed end-product: Dukki Hong and Simon Bradshaw, *"Digital trade mark infringement and 3D printing implications: What does the future hold?"* in Dinusha Mendis, Mark Lemley & Matthew Rimmer (eds.) (Cheltenham and Northampton; Edward Elgar; 2019), Chapter 4 at 3.3.

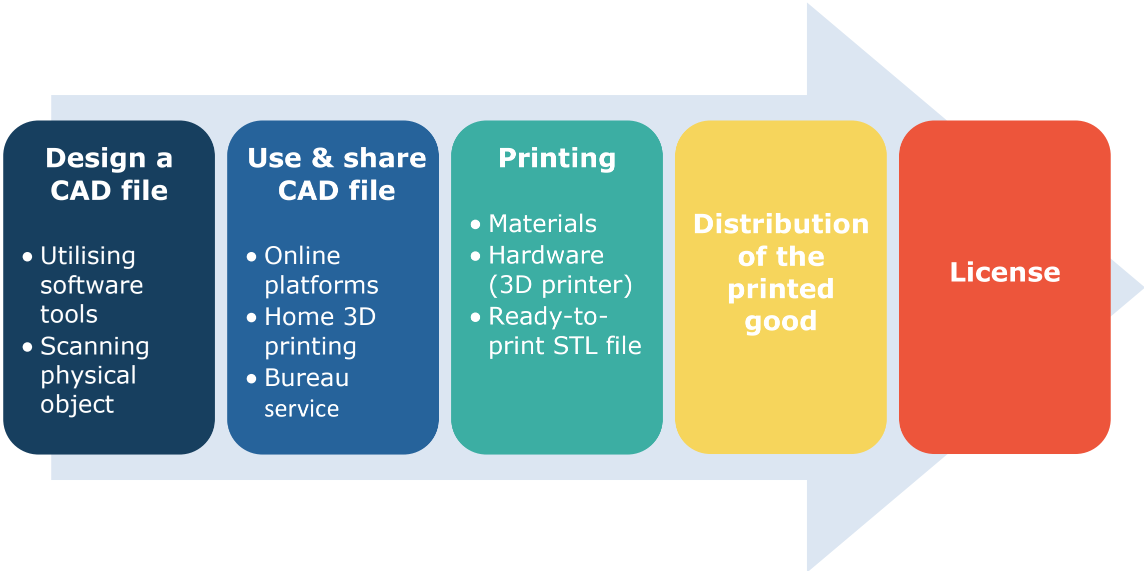
3.3. Summary of 3D Printing and Application of Exceptions and Limitations: At-A-Glance Table

PATENT LAW		
HOME 3D PRINTING	**PRINTING AT BUREAU OR OTHER PUBLIC PLACE**	**SHARING OF CAD FILES**
Home desktop printing is likely to meet the requirement of 'private', as opposed to 'public', and not necessarily 'secret', use. However, different interpretations could arise in specific cases, such as if a printed object is further shared with others, if the target of the sharing activity might be a relevant point to consider in regard to whether such an act was done for private purposes or not, or if a person engages in 'home printing' and routinely uses it, for instance, as part of his/her professional activity.	Whether the 3D printer is located in a public space or in a commercial establishment should not be of relevance, as the condition of 'private' use should relate only to the actual purpose of the activities undertaken with the protected object. Neither is the fact that compensation has been paid for the printing service. However, the fact that a service is supplied by a service provider on behalf of a private user would be highly relevant. In this case the private user is not actually the one engaging in the 'making' or 'using' of the protected object – the service provider is. Under the current understanding of the private and non-commercial use exception in Europe, using a third party to engage in conduct permitted under the exception would not be allowed. Thus, it is highly doubtful that the exception would extend to a case when the conduct is performed by a person other than the one who would personally enjoy the result of such conduct.	Whether and to what extent the private use exception can apply in the case of sharing of CAD file largely depends on the relationship with the CAD files and the patented objects that they represent, something that is unclear under current rules. Different interpretation of this relationship might lead to different outcomes in the application of the private use exception, as explained above.
COPYRIGHT LAW		
HOME 3D PRINTING	**PRINTING AT BUREAU OR OTHER PUBLIC PLACE**	**SHARING OF CAD FILES**
If an end user prints a CAD file at home and does not share it nor disseminate it through online platforms or torrent sites, then such an activity will qualify for the private use exception under Article 5(2)(b) of the InfoSoc Directive. However, if an end user	A person who commissions a bureau service to 3D print or scan an object in exchange for financial payment, will not benefit from the private use exception. A person who utilises a public library, research institution etc, may rely on the private use exception if the activity they engage in, is for a non-	An uploader who makes CAD files available to an indeterminate number of public users, will infringe 'communication to the public' right. On the other hand, the private use

directly or indirectly engages in any commercial activity such as printing a 3D model for dissemination and remuneration or shares the printed product on a platform owned by the user, which generates income through advertising, the exception will be defeated.	commercial purpose and is based on a lawful source. Bureau services as commercial entities will not benefit from the private use exception or other exceptions. Bureau services could be subject to a 'blanket licensing scheme' which would enable them to legally reproduce and 3D print IP-protected objects, in the future. This could be made possible by collective management organisations and their licensing shcemes.	exception will appy to those who upload CAD files to a small group of friends via a private account or to a password-protected intranet website (*de minimis* principle). Downloading a CAD file from an unlawful source and for reproduction infringes copyright. Downloading from a lawful use for private use or research or private study will not.
DESIGN LAW		
HOME 3D PRINTING	**PRINTING AT BUREAU OR OTHER PUBLIC PLACE**	**SHARING OF CAD FILES**
Home 3D Printing falls within the private use exception of the EU design law framework. It is suggested that 'private' downloading of the design contained in a CAD file from an knowingly unlawful source has to fall out of this exception. Moreover, it is suggested to provide protection against the circumvention of technical measures preventing certain uses of the CAD file. It is suggested that a teleological interpretation narrowing down the private use limitation would be favourable.	Printing at a bureau or other public space cannot be cannot be considered private use. Due to the controversial academic discussion in this regard and the missing precedence in this respect, a clarification in this this area is strongly recommended.	With regard to the case where a person non-commercially and privately shares the CAD file with e.g. family or friends the private use exception of the EU Design law framework will apply. Uploading the design to a publicly accessible website does not fall within the 'private and non-commercial use' limitation. It is suggested that downloading a design from a public website will not fall within the limitation if the source is unlawful.
TRADE MARK LAW		
HOME 3D PRINTING	**PRINTING AT BUREAU OR OTHER PUBLIC PLACE**	**SHARING OF CAD FILES**
Home (private) 3D printing: No infringement. Trade marks only protect	Private printing at a 3D service bureau or at other public spaces: depends on	CAD file sharing: Uses in the private sphere when offering the CAD file generally

against infringing commercial use. Private use will not infringe.	individual circumstances.	permitted under trade mark law. Use in file sharing networks (such as Bittorrent) may be out of reach for trade mark law.

CHAPTER FOUR:
3D PRINTING AND IP INFRINGEMENT



4. Introduction

This section explores infringement issues including intermediary liability issues arising from 3D printing and scanning. In doing so and in considering each IP right, the discussion will focus on all elements of the 3D printing process (as per the diagram above).

In particular, in considering infringement, the discussion will focus on designing a CAD file (*step 1*), using and sharing the CAD file (*step 2*) and printing (*step 3*). Thereafter the chapter will move to a discussion of intermediary liability in exploring and questioning its relevance and what it means for 3D printing.

The structure encompassing (a) designing a CAD file, (b) using and/or sharing a CAD file and printing a model was adopted to explore the following issues.

a) **designing a CAD file** – i.e. creating a file from inception or scanning a physical object to create a design file. As such, depending on how the CAD file is created, issues of infringement can arise;

b) **sharing the CAD file** – i.e. once created, the file can be uploaded and hosted on online platforms thereby leading to infringement (the liability of internet intermediaries who host such CAD files will be considered in the latter part of the chapter);

c) **3D printing the 3D model** – in some, not all circumstances, the CAD file will be 3D printed and distributed leading to infringement as well.

4.1. Infringement Issues under Patent Law

The analysis of infringement activities in the context of patent law applies to a large extent equally to the three stages of 1) designing, 2) sharing and 3) printing a CAD file as identified above. Whilst a separate systematic and categorical analysis of the separate stages of the 3D printing process is not as relevant in this context the differences are pointed out if, and when relevant.

The Convention for the European Patent for the Common Market (Community Patent Convention, CPC)[343] and the Unified Patent Court Agreement (UPCA) both contemplate two types of patent infringement activities: direct and indirect patent infringement.[344] Direct infringement occurs when someone *'makes, sells, places on the market, uses, offers, imports or stores'* a patented invention without authorisation.[345] It should be noted that, an exclusive right to a patent does not provide the rights holder with any exclusive right to distribute nor make available to the public, as is the case with copyright law (see section below on copyright infringement). Therefore, activities such as sharing and hosting have not thus far been greatly discussed in the patent literature, due their relatively less relevance in the context of patent law.

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'.[346]

With regards to *direct infringement*, the most relevant statutory right in relation to 3D printing is the act of 'making' in relation to product-type of claims. Not surprisingly, in fact, this is also the exclusive right that has been mostly discussed in the literature thus far.

Although there is a lack of full harmonisation of patent infringement in Europe, the concept of 'making' a patented invention has generally been interpreted in similar ways in most European countries. As such, for product patents 'making' could include producing a product from raw materials, transforming a product's form or function, assembling a product from simple or complex pieces, or even building a product from an assembly kit. The 'making' of a new product can take place even if the parts used in its creation are second-hand or refurbished. A product does not need to be completely finished in order to infringe. An unfinished product is generally considered to be 'made' when it has progressed far enough in the manufacturing process to include, either literally or equivalently, the inventive elements covered by the patent claim. The manufacturing method and the quantity in which the product is produced is irrelevant, as far as infringement of a product patent is concerned.[347]

In this context, a first important point to consider in general, and in the context of 3D printing especially, relates to the fact that, even though it is a clear infringement to reproduce someone else's existing invention, it is unclear, after the first sale of a physical product, to what extent modifying or repairing the physical embodiment of a patented invention is also allowed without reaching the level of 'making' it (thus

343 [1976] OJ L 17/1 Agreement of a Unified Patent Court, [2013] C 175/1 (CPC).
344 See Articles 25 and 26 of the UPC Agreement.
345 See e.g. Article 25 of the UPC Agreement.
346 See e.g. Article 26 of the UPC Agreement.
347 See e.g. Marcus Norrgård, *Patentin loukkaus* (Sanoma Pro Oy, Helsinki 2009).

infringing).[348] This issue is linked to the interpretation of the principle of exhaustion. As with other IPR, also for patent rights, 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.[349] In other words, the purchaser's right to use is supported by the exhaustion doctrine. The exhaustion principle also covers the loan and *ordinary repair* of the product. Ordinary repair (including maintenance) of a product sold is allowed only insofar as such repair does not equate to 'making' the invention. The distinction between 'making' versus 'repairing', however, is not straightforward. Although making or printing copies of someone else's patented invention is a clear infringement, it is not clear whether and to what extent purchasing a patented item and subsequently modifying it or repairing it is allowed. For instance, whether repairing a patented product by replacing parts of it qualify as 'ordinary' repair, or constitutes instead 'remaking' the invention and, as such, infringing upon the rights of the patentee is a question that often needs to be addressed on a case-by-case basis.

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) (i.e. stage 3) (print) would be 'making' the device and, thus, directly infringing upon the patented invention.[350] However, on the one hand, whether printing only some parts of the claimed product equates to 'repairing' it (which is often allowed) as opposed to 'making' it, is not clear at the outset without interpreting the claims. The issue related to 'repairing' and 'making' the patented product is particularly unclear in the context of 3D printing, because this technology allows easy-to-make digital changes (to the CAD file) that might result in significant physical modifications (once the product is printed out). Such a context might blur the line between 'making' and 'repairing' even further, and may require even more interpretative guidelines, as it might often be difficult to determine when a tweaked CAD file of a product infringes upon a patented invention.

A second important challenge with pursuing direct infringement types of activities in 3D printing relates to the relationship with CAD files and the patented objects that they represent. As explained in other sections of this report, this is unclear under current rules. Therefore, it is questionable whether sharing a digital representation of a patent protected object over the Internet (stage 2) (share) would give rise to patent

[348] Relevant cases from Germany include, for instance*:* BGH 14.07.1970, GRUR 1971, 78, 80 *Diarähmchen V.;* BGH 17.07.2012, docket no. X ZR 97/11 *Palettenbehälter II*, available in German at: http://juris.bundesgerichtshof.de/cgi-bin/rechtsprechung/document.py?Gericht=bgh&Art=en&sid=3c6d49f845dcefd695bb195c4e4722bb&nr=61447&pos=0&anz=1. See the English translation in *IIC*, *Pallet Container II (Palettenbehälter II)* (2013) 44 at 351–360, 351, DOI 10.1007/s40319-013-0044-3.; OLG Düsseldorf GRUR 1938, 771, 775; BGHZ 2, 287 = GRUR 1951, 452, 454 *Mülltonne; Germany:BGH Förderinne;* LG Düsseldorf GRUR 1988, 116, 119 *Ausflussschieberverschluss*: . For UK relevant case law see e.g.: *United Wire Ltd v Screen Repair Services (Scotland) Ltd* [2001] F.S.R. 24 HL; *Schütz (UK) Ltd v Werit (UK) Ltd (Rev 1)* [2013] UKSC 16 (13 March 2013). Although the case law in Nordic countries is scarce, relevant literature in the field includes: M Norrgård, *Patentin loukkaus*, (Sanoma Pro Oy, Helsinki 2009); N Lindgreen, J Schovsbo & J Thorsen, *Patentloven med kommentarer* (Akademisk Forlag, Koebenhavn 2012), 170; A Stenvik, *Patentrett* (Cappelen Damm, Oslo 2013); B Domeij, *Patenträtt* (Iustus, Uppsala 2007), 93; U Bernitz, G Karnell, L Pehrson & C Sandgren, *Immaterialrätt och otillbörlig konkurrens* (Jure Förlag, Stockholm 2013), 192.

[349] See, for instance, Agreement on a Unified Patent Court (UPC Agreement), Article 29.

[350] All Member States must provide 'making' as a part of the exclusive right associated with a patent right by virtue of the TRIPs agreement. *See* TRIPs Art. 28(1) 'for product patent at least a right to (a) prevent third parties not having the owner's consent from the acts of: making, using, offering for sale, selling, or importing for these purposes that product' and for a process patent '(b) to prevent third parties not having the owner's consent from the act of using the process, and from the acts of: using, offering for sale, selling, or importing for these purposes at least the product obtained directly by that process.'

infringement liability at all.[351] Indeed, this is a key question for both the phases of 1) designing (especially when the designer does not start from scratch, but by scanning an existing protected object) and 2) sharing. On the one hand, whether a CAD file of a protected item could be equated to a physical, tangible object and, as such, whether reproducing the file could be considered as 'making' the physical object is a question relevant for direct infringement liability. Some scholars[352] have argued that for patentees to 'keep their hands' on their patent rights the reach of the patent right should be extended to the 'making' of the CAD files (and not merely to 'printing' the physical object), this way expanding the possibilities for finding direct patent infringement even before the object has been printed out (i.e. finding infringement already at stages 1) or 2), not just at stage 3). The assumption for this way of thinking is that a CAD file is not simply an important blueprint of the physical device, but rather a powerful tool that renders its possessor just as satisfied as if he is possessed with the physical object itself. As such, 'making' CAD files of patented objects should equate to an infringing activity (as 'making' the actual invention).[353] Against this line of thinking, however, it should be noted that printing a physical object from a CAD file is not a 'simple click of a button', but a involves a more complex process that requires considerable technical expertise (both in the pre- and post- printing phase). As such, considering CAD files as same as physical objects and, this way, equating the making of a CAD file on a protected object to direct patent infringement, should be considered with high caution at the least.

In the context of *indirect infringement* the current European framework finds indirect patent infringement where means (which is not itself an infringement of the patent at stake) that relates to an essential element of a patented product, or method, is supplied to any person with the knowledge that such means will be used in an infringing product, or method.[354] Similar provisions to the UPCA have been adopted in the UK,[355] Germany,[356] as well as in all the Nordic Countries[357] and in general in most EU countries. In all these countries, in order for indirect infringement to occur the alleged infringer must:

1) Supply or offer to supply;
2) On the national territory (where the patent has effect);
3) Any person other than a party entitled to exploit the patented invention;
4) With means related to;
5) An essential element of that invention;
6) For putting it into effect on the national territory;

[351] *See* Rosa Maria Ballardini, Marcus Norrgård & Timo Minssen, *Enforcing Patents in the Era of 3D Printing*, 10 (11) (2015) *Journal of Intellectual Law & Practice*, 850.
[352] See e.g. Tim Holbrook, & Lucas Osborn, 'Digital Patent Infringement in an Era of 3D Printing' (2015), *UC Davis Law Review,* Vol. 48:1319, pp. 1319-1385. http://dx.doi.org/10.2139/ssrn.2483550
[353] ibid.
[354] See e.g. UPC, Article 26.
[355] See Section 60(2) of the UK 1977 Patents Act.
[356] See Section 10 of the German Patent Act.
[357] Section 3(2) of the Finnish Patent Act (550/1967, as amended), Section 3(2) of the Swedish Patent Act (1967:837, as amended), Section 3(2) of the Danish Patent Act (Lovbekentgoerelse nr 108 af 24. Januar 2012) and Section 3(2) of the Norwegian Patent Act (15 December 1967 nr 9, as amended).

7) When the third party knows, or should have known that those means are suitable and intended for putting that invention into effect;

8) Indirect infringement for staple products only under certain additional conditions.

Importantly, in the UK,[358] Germany[359] and Nordic countries[360] (as well as in most jurisdictions in Europe) an indirect infringement can be committed even where no direct infringement has occurred.

One key question in relation to indirect infringement in the 3D printing context relates to whether a digital work, such as a CAD file, can be considered as a 'means' for putting the invention into effect. Also issues related to whether the CAD file can be considered as the 'essential element' and whether the 'knowledge' requirement is met have been discussed in the literature to some extent.[361] In this report, however, the discussion mainly entails the concept of 'means' as it is by far the most controversial aspect. Indeed, in most cases the question would be interpreted in relation to how the claims of the asserted patents are written and to what extent the CAD file itself or the creation of the CAD file is read in light of the claims. On a general level, however, the way that European patent doctrines have interpreted concepts like 'means' thus far might cause problems for IP holders in terms of finding indirect infringement liabilities when (unprotected) CAD files of (protected) physical objects are created (stage 1)) or shared (stage 2)).

Precisely what constitutes the relevant types of 'means' is not defined in the law. However, historically, 'means' have been interpreted as consisting of physical or tangible nature. Accordingly, the common understanding has been that simple and abstract instructions *per se* would not qualify as 'means' in the context of indirect infringement. Moreover, even though national case law of EU member States does not seem to object to the inclusion of software in the definition of 'means', other types of digital works have thus far not been considered to qualify as 'means' for the purpose of indirect infringement of patents.[362] Following this interpretation, it becomes questionable whether and to what extent IP holders of (physical) items protected by patents, that are then digitised and shared over the internet without permission, have any tools at all to protect themselves via filing indirect infringement actions. In fact, if 'means' continues to be interpreted, as it traditionally has been, as something 'physical' or 'tangible' (with the only exception of software), then this would radically limit possibilities for pursuing indirect type of infringement activities in many contexts related to 3D printing (unless CAD files would be considered as software for the purpose of patent law). Indeed, in this increasingly digitised world where inventions linked to the digital rather than analogue environment, it would seem advisable to extend the interpretation of 'means' to digital items as well.

Summary

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358 UK: Grimme v Scott [2010] EWCA (Civ) 1110 and KCI Licensing v Smith & Nephew [2010] EWCA Civ 1260.

359 Germany: Deckenheizung [BGH X ZR 153/03], 13 June 2006.

360 Norrgård (2009), at pp. 86-87.

361 See e.g. Rosa Maria Ballardini, Marcus Norrgård & Timo Minssen , *Enforcing Patents in the Era of 3D Printing*, 10 (11) (2015) *Journal of Intellectual Law & Practice*, 850.

362 See national cases like *Agilent Technologies Deutschland GmbH v Waters Corporation [2004] EWHC 2992 (Ch), 36–37 and Menashe Business Mercantile Ltd v William Hill Organization Ltd* [2003] R.P.C. 31 from the UK; BGH GRUR 2001, 228, 231, LG Düsseldorf GRUR Int 1989 695; *König Mitt* 2000, 10, 12 ff, LG Düsseldorf 22.2.2007 4b O 220/06: *digitale Computerdatei and* BGH decision of 22.11.2005, GRUR 2006, 570- *Extracoronales Geschiebe* from Germany.

- The major challenges in relation to *direct infringement* in the 3D printing context refer to the interpretation of illegitimate 'making' in respect to legitimate 'repairing' of the patented invention (in relation to product-types of claims). Although, 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, whether printing only some parts of the claimed product equates to 'repairing' it, as opposed to 'making' it, is not clear at the outset without interpreting the claims. This issue is especially relevant for stage 3) printing.

- Another important challenge with pursuing direct infringement types of activities in 3D printing relates to the relationship with CAD files and the patented objects that they represent. Because this link is unclear under the current rules, it is questionable whether sharing a CAD file representing a patent protected object over the Internet would give rise to patent infringement. This is relevant for both stages 1) creating and 2) sharing.

- In relation to indirect infringement, the main challenge refers to how the concept of 'means' is interpreted under European patent doctrines. Should 'means' continue to be interpreted, as it traditionally has been, as something 'physical' or 'tangible', then this would radically limit possibilities for pursuing indirect type of infringement activities in many contexts relating to 3D printing.

4.2. Infringement Issues under Copyright Law

3D printing begins life as a digital CAD file which makes it easier to reproduce copies and harder to detect infringement.[363]

In the context of 3D printing, there are three scenarios in which infringement issues can occur. These include:

a) the process of designing a CAD file (either from inception or through scanning);

b) sharing the CAD file through online platforms; and

c) printing the CAD file and distributing the printed object.

These infringement scenarios come under Article 2 of the InfoSoc Directive which states that 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'.[364] In other words, whoever reproduces a work protected by copyright law, without the authorisation of the rights holder, will be infringing the law.

The sections below, will now consider each of the above 3D printing scenarios in the context of copyright infringement.

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[363] See Bad Vibrations: 'UCI Researchers Find Security Breach in 3-D Printing Process: Machine Sounds Enable Reverse Engineering or Source Code', UCI News (2 March 2016) https://news.uci.edu/research/bad-vibrations-uci-researchers-find-security-breach-in-3-d-printing-process/

[364] Article 2(a) InfoSoc Directive.

4.2.1. Designing a CAD File

A CAD file may be created by (a) designing it through the use of software or (b) by scanning a physical object (under copyright protection). In each of these cases an important question to explore is whether the work has been reproduced in the context of Article 2(a) InfoSoc Directive or whether it has subsequently undergone some form of modification in respect of its design (form)[365] – without the authorisation of the rights holder. A third scenario is (c) where a CAD file is created by scanning out-of-copyright works – particularly drawn from the cultural sector. In such circumstances, the scanned object may generate new copyright – but raises questions about the process and licensing practices. Each of these scenarios will be considered in turn.

In the first instance, where a CAD file is designed from inception through the use of open-source modelling software such as FreeCAD,[366] OpenSCAD,[367] it is unlikely to infringe copyright. As the CAD file is being designed from inception, it generally implies that the designer is using his or her 'personal touch' to create the design, as opposed to reproducing an existing design.

However, a CAD file which is created through scanning a physical object, gives rise to a few questions. In such a scenario, open-source CAD software such as Meshmixer,[368] Blender[369] amongst others are used to 'clean' the file which has been scanned, as explained in Chapter 1. The 'cleaned' file can then be shared, printed or distributed as the case may be. However, where a physical object is scanned and reproduced in its entirety,[370] it raises a number of copyright questions, requiring consent or permission of the rights holder to avoid infringement.[371]

Can a scanned work lead to direct infringement? The first question is whether there has there been a reproduction of original elements of a protected work through scanning the object? If this question is answered in the affirmative and if the scanned work is a replica of the underlying work, the scanned work will infringe Article 2 – reproduction right.

Can a scanned work lead to the creation of a derivative work? Secondly has there been any alteration or modification to the scanned physical object representing the designer's own intellectual creation or personal touch, thereby leading to a derivative work, meeting the requirement of originality? In such a scenario, the modification to the underlying work must be substantial. Cases such as *Painer,*[372] *Antiquesportfolio*[373] and

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[365] *Art and Allposters International BV v Stichting Pictoright* C-419/13, EU:C:2015:27.

[366] FreeCAD provided by 3D printing company *iMaterialise*, is a free 3D modelling software. https://www.freecadweb.org/

[367] Openscad, provided by 3D printing company, Ultimaker, is also a free 3D modelling software http://www.openscad.org/

[368] Meshmixer is provided by 3D printing company *Autodesk,* and is used specifically for 'cleaning' a 3D scan or 3D printing http://www.meshmixer.com/

[369] Blender, provided by 3D printing company *Sculpteo,* is a free 3D modelling software https://www.blender.org/

[370] *Infopaq International A/S v Danske Dagbaldes Forening* (C-5/08) [2010] FSR 20 at [24].

[371] Unless it comes under an exception such as private copying.

[372] *Painer v Standard Verlags GmbH* (C-145/10) [2012] ECDR 6 (ECJ (3rd Chamber).

[373] *Antiquesportfolio.com Plc v Rodney Fitch & Co. Ltd.* [2001] FSR para. 36.

Art and Allposters[374] although they do not deal with 3D printing, *per se*, provide some guidance here.

In *Painer,* the Court held that the use of a portrait photograph as a template to establish a photo-fit did not infringe the copyright of the portrait photograph. Referring to *Infopaq*, the Court established that portrait photographers could meet the originality standard by making creative choices in setting up, shooting and developing the photo.[375]

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 which culminated in exhibiting particular qualities including the colour, features and details of the items. 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[376] but sufficient to demonstrate a degree of skill for copyright to exist in the photographs.[377]

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. The reasoning adopted by the CJEU was that a canvas transfer process of a poster 'results in the creation of a new object incorporating the image of the protected work'.[378]

These cases which deal with photographs are akin to scanning – to some extent. In both photography and scanning, creative choices have to be made. As such, applying the above-discussed cases to scanned physical objects, it can be argued that such objects could potentially lead to a derivative work, meeting the level of originality that is required on the basis of their authorial input i.e. the personal touch of the creator[379] (rather than being verbatim or a replica), if there is evidence of substantial modification to the underlying work. As such, it could be deduced that by making creative choices such as selecting particular views of the physical object when a 3D digital model is created through scanning an object, is sufficient to make the 3D digital model an 'intellectual creation of the author reflecting his personality and expressing his free and creative choice'[380] in its production.

What is the copyright status of scanned out-of-copyright works? The Copyright Directive also makes reference to works which are out-of-copyright. Recital 53 stipulates that faithful reproductions of public domain art should not be protected at all because 'In the field of visual arts, the circulation of faithful reproductions of works in the public domain contributes to the access to and promotion of culture (or access to cultural heritage). In the digital environment, the protection of these reproductions through copyright or related rights is inconsistent with the expiry of the copyright protection of works.'[381]

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374 *Art and Allposters International BV v Stichting Pictoright* C-419/13, EU:C:2015:27.

375 *Painer v Standard Verlags GmbH* (C-145/10) [2012] ECDR 6 (ECJ (3rd Chamber).

376 *Antiquesportfolio.com Plc v Rodney Fitch & Co. Ltd.* [2001] FSR para. 36.

377 ibid. at para. 37.

378 *Art and Allposters International BV v Stichting Pictoright* C-419/13, EU:C:2015:27, para 40.

379 C-476/17 *Pelham and Others* (the *Metall auf Metall* case).

380 *Painer* at para. 99.

381 European Parliament legislative resolution of 26 March 2019 on the proposal for a directive of the European Parliament and European Council on copyright in the digital single market (Copyright Directive), Recital 53 at https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32019L0790&from=EN In this context, see also the Declaration of Cooperation on Advancing Digitisation and Cultural Heritage signed by EU member states in April 2019. This declaration promotes the 3D digitisation of cultural heritage

Article 14 of the Directive states that 'Member States shall provide 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 shall 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'.*[382]

In a 3D scanning context, this leads to the third scenario of creating a CAD file where 3D scanning involves the restoration and reconstitution of out-of-copyright works.[383]

The *Dead Sea Scrolls*[384] case examined by the Supreme Court of Israel sheds some light on the issue. The Court held that Professor *Qimron's* reconstitution of the 2000-year old *Dead Sea Scrolls* was an original work for purposes of copyright. The Court held that it was original in the sense that Professor *Qimron* used his 'knowledge, expertise and imagination, exercised judgement and chose between different alternatives',[385] thereby pointing to authorial input required for meeting the threshold of originality. Therefore, the Court held that Professor Qimron had copyright in the deciphered text as a literary work.

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 has been exercised in the recreation of such works. He argues that copyright should not only 'incentivise' works, which are 'materially altered' from the pre-existing work. He states that it could be in the public interest for authors to make identical replicas of antecedent works which are of major cultural significance or extremely inaccessible or both'.[386]

As such, the important aspect is establishing 'authorial input'. Both the case law and the EU Directive point in this direction.

Therefore, where a CAD file ('work') is created through scanning of works which are out of copyright –leading to a substantially modified version of the physical object, through 'authorial input or personal touch', it could be considered a new work, attracting new copyright – although this needs further clarification in the 3D printing world.[387] In other words, the intention of the individual scanning the work is significant in such cases. For example, a cultural organisation commissioning the scanning of an artefact for creating a new model for educational purposes could be seen as a new work, if there is evidence of authorial input. On the other hand, an individual scanning an artefact and reproducing it

artefacts, monuments and sites whilst enhancing cross-sector and cross-border cooperation in the digitised cultural heritage sector https://ec.europa.eu/digital-single-market/en/news/eu-member-states-sign-cooperate-digitising-cultural-heritage

382 Article 14, 'Works of Visual Art in the Public Domain'.

383 This question was explored in a project, led by Dinusha Mendis of the Centre for Intellectual Property Policy and Management (CIPPM), Bournemouth University in collaboration with Museotechniki Ltd (UK) and Uformia AS (Norway), was funded by the UK Arts and Humanities Research Council (AHRC) and CREATe, University of Glasgow. The two-year project concluded in August 2017.

384 *Eisenmann v Qimron* 54(3) PD 817. See also, Michel Birnhack, 'The Dead Sea Scrolls Case: Who is an Author?' [2001] 23(3) *European Intellectual Property Review*, pp. 128-133; T. Lim, H MacQueen & C Carmichael (eds), *On Scrolls, Artefacts and Intellectual Property* (Sheffield" Sheffield Academic Press; 2001).

385 *Eisenmann v Qimron* 54(3) PD 817

386 Burton Ong, Originality from copying: fitting recreative works into the copyright universe [2010] (2) *Intellectual Property Quarterly* pp. 165-199 at p. 174.

387 See also, Dinusha Mendis, 'Back to the Future'?: From Engravings to 3D Printing – Implications for UK Copyright law in Dinusha Mendis, Mark Lemley and Matthew Rimmer *3D Printing and Beyond: Intellectual Property and Regulation* (Edward Elgar, 2019).

as it was (i.e. as a replica), will amount to a copy. This is also in line with the aforementioned Article 14 of the Copyright Directive*.*

4.2.2. Sharing CAD Files: Uploading and Hosting on Online Platforms

This section will examine whether the online sharing of a CAD file constitutes an act of communication to the public. As such this part of the discussion examines the second aspect of the infringement issues – sharing a CAD file. The question of liability of online platforms engaged in such activity will be explored separately in the following pages.

4.2.2.1. Uploading CAD Files to a Publicly Accessible Online Platform

In recent years, online platforms such as *YouTube* and *Facebook* have adopted 'upload filters' which detect copyright works being uploaded and shared without the permission or consent of the rights holder. These 'content recognition technologies' adopted by these companies automatically check whether the users who publish content such as videos, images, audio files etc., are protected by copyright. If the system detects an infringement the upload can be blocked.

Recently, the Copyright Directive has come under significant criticism[388] for extending the 'upload filter' obligation to all platforms as reflected in Article 17 of the Copyright Directive. A reading of Article 17(4)(a)-(c) indicates 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 rights holders.

Whilst this places a burden on online platforms and users in the context of uploading and sharing creative content, the new Copyright Directive includes a new provision which may benefit those in the 3D printing industry. Article 2(6) of the 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 this context, it is possible that industry-focused 3D printing platforms such as *3D Hubs* and *CGTrader* for example, 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'.

4.2.2.2. Hosting CAD Files on Online Platforms

Apart from the act of uploading, online platforms also host uploaded content, thereby paving the way for sharing. Furthermore, online platforms dedicated to the dissemination and sharing of 3D designs provide online tools[389] that facilitate creation, editing, uploading, downloading, remixing and sharing of 3D designs. In some cases, where the CAD file is shared without the consent or permission of the author, it raises questions pertaining to 'communication to the public'.

In the past few years there have been such instances occurring on online platforms dedicated to 3D printing, as reflected in the examples below.

[388] Reda, Julia. EU copyright reform/expansion. https://juliareda.eu/eu-copyright-reform/

[389] Phil Reeves and Dinusha Mendis, *The Current Status and Impact of 3D Printing within the Industrial Sector: An Analysis of Six Case Studies* (UK Intellectual Property Office 2015) at p. 40.

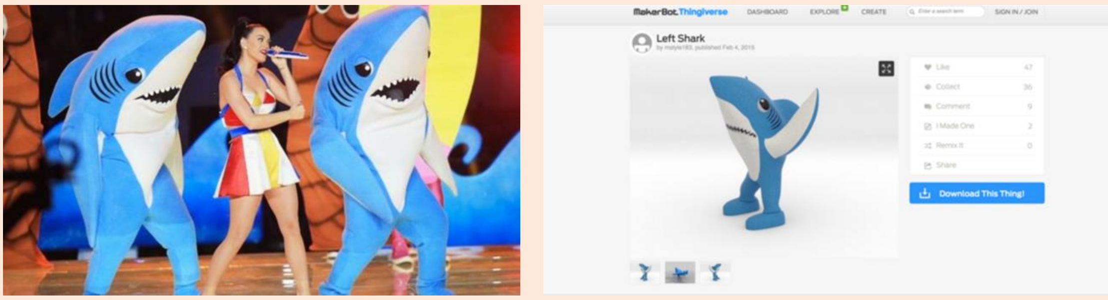
Pokémon targets 3D printed design, citing copyright infringement

In August 2014, online platform, *Shapeways* received a 'cease and desist' letter from *Pokémon International* for hosting a look-alike of the *Pokémon Balbasaur Planter* model. The model was being shared on the *Shapeways* platform as well as being sold through their bureau service. Following the cease and desist letter, *Shapeways* stopped such activities.

(Source: 3Dprintingindustry.com). Left- original; Middle and Right – copies

Katy Perry's Lawyers Demand Removal of 3D Printable Left Shark from Shapeways

Similar to the above example, in February 2015, lawyers representing Katy Perry sent a 'cease and desist' letter to *Shapeways* requesting that they remove the 'Left Shark' 3D model from their site. The Left Shark was the mascot which appeared during Superbowl Halftime and became an instant meme – and went on to sell many 3D printed versions of it on *Shapeways.*



(Source: 3Dprintingindustry.com). Left- Katy Perry and Left Shark Mascot; Right – 3D Model made available on another platform following the issue with Shapeways

Box 1 Sharing CAD files – Communication to the public

4.2.2.3. What Does this Mean for 3D Printing? Infringement Issues

Article 3 of the InfoSoc Directive 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'.

The jurisprudence of the CJEU has further interpreted this Article to mean that a protected work may be infringed whenever it is made available to the public by any means.[390] There are two aspects to this discussion. First, there has to be an 'act of communication' and secondly, the communication should be made to a 'public'.

In the case of the former – the act of communication – can be made in such a way that those who comprise the public can access it, from wherever and whenever they individually choose, irrespective of whether they choose to do it or not.[391]

Secondly, the CJEU has specified that the concept of the 'public' refers to an indeterminate number of potential viewers and implies a fairly large number of people.[392] In that regard the concept of 'public' involves a certain *de minimis* threshold, which excludes from that concept groups of persons concerned which are too small, or insignificant.[393]

A line of case law has further clarified that a 'new public' means a public that was not already taken into account by the copyright holders when they authorised the initial communication of their work to the public.[394] In this context, the profit-making nature of a communication is relevant.

Accordingly, any act by which a user, with full knowledge of the relevant facts, provides its clients with access to protected works will constitute an 'act of communication'.[395] As such, the work need only be made available in such a way that members of the public *may* access it.[396] However, the mere provision of physical facilities is not sufficient as to constitute communication to the public.[397] For example, in the CJEU case of *SGAE v Rafael Hoteles SL*[398] it was held that the hotel had *'full knowledge of the consequences of its action, to give access to the protected work to its customers. In the absence of that intervention, its customers, although physically within that area, would not, in principle, be able to enjoy the broadcast work.'*[399] Advocate General Sharpston explained that *'the*

[390] *Sociedad General de Autores v Editores de España (SGAE) v Rafael Hoteles SA* [2006] ECR I-11519 C-306/05 at 42. See also, E Rosati, Neighbouring Rights For Publishers: Are National And (Possible) EU Initiatives Lawful? (2016) 47(5) *International Review of Intellectual Property and Competition Law*, 569; *Football Association Premier League Ltd v QC Leisure* [2012] All E.R. (EC) C-403/08 and 429/08 629.

[391] Case C-161/17 *Land Nordrhein-Westfalen v Dirk Renckhoff* ECLI:EU:C:2018:634.

[392] Case C-527/15 *Stichting Brein v Ziggo BV et al* ECLI:EU:C:2017:465; [2017] E.C.D.R. 19, para 25.

[393] Case C-527/15 *Stichting Brein v Ziggo BV et al* ECLI:EU:C:2017:465; [2017] E.C.D.R. 19, para 41.

[394] Case C-161/17 *Land Nordrhein-Westfalen v Dirk Renckhoff* ECLI:EU:C:2018:634.

[395] Case C-527/15 *Stichting Brein v Ziggo BV et al* ECLI:EU:C:2017:465; [2017] E.C.D.R. 19, para 34. *See also,* C-466/12 *Svensson v Retriever* Sverige AB (13 February 2014); C-348/13 *BestWater v Mebes & Potsch* (21 October 2014); C-160/15 *GS Media v Sanoma Media NL* (8 September 2016).

[396] Case C-527/15 *Stichting Brein v Ziggo BV et al* ECLI:EU:C:2017:465; [2017] E.C.D.R. 19, para 43.

[397] *Football Dataco Limited, The Scottish Premier League Limited, The Scottish Football League, PA Sport UK Ltd v Sportradar GmbH (a Company Registered in Germany), Sportradar AG (a Company registered in Switzerland)* [2010] EWHC 2911 (Ch) Mr Justice Floyd at 74.

[398] *Sociedad General de Autores v Editores de España (SGAE) v Rafael Hoteles SA* [2006] ECR I-11519 C-306/05 at 42.

[399] ibid. at 40 and 42.

hotel owner is in the same situation as a third party who relays original programmes broadcast or transmitted by cable.' [400]

This ruling was confirmed in the subsequent case of *FA Premier League,*[401] where the CJEU held that a pub owner committed an act of communication to the public by switching on a television in a pub, stating that the owner of the *'public house intentionally gives the customers present in that establishment access to a broadcast containing protected works via a television screen and speakers. Without his intervention the customers cannot enjoy the works broadcast, even though they are physically within the broadcast's catchment area.'* [402]

Furthermore, later cases such as *Svensson,*[403] focused on access provided through hyperlinks. In particular, this case queried whether such links which redirects internet users to protected works freely available online can amount to a communication to the public – and the CJEU stipulated that it does not, thereby confirming that in such cases it does not infringe copyright. The CJEU further clarified that the right of 'communication to the public' applied only to situations where the works linked to, were made freely available with the consent of the rights holder, but also noted that an 'individual assessment' needs to be made in each case.[404] Thereafter cases such as *BestWater*[405] and *GS Media*[406] further confirmed this reasoning but attempted to provide more clarity. For example, in *GS Media* the CJEU sought to distinguish between the posting of links by ordinary internet users (who may not have all the information to hand to make a detailed assessment of the works they are linking to, in order to ascertain whether or not they are published with consent) and those users of the internet who seek to profit by sharing works of other people or who knowingly and deliberately infringe copyright.

In other words, *GS Media* established that posting of hyperlinks to works published without the author's consent on another website with knowledge, whether actual or constructive, and where the activity is carried out for profit, can amount to an infringement thereby satisfying the requirements of communication to the public.[407]

Applying the CJEU jurisprudence to the present context, it can be questioned whether hosting CAD files on online platforms is communication to the public, thereby leading to copyright infringement? Drawing on the above mentioned case law, in particular the recent reasoning in *GS Media*, it can be argued that where online platforms host copyright material without the author's consent and doing so with actual or constructive knowledge in return for a financial gain, will amount to an act of communication leading to copyright infringement. Drawing on the above examples relating to Pokémon and Katy Perry, it was little surprise Shapeways was issued with 'cease and desist' letters as Shapeway's business model is one that comes under the category of profit-making.

However, it is equally important to note that, if the hosting is carried out by an 'ordinary internet user' in the context of *GS Media*, then the situation will be different. This also has a bearing on the so-called 'value gap' between the position of creators and right holders to negotiate and be remunerated for the online use of their content by certain

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400 ibid. at 53.
401 *Football Association Premier League Ltd v QC Leisure* [2012] All E.R. (EC) C-403/08 and 429/08 629.
402 ibid. at 195 and 196.
403 C-466/12 *Svensson v Retriever Sverige AB* (13 February 2014) ECLI:EU:C:2014:76.
404 ibid.
405 C-348/13 *BestWater v Mebes & Potsch* (21 October 2014) ECLI:EU:C:2014:2315.
406 C-160/15 *GS Media v Sanoma Media NL* (8 September 2016) ECLI:EU:C:2016:644.
407 ibid.

user-uploaded content platforms – whilst bearing in mind extent of online platforms such as *YouTube* and *Facebook* and smaller start-up platforms. Article 17.5 of the Directive states that 'in determining whether the service provider has complied with its obligations … and in light of the principle of proportionality, the following elements, amongst others, will be taken into account:

a) the type, the audience and the size of the service and the type of works or other subject matter uploaded by the 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 (a) which have been in existence for less than three years; (b) which have a turnover of less that 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.[408]

The issue with online platforms in the 3D printing industry is that whilst there are a number of large online platforms which exceed 5 million monthly users, there are an increasing number of start-up platforms in the sector.[409] However according to the Copyright Directive, these platforms will also have to 'monitor' and ensure that they act expeditiously to remove any unauthorised content, to ensure they avoid liability. In this sense, the current law applies to 3D printing online platforms in the same manner it does for other content; the issue is that there are many more start-ups in this field, which will be burdened by the new provisions.

A second difficulty with 3D printing is that it encompasses all IPRs and whilst the Copyright Directive in particular tackles the issue of hosting and linking in the context of copyright and communication to the public, it is clearly limited to copyright – while CAD files and 3D objects extend to all IPRs, which makes the situation more complex than for other content such as images, videos and music which is shared online.

4.2.3. Printing the 3D Model: Infringement Issues Through Distribution

Article 4 of the InfoSoc Directive, sets out the distribution right and particularly, in relation to Article 4(1) states that 'Member States shall provide for authors, in respect of the original of their works or of copies thereof, the exclusive right to authorise or prohibit *any form of distribution* to the public by sale or otherwise'.

The most common form of distribution is sale. 'Sale' is also mentioned as the primary example of distribution in article 4(1) InfoSoc Directive. Other acts of distribution must entail a transfer of the ownership of the object.[410]

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[408] Recital 66 Copyright Directive at https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32019L0790&from=EN

See also, European Commission (Press Release), Questions and Answers: European Parliament's Vote in Favour of Modernised Rules Fit for the Digital Age (26 March 2019) at http://europa.eu/rapid/press-release_MEMO-19-1849_en.htm

[409] Phil Reeves and Dinusha Mendis, *The Current Status and Impact of 3D Printing within the Industrial Sector: An Analysis of Six Case Studies* (UK Intellectual Property Office 2015).

[410] CJEU of 17.4.2008, C- 456/06 para. 36 - *Peek & Cloppenburg/Cassina*.

A relevant distribution does not have to be on a commercial scale. Copyright also protects against unauthorised distribution for private purposes. But it needs to be a distribution 'to the public', as explicitly stated in article 4(1) InfoSoc Directive.

In the context of 3D printing and scanning, this raises some interesting issues. First, where an object has been scanned, cleaned, 3D printed and then sold by someone other than the rights holder, it can amount to an infringement of copyright as per Article 4(1) of the InfoSoc Directive. As such, where the 3D model is a protected (artistic) work and is distributed without the rights holder's consent, permission or licence, it will amount to copyright infringement.[411] In a 3D scanning and printing context, if the scanned work is a faithful reproduction of the original, it will clearly contravene Article 4(1) of the InfoSoc Directive thereby leading to infringement through distribution.

On the other hand, and as discussed in the previous section, a second scenario arises if the scanned and printed physical product is substantially modified, leading to a derivate work, meeting the threshold for originality and attracting its own copyright. In such a scenario, it is possible that the new work will be eligible for its own right of distribution under Article 4(1). Therefore, depending on whether a scanned, substantially modified product, reflecting authorial input can attract new copyright, as a derivative work, Article 4(1) will apply. However there is a lack of jurisprudence in this area; case law from the 2D world, points in the direction of a new work – but needs further clarity in the 3D world. The same argument holds true for out-of-copyright work.

A second scenario arises in the case of a sale of a CAD file on a public platform such as *eBay* – which will *not* entail the 3D model being printed. This scenario leads to the same conclusion as distributing a faithful repeoduction of a scanned and 3D printed object (without the rights holder's or licensor's permission) and in effect will infringe the distribution right. The difference will arise if the CAD file representing the 3D model is not a faithful reproduction and is capable of demonstrating substantial modification and authorial input leading to a new work. However, as seen in the *Pokémon Balbasaur Planter* issue illustrated at section 4.2.2.2, where the modfication is seen as insubstantial, it will lead to copyright infringement and infringement of the distribution right. As mentioned above, this is also the case where there has been no commercial sale, but has been distributed 'to the public' as in the case of online sharing platforms dedicated to 3D printing. In contrast, a gift in the form of a 3D printed product to a close family member or friend will not be a distribution in the sense of article 4(1) InfoSoc Directive.

It is also worth mentioning as before, if the sharing of the CAD file or 3D printed product is for research, educational purposes or for any activities which come under the copyright exceptions, then liability can be avoided.

4.2.4. Infringement and Moral Rights of the Author

In a 3D printing context, it is interesting to question the moral rights of the author. It is also interesting to note as Matthew Rimmer states that, historically, there have been significant conflicts in respect of moral rights and remix culture ranging from

[411] Jan Bernd Nordemann/Michael Rueberg/Martin Schaefer, 3D-Druck als Herausforderung für die Immaterialguetterrechte', (2015) *Neue Juristische Wochenschrift (NJW),* 1265 at 1266.

photography, appropriation art, music sampling and so on.[412] Presently, the issue of moral rights as it applies to 3D printing is relevant and worthy of consideration.

In this context, Article 6*bis* of the Berne Convention for the Protection of Literary and Artistic Works 1886 is relevant. Article 6*bis* establishes minimum international standards of protection in the field of copyright, which states that the author has 'the right to claim authorship of the work and to object to any distortion, mutilation or other modification of, or other derogatory action in relation to, the said work, which would be prejudicial to his honor or reputation'.

In a 3D printing sphere this means that those creating a 3D digital image or model needs to be identified as the author of the original artistic work in a form which brings the creator's identity to the notice of those receiving the disseminated work. Where copyright subsists in the 3D model itself the creator of the 3D digital model will need to be clearly identified.[413]

In this manner, the creator of the work has the right to object to derogatory treatment. For example, where a 3D model is created of a licensed work for inclusion in an Open Educational Resource (OER), the creator of the OER should consider whether there is a risk the creation of the 3D model would be considered prejudicial to the honour or reputation of the author to avoid infringing moral rights or the licence.[414] If a work is subject to a No Derivatives (ND) CC licence then an author or director will be able to challenge the creation of an adaptation or derivative work, if the treatment of the work can be shown to be derogatory.[415]

It is also interesting to consider the moral rights provisions of the online platforms hosting the CAD files. Certain online platforms (based in countries outside the EU, mainly USA) offering CAD files for upload, download, sharing etc. require the users to waive their moral rights in signing up to such platforms,[416] or other rights with respect to attribution of authorship of their content upon registration.[417] Whilst it may be argued that many online platforms (dedicated to other types of content) carry similar terms and conditions, it is also important to bear in mind that moral rights cannot simply be waived – especially in countries such as France – and therefore such agreements will have little effect in such countries.

Summary

- **Designing a CAD file – (a) designing a CAD file from inception:** a CAD file which is designed from inception through the use of 3D modelling software, is unlikely to infringe copyright, as long as the designer does not reproduce another person's design without their consent.

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412 Matthew Rimmer, Makers Empire: Australian Copyright Law, 3D printing and the 'Ideas Boom' in Dinusha Mendis, Mark Lemley and Matthew Rimmer, *3D Printing and Beyond: Intellectual Property and Regulation* (Edward Elgar, 2019).

413 Elizabeth Adeney, *The Moral Rights of Authors and Performers: An International and Comparative Analysis* (Oxford University Press, 2006).

414 JISC, 3D Digitisation and Intellectual Property Rights (17 January 2014) at https://www.jisc.ac.uk/guides/3d-digitisation-and-intellectual-property-rights

415 ibid.

416 Dinusha Mendis and Davide Secchi, *A Legal and Empirical Study of Online Platforms and an Analysis of User Behaviour* (London: UK Intellectual Property Office; 2015), pp. 19–20.

417 ibid.

- **(b) A CAD file which is created through scanning a physical (copyright protected) product**, may attract new copyright, as a new or derivative work, if it can be shown that the scanned 3D model represents the intellectual creation of the author reflecting his or her personality and expressing their free and creative choices. Furthermore, substantial modification will need to be demonstrated between the underlying work and 3D printed work, if infringement is to be avoided. If not, the scanned and printed object will be seen as a faithful reproduction of the original, contravening Article 2 of the InfoSoc Directive. Further clarification on this point is recommended.

- Article 14 of the Copyright Directive deals particularly with **out-of-copyright works**. The Directive clarifies 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 shall 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'.* Therefore, 3D objects, which are scanned for restoration purposes, may get a new copyright if the authorial input can be established through creative choices such as the positioning of the object, the angle at which it was scanned, the lighting, the focus and all such aspects which are needed to meet the threshold of originality. This is similar to the 2D world, where a photograph attracts new copyright, even if the new photograph is based on an out-of-copyright work.

- **Sharing a CAD file – (a) uploading:** Article 17 of the Copyright Directive ('upload filter') requires platforms to monitor uploads through content recognition technologies. However, Article 2(6) of the 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' – which is beneficial for those in the 3D printing sector.

- **(b) Hosting:** Online platforms hosting copyright material without the author's consent and doing so with actual or constructive knowledge in return for a financial gain, will be involved in an act of communication and could be held liable for copyright infringement. The application of this criteria will depend on the size of the platform, the turnover (€10 million) and monthly users (more than 5 million monthly users). Moreover, where an online platform falls within the context of Article 2(6) of the Copyright Directive as mentioned above, it will not come within the definition of 'online content sharing service providers' and therefore will be exempt from liability.

- **Printing and Distributing the 3D Model:** where a 3D model has been 3D printed and then distributed by someone other than the rights holder, it can amount to an infringement of copyright as per Article 4(1) of the InfoSoc Directive. However, where a scanned and printed product is substantially modified, reflecting authorial input and originality, it can potentially attract new copyright, as a derivative work, with the possibility for Article 4(1) to apply to the new work. Where a CAD file is sold on a public platform, the same rules will apply as it does for the printed product unless it is substantially modified, reflecting authorial input in which case it could be seen as an independent work. Where there has been no commercial sale, but where the CAD file has been distributed 'to the public' as in the case of online sharing platforms dedicated to 3D printing, it will infringe Article 4(1).

- Article 6bis of the Berne Convention will apply when considering the **moral rights** of the creator allowing a creator to object to derogatory treatment of their work on an online platform, for example.

4.3. Case Study 5: Design Data and IP Rights – A New Approach?

Case Study and Overview

3D scanning technology is particularly used by museums and cultural institutions for preservation, restoration and conservation of cultural heritage as well as reproduction of their collections for exhibition. Apart from museums, the industrial sector also relies on 3D scanning for restoration of parts (particularly in the consumer goods, construction, aerospace and automotive sectors). In both sectors the copyright term and licensing (if the copyright term has expired) are key. In such cases, and considering it from the perspective of the 'author's own intellectual creation' the question is whether restoration and re-creation of ancient artefacts leading to a new physical product, should in turn lead to a new work, attracting new copyright? In other words, under what circumstances, should a new right, if at all, be considered? Also, are there new approaches which such cultural institutions need to think about in creating IP policies to accommodate 3D scanning and 3D printing? In particular, are these questions akin to scanning books, similar to the *Google* digitisation project?

Issues and Relevant IPRs

Use of 3D scanning (and 3D printing) has many benefits for restoration and preservation as well as for those who are visually impaired. However, it begs the question whether it is simply a copy of the original? In response, it should be noted that in the 2D space, there are IP cases which point to new subject matter (copyright) in terms of ancient artefacts *(Qimron v Dead Sea Scrolls)* and photography *(Antiquesportfolio)* to provide a couple of examples. In such cases, the purpose and intention was clear: the need for restoration and re-creation was to create a 'copy' for the public good and in both cases, much intellectual creation was expended by the creators. For example, the Court in *Qimron* held that *Qimron's* reconstitution of the 2000-year old *Dead Sea Scrolls* was an original work for purposes of copyright and established the deciphered text as a literary work. 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 which culminated in exhibiting particular qualities including the colour, features and details of the items. 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 sufficient to demonstrate a degree of skill and authorial input for copyright to exist in the photographs (see also section 4.2.1 above). Therefore, there is no reason why a similar approach cannot be adopted in the 3D scanning /3D printing context, if the purpose of the act is clearly not to infringe the authorship or ownership. Furthermore, as indicated by two SMEs (Int.35 and Int.39) and where substantial modfication can be evidenced in the scanned product (distinct from the antecedent work). It will also depend on *where* the 3D scanning is carried out. As one of the interviewees indicated (Int.35), the ownership of the artefact in the UK will almost always be held by the museum. In contrast, in countries such as Greece, Italy, Belgium amongst others, the Central Government has ownership of such artefacts.

Examples

'Potential IP infringement is obviously not just physical reproduction. If you could accurately reproduce a work of art, identical to the original and you are able to produce it in its physical form, then there is a blatant infringement of IP. But that only speaks to physical object IP. There is a huge amount of digital IP, like music, media, TV, bootlegging of games, movies … if you look at the direction that the

world is moving, probably the digital is at some point on a trajectory to overtake the physical world in terms of IP value. So, then that would include other forms of digital reproduction as well that would be I guess analogous to 3D scanning and 3D printing in a physical form' (Int. 39).

'I don't know whether there would be more IP value in physical items or in digital items but certainly if you look at the direction that the world is moving, probably the digital is at some point on a trajectory to overtake the physical world in terms of IP value' (Int.39).

Solutions and Recommendations

Whilst existing rights can be drawn upon to deal with the issues in this area, the companies operating in this area needs to update their IP policies to reflect 3D printing/scanning with at least the following contractual terms in place: (a) licensing conditions; (b) IPRs; (c) earnings; (d) partnerships with third parties; (e) marketing and (f) competition.

Case Study 5 Design Data and IP Rights – A New Approach?

4.4. Infringement Issues under Design Law

According to a recent public consultation by the European Commission, stakeholders in the design industry were undecided whether the current EU design law framework provided sufficient protection against third parties copying a protected design by means of 3D printing.[418] In the following sections, this report will provide insights as to whether this sentiment can be regarded as valid.

Registered design rights (both RCD and national design rights) are infringed by the use of the design, or a design that does not produce on the informed user a different overall impression, in the EU without the consent of the holder.[419] 'Use' covers *inter alia* the making, offering, putting on the market, importing, exporting or using of a product in which the design is incorporated or to which it is applied, or stocking such a product for such purposes.[420] It is important to note that no intention to infringe is required.[421]

According to Article 19(2) of the Design Regulation, UCDs are infringed under the same circumstances with one important qualification – the contested 'use' must result from copying the design. 'Copying' is not dealt with in the Regulation itself, but the recitals define it as a 'use' that is not 'resulting from an independent work of creation by a designer who may be reasonably thought not to be familiar with the design made available to the public'.[422]

[418] *Factual Summary report on the public consultation on the evaluation of EU legislation on design protection (Ref. Ares(2019)4979430)* (30 July 2019), p. 129.
[419] Articles 10(1) and 19(1) of the Design Regulation, Articles 9(1) and 12(1) of the Design Directive.
[420] Articles 19(1)2 of the Design Regulation and 12(1)2 of the Design Directive.
[421] David Stone, *European Union Design Law – A Practitioners' Guide*, (2nd ed), (OUP, 2016), para. 19.54.
[422] Recital 19(2) of the Regulation and *see* also recital 21 of the Regulation.

4.4.1. Designing

4.4.1.1. Creating

The first question to be asked in this chapter is whether creating a design from inception with the means of software tools resulting in a CAD file or by customising a valid design incorporated in a CAD file constitutes an infringement of EU Design law.

As a person creating a design from inception is the overarching goal of the EU Design law framework[423] no infringement will occur by doing so with the help of software tools. Rather, this creation will be subject to protection under EU Design law (see chapter 2 above).

Customisation occurs in situations where the original proprietary design is used as basis for inspiration or as a part of composition design. This process is more likely to take place with the rise of 3D printing as it is very convenient to change existing CAD files and may happen privately or commercially. It has been suggested that the emergence of design customisation would lead to a lack of protection against infringement for the designer of the original file.[424]

The author, however, agrees with *Nordberg* and *Schovsbo* who argue that 'customisation' will pose the traditional difficulties associated with delimiting the scope of pre-existing design rights.[425] It is therefore submitted that 'customisation' will have to be discussed in connection with 'protection', in particular the 'individual character' requirement, rather than 'infringement' and the reader is referred to chapter 2 above.

4.4.1.2. Scanning

The second question to be asked in this chapter is whether 3D scanning a valid design constitutes a 'use'. It is important to remember that the computer to which the scanner is connected to will create a design contained in a CAD file on its hard drive. As mentioned above, an action constitutes a use if it falls within one of the actions of the non-exhaustive list or otherwise is used. However, an action may not qualify as use if it is only a so-called preparatory act.[426]

A preparatory act encompasses the installation of machines, the acceptance of an order to manufacture, the entering into a contract for the production or drafting of sketches.[427] It has been suggested by *Mengden*[428] as well as by *Wiedemann* and *Engbrink*[429] that the creation of a design contained solely in a CAD file is a preparatory act.

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[423] See for example recital 7 of the Regulation.

[424] See also *The Economic Review of Industrial Design in Europe — Final Report (MARKT/2013/064//D2/ST/OP)*, (January 2015), p.133 with reference to Thomas Margoni, Not for Designers: On the Inadequacies of EU Design Law and How to Fix It [2013] 4(3) *Journal of Intellectual Property, Information Technology and E-Commerce Law* paras. 44 and 45.

[425] Ana Nordberg and Jens Schovsbo, in Rosa M. Ballardini, Marcus Norrgård and Jouni Partanen (eds), *3D Printing, Intellectual Property and Innovation – Insights from Law and Technology* (Wolters Kluwer, 2017), para. 13.03[3].

[426] Mario Franzosi, Marc-Roger Hirsch, Willem A. Hoyng et al., *European Design Protection - Commentary to Directive and Regulation Proposals*, (Wolters Kluwer, 1996), p.131.

[427] Mario Franzosi, Marc-Roger Hirsch, Willem A. Hoyng et al., *European Design Protection - Commentary to Directive and Regulation Proposals*, (Wolters Kluwer, 1996), p.131.

[428] Martin Mengden, 3D-Druck – Droht eine „Urheberrechtskrise 2.0"? Schutzumfang und drohende Rechtsverletzungen auf dem Prüfstand [2014] 17(2) *MultiMedia und Recht* 80.

Mengden's first argument is that the creation of a CAD file must be preparatory because, once created, the CAD file may still be altered and there are several further intermediate steps before it is 'physically produced'.[430] Hence, creating a CAD file supposedly resembles the 'drafting of sketches'.[431] It is submitted, however, that this argumentation cannot be followed as it relies upon two rebuttable arguments. This argument partly relies on a hypothetical action ('may still be altered') that will not be taken into account. Moreover, *Mengden* assumes that since there are several intermediate steps before the actual physical production takes place, the action of creating a CAD file must be seen as preparatory. This view neglects that there are other possible infringing actions to be considered apart from making a design.

Wiedemann and *Engbrink* argue that the scanning of designs must be seen as preparatory act because considering it a 'use' would lead to criminalising the scanning person.[432] This view is contrary to the (universal) legal principle of *ex iniuria ius non oritur* (a right does not arise from wrongdoing).

However, it has to be considered whether the mere act of 3D scanning a valid design indeed constitutes 'making' within the meaning of Articles 19(1) of the Design Regulation and 12(1) of the Design Directive. Making has been defined to be 'the creation of the design-infringing products'.[433] This broad definition would encompass the creation of a design contained merely in a CAD file. However, it is correct of *Mengden* to argue that only a 'physical production' of the design, but not the creation of a mere non-physical CAD file containing the design, falls within the meaning of making.[434] This view is rather comprehensible when examining the wording of the statute in languages other than English. For example, the language in French 'fabrication', in German 'Herstellung' and in Danish it is 'fremstilling'. The wording in these languages clearly indicates that 'making' is an industrial procedure including machinery and, hence, must be physical.

However, it is submitted agreeing with *Nordberg* and *Schovsbo,*[435] *Nordemann,* Rüberg and *Schaefer*[436] as well as *Malaquias*[437] that 3D scanning must be considered an 'other use' of the design as conferred by Articles 19(1) and 12(1) of the Design Directive.[438]

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429 Markus Wiedemann and Dennis Engbrink, Rechtliche Auswirkungen des 3D-Drucks auf Immaterialgüterrechte und gewerbliche Schutzrechte [2017] *Zeitschrift zum Innovations- und Technikrecht* 74.

430 Martin Mengden, 3D-Druck – Droht eine „Urheberrechtskrise 2.0"? Schutzumfang und drohende Rechtsverletzungen auf dem Prüfstand [2014] 17(2) *MultiMedia und Recht* 80.

431 Martin Mengden, 3D-Druck – Droht eine „Urheberrechtskrise 2.0"? Schutzumfang und drohende Rechtsverletzungen auf dem Prüfstand [2014] 17(2) *MultiMedia und Recht* 80.

432 Markus Wiedemann and Dennis Engbrink, Rechtliche Auswirkungen des 3D-Drucks auf Immaterialgüterrechte und gewerbliche Schutzrechte [2017] *Zeitschrift zum Innovations- und Technikrecht* 74.

433 Mario Franzosi, Marc-Roger Hirsch, Willem A. Hoyng et al., *European Design Protection - Commentary to Directive and Regulation Proposals*, (Wolters Kluwer, 1996), p.131.

434 Martin Mengden, 3D-Druck – Droht eine „Urheberrechtskrise 2.0"? Schutzumfang und drohende Rechtsverletzungen auf dem Prüfstand [2014] 17(2) *MultiMedia und Recht* 80.

435 Ana Nordberg and Jens Schovsbo, in Rosa M. Ballardini, Marcus Norrgård and Jouni Partanen (eds), *3D Printing, Intellectual Property and Innovation – Insights from Law and Technology* (Wolters Kluwer, 2017), para. 13.04.

436 Jan B. Nordemann, Michael Rüberg and Martin Schaefer, 3D-Druck als Herausforderung für die Immaterialgüterrechte [2015] 68(18) *Neue Juristische Wochenschau* 1267.

437 Pedro Malaquias, Consumer 3d Printing: Is the UK Copyright and Design Law Framework Fit for Purpose? [2016] 6(3) *Queen Mary Journal of Intellectual Property* para. III.A.1.i.

438 See also in this regard Thomas Margoni, Not for Designers: On the Inadequacies of EU Design Law and How to Fix It [2013] 4(3) *Journal of Intellectual Property, Information Technology and E-Commerce Law* paras. 44 and 45.

The first reason for this interpretation is the broad definition of 'use', and the non-exhaustive nature of the list of examples of 'use', that leads us to the presumption that the legislators are intending a broad[439] protection of designs. It has been argued that the legislator at all instances wanted to avoid loopholes in protection.[440] This favours the view that 3D scanning of a design is an infringing act.

Moreover, it is submitted that reasons of coherence dictate the adoption of this interpretation of use. It has already been submitted that a design contained solely in a CAD file may gain protection under EU design law.[441] This was based on the assumption that it does not matter 'how, or through which means' the design will be realised; it is the protection of the design *per se* that matters.[442] It is suggested that if it does not matter how or through which means the designs is protected, then it may also not matter how or through which means the product incorporating the design is replicated in order to establish an infringement. That is, a protection of designs having merely a non-physical state implies that these may be used in a merely non-physical state. As a result, 3D scanning and the hereby implicated digital replication of a valid design has to be considered a 'use' within the meaning of Articles 19(1) of the Design Regulation and 12(1) of the Design Directive.

Musker's definition of use also favours this view. He has suggested that any 'activities which profit from the design are uses'.[443] Here, the 3D scanning results in possessing of another (non-physical) copy of the design in form of a CAD file. Hence, in comparison to the situation without 3D scanning a person is enriched by a copy of the design in another physical state and has therefore profited from this activity.

It has been discussed, however, if the act of 'creation of a design document' should be included as an infringing use in order to gain protection against the scanning of valid designs.[444] As a template for such a provision Section 226 (1)(b) Copyright Designs Patents Act (CDPA 1988) (UK) has been suggested as this provision extends primary design infringement to 'making a design document recording the design for the purpose of enabling such articles to be made'. The definition of a design document is provided within Section 263 CDPA 1988 and states that '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. This definition supposedly encompasses CAD created for the purposes of 3D printing. In the opinion of the authors such a clarification is not needed as 3D scanning already is considered a use as discussed above. However, due to the different interpretations in the literature, such a clarification is necessary in order to avoid futile contentions in the future.

4.4.2. Using and Sharing the CAD file

Sharing a CAD file containing the protected design may take place by uploading, hosting or downloading the file and occurs also via the means of ISPs (the latter will be

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[439] David Musker, *Community Design Law: Principles and Practice,* (OUP, 2002), para. 1-127.

[440] Mario Franzosi, Marc-Roger Hirsch, Willem A. Hoyng et al., *European Design Protection - Commentary to Directive and Regulation Proposals*, (Wolters Kluwer, 1996), p.131.

[441] *See* Chapter 2.

[442] Mario Franzosi, Marc-Roger Hirsch, Willem A. Hoyng et al., *European Design Protection - Commentary to Directive and Regulation Proposals*, (Wolters Kluwer, 1996), p. 43 footnote 25.

[443] David Musker, *Community Design Law: Principles and Practice,* (OUP, 2002), para 1-127.

[444] *Legal review on industrial design protection in Europe (MARKT2014/083/D)* (15 April 2016), p. 133; Pedro Malaquias, Consumer 3D Printing: Is the UK Copyright and Design Law Framework Fit for Purpose? [2016] 6(3) *Queen Mary Journal of Intellectual Property* para. IV.A.

examined later in the chapter). In the following, it shall be assessed whether sharing can be considered an infringement.

4.4.2.1. Uploading to a publicly accessible website

Mengden relies on the provisions stipulating the possibility of a preventable action of indirect infringement in patent law and the law of utility models in order to argue that a person uploading indirectly infringes design rights.[445] German patent and utility model law and the equivalent for patents in the UK patent law both provide that a patent or utility model is infringed where a person contributes to, but does not directly take part in the infringement.[446] *Mengden* argues that uploading the CAD file is supplying the means, relating to an essential element of the invention, for putting the invention into effect. However, EU design law and German design law both do not include such a provision. Moreover, even if such an indirect infringement principle could be applicable within design law, supplying a third party with the CAD file must be interpreted as a direct infringement since the design is incorporated in the CAD file (see above). Therefore, *Mengden's* reasoning cannot be followed for the interpretation of European Union design law[447] and uploading a CAD file to a public accessible website cannot be considered an indirect infringement.

It could, however, be considered that the uploading is offering a product incorporating the design. *Ohlgart* suggests that 'offering' means 'proposing to a third party, i.e. a member of the general public the transfer of physical control of the design-infringing products'.[448] An upload to a publicly accessible website must be considered, in effect, as an offer to transfer the control over the design to a member of the public. This becomes even more clear when it is considered that offering does not require any sale of the product.[449] However, at first glance, *Ohglart's* definition of offering would not include the uploading of a design contained in CAD file to a website as there is no transfer of 'physical' control of the design in this mere digital action. However, *Ohlgart* explains further that 'offering' 'can also be assumed in a case where the design-infringing products have not yet been created at the date when the offer was made'. He is of the opinion that offering must not be dependent upon 'making' as it is a separate, independent infringing act. Therefore, 'offering' is unconditional upon the physical existence of the goods offered. As a result, designs contained merely in CAD files can also be offered. Following *Ohlgart's* reasoning means that the action of uploading the CAD file containing the design to an accessible website constitutes 'offering' within the meaning of Articles 19(1)2 of the Regulation and 12(1)2 of the Directive.

This finding is in line with the arguments made by *Reeves* and *Mendis*[450] (arguing from a UK perspective) as well as *Nordberg* and *Schovsbo*[451] who consider the uploading of a CAD file an infringement. As this interpretation provides reasonable protection of the

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[445] Martin Mengden, 3D-Druck – Droht eine „Urheberrechtskrise 2.0"? Schutzumfang und drohende Rechtsverletzungen auf dem Prüfstand [2014] 17(2) *MultiMedia und Recht* 80.

[446] Patentgesetz § 10, Gebrauchsmustergesetz § 11(2) and Patent Act (1977) s.60(2).

[447] Mario Franzosi, Marc-Roger Hirsch, Willem A. Hoyng et al., *European Design Protection – Commentary to Directive and Regulation Proposals*, (Wolters Kluwer, 1996), p.129 and 137.

[448] Mario Franzosi, Marc-Roger Hirsch, Willem A. Hoyng et al., *European Design Protection – Commentary to Directive and Regulation Proposals*, (Wolters Kluwer, 1996), p.134.

[449] David Stone, *European Union Design Law – A Practitioners' Guide*, (2nd ed), (OUP, 2016), para. 19.59.

[450] Dinusha Mendis and Phil Reeves, *The Current Status and Impact of 3D Printing Within the Industrial Sector: An Analysis of Six Case* Studies, (Intellectual Property Office, 2015), p. 9.

[451] Ana Nordberg and Jens Schovsbo, in Rosa M. Ballardini, Marcus Norrgård and Jouni Partanen (eds), *3D Printing, Intellectual Property and Innovation – Insights from Law and Technology* (Wolters Kluwer, 2017), para. 13.04[B][2].

design, an explicit change to the statute as has been suggested is not necessary and is not encouraged.[452]

Unlike offering, putting on the market has been defined as actually providing a third party with the 'physical' control of the design-infringing products.[453] The exclusion of designs merely contained in CAD files of that preventable form of use offers a reasonable possibility to differentiate between the 'physical' and 'non-physical' infringement.

4.4.2.2. Hosting

Before proceeding to further examination, it is important to differentiate between hosts that upload the designs to the websites themselves and hosts that merely provide an online platform for users to upload the designs (i.e. an online repository, as for example shapeways.org or thingiverse.com). The former action clearly falls within the meaning of offering due to the above stated reasons. Online repositories, however, shall be the subject of the following assessment. The infringement of UCDs is exempted from this assessment, as it cannot be reasonably expected that the host is 'copying' in this respect. Possible infringing actions could be offering or storing.

As mentioned, offering has been defined as proposing to a third party (i.e. a member of the general public) the transfer of control of the design-infringing products. It appears to be problematic that it is not the host of an online platform who is actually proposing the transfer of control of the CAD files rather the party uploading the file. The fact that use lacks a subjective requirement could lead to the conclusion that the operator is 'offering' the design as it is proposed to a third party on the hosted website. However, one has to consider that it is the act of uploading itself that is the causal act for proposing the control of the design. Therefore, it is submitted, it is solely the party uploading the file who is infringing the design by 'offering' and not the operator.

The prohibitions are extended to 'stocking' such a product for those purposes. 'Stocking' includes not only in-store provisions of products, but all forms of storage. The host of a website stores the design contained in the CAD file for the purpose of the uploading party offering it. Furthermore, stocking must include hosting the design contained in the CAD file on a website as the action can take all kinds of forms. This would lead to the conclusion that hosting an online platform where users may up- and download designs contained in CAD files constitutes 'stocking'.

Ohlgart, however, suggests a test that examines who is in 'economic control' of the design-infringing products in order to determine who is the stockist. This test might be helpful in respect of physical stocking and distribution. But since the economic control of such platforms may not be very transparent (e.g. by the contracting parties adopting agency models), this test may not be suitable for the digital environment.

Therefore, it is submitted, hosting an online platform where the uploading party may upload infringing material (offering designs contained in CAD files) constitutes 'stocking'. Similarly, *Malaquias* considers hosting a use.[454]

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[452] *Legal review on industrial Design Protection in Europe (MARKT2014/083/D)* (15 April 2016) p. 133.

[453] Mario Franzosi, Marc-Roger Hirsch, Willem A. Hoyng et al., *European Design Protection – Commentary to Directive and Regulation Proposals*, (Wolters Kluwer, 1996), p 135.

[454] Pedro Malaquias, Consumer 3d Printing: Is the UK Copyright and Design Law Framework Fit for Purpose? [2016] 6(3) *Queen Mary Journal of Intellectual Property* para. III.B.2.

In the light of the above the author is not in favour of supposedly clarifying 'patent-like' provisions against indirect (intermediary) design infringement that are intended to facilitate enforcement[455] as the current law already provides for the necessary protection of rightholders in this hindsight. *Nordberg* and *Schovsbo* are also critical of such patent-like provisions against indirect design infringement as these – in contrast to design law – require knowledge[456] and thereby may seem less effective.

4.4.3. Printing and Distributing

3D printing a copy of a valid design is widely agreed to constitute 'making' of a product incorporating the design within the meaning of Articles 19(1) of the Design Regulation and 12(1) of the Design Directive.[457]

Acts necessary for distributing a printed design may constitute several infringements such as 'offering', 'putting on the market', 'importing', 'exporting' or 'stocking' within the meaning of Articles 19(1) of the Design Regulation and 12(1) of the Design Directive.

Summary

- **Designing a CAD file** – (a) designing a CAD file from inception without any doubt does not constitute an infringement of the rights conferred by EU design law. Customising existing designs will pose the traditional difficulties associated with delimiting the scope of pre-existing design rights and is a matter of design protection rather than infringement.

- (b) a CAD file which is created through scanning a physical (protected) product: It is controversially discussed whether scanning a protected design may constitute an infringement. A clarification to this effect is therefore recommended.

- **Sharing a CAD file** – (a) uploading a CAD file to a publicly accessible website will most likely constitute a direct infringement.

- (b) hosting is also considered a use of the design and this is why the clarifications that have been suggested in this respect are unnecessary. Downloading a design contained in a CAD file must also be evaluated as a use.

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455 *Legal review on industrial design protection in Europe (MARKT2014/083/D)* (15 April 2016) p. 133.

456 Ana Nordberg and Jens Schovsbo, in Rosa M. Ballardini, Marcus Norrgård and Jouni Partanen (eds), *3D Printing, Intellectual Property and Innovation – Insights from Law and Technology* (Wolters Kluwer, 2017), para. 13.04[B].

457 Simon Bradshaw, Adrian Bowyer and Patrick Haufe, The Intellectual Property Law implications of Low-Cost Printing [2010] 7(1) *SCRIPTed – A Journal of Law, Technology and Society* 19; Dinusha Mendis, "The clone wars": episode 1 - the rise of 3D printing and its implications for intellectual property law – learning lessons from the past? [2013] 35(3) *European Intellectual Property Review 164*; Martin Mengden, 3D-Druck – Droht eine „Urheberrechtskrise 2.0"? Schutzumfang und drohende Rechtsverletzungen auf dem Prüfstand [2014] 17(2) *MultiMedia und Recht* 80; Lambert Grosskopf, 3D-Druck Personal Manufacturing [2012] 28(9) *Computer und Recht* 620; Christian Stücke, *Rechtsfragen des 3D-Druckes* (Beck-Online.de, 11 January 2013) http://community.beck.de/gruppen/forum/rechtsfragen-des-3d-druckes; Ana Nordberg and Jens Schovsbo, in Rosa M. Ballardini, Marcus Norrgård and Jouni Partanen (eds), *3D Printing, Intellectual Property and Innovation – Insights from Law and Technology* (Wolters Kluwer, 2017), para. 13.03; Jan B. Nordemann, Michael Rüberg and Martin Schaefer, 3D-Druck als Herausforderung für die Immaterialgüterrechte [2015] 68(18) *Neue Juristische Wochenschau* 1267; Markus Wiedemann and Dennis Engbrink, Rechtliche Auswirkungen des 3D-Drucks auf Immaterialgüterrechte und gewerbliche Schutzrechte [2017] *Zeitschrift zum Innovations- und Technikrecht* 78, Pedro Malaquias, Consumer 3d Printing: Is the UK Copyright and Design Law Framework Fit for Purpose? [2016] 6(3) *Queen Mary Journal of Intellectual Property* para. III.B.1.

- Printing and Distributing the 3D Model are both acts which have to be considered an infringement of the rights conferred by EU Design law.

4.5. Infringement Issues under Trade Mark Law

In considering trade mark infringement within the 3D printing process, the follow structure encompassing (a) designing a CAD file, (b) sharing a CAD file and (c) printing a model, will be followed.

4.5.1. Trade Mark infringement through designing a CAD file

Where the CAD file in its design data contains a registered trade mark (e.g. word figurative or three-dimensional trade mark), it is important to question whether this gives rise to a trade mark infringement. As stated above, a trade mark may become part of the CAD file through inception or scanning of a physical object.

One example is a CAD file of toy bricks, which contains the LEGO trade mark:[458]

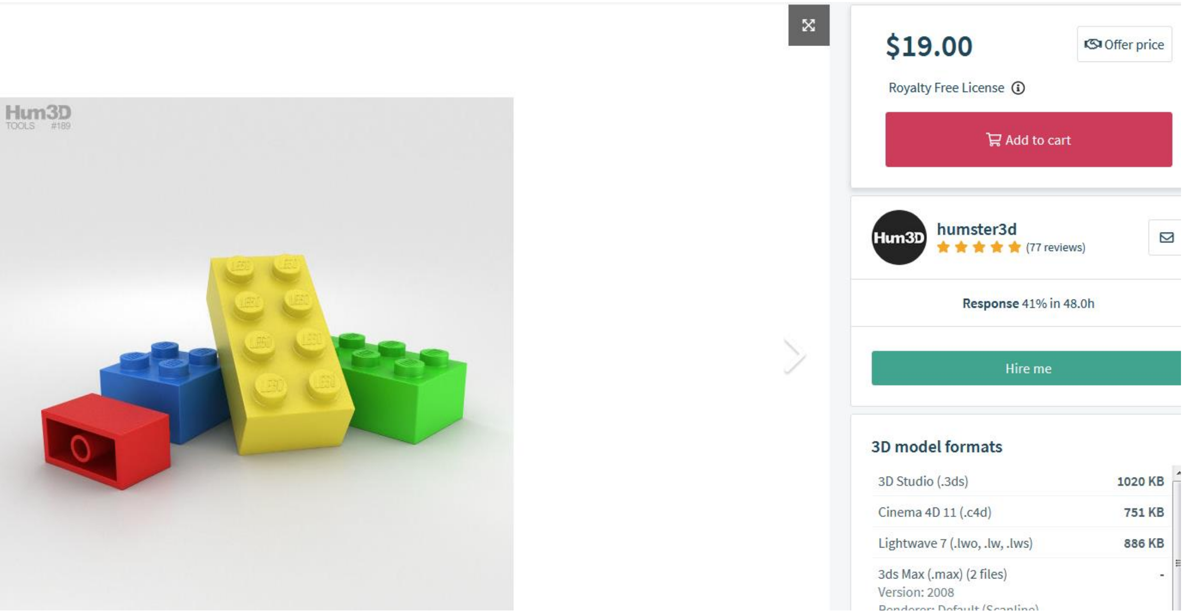

Figure 23 (Source: CGTrader)

According to Art. 9 EUTMR and Art. 10 TM Directive, the owner shall enjoy exclusive right in the registered trade mark. In particular, the owner is protected against a use of an identical trade mark for identical services, against a confusingly similar use or – in case of a certain reputation of the trade mark – against a use which without due cause takes unfair advantage of, or is detrimental to, the distinctive character or the repute of the trade mark. Also, pursuant Art. 9 (3) (a) EUTMR and Art. 10 (3) (a) TM Directive, the following may be prohibited by the trade mark owner in case of an infringing use: 'affixing the sign to the goods or to the packaging of those goods'.

[458] The example is taken from the platform CGTRADER, see https://www.cgtrader.com/3d-models/various/various-models/lego-brick-d312ca17-330f-469e-b589-6e6275b9a034

4.5.1.1. Inclusion of the Protected Trade Mark into a CAD file: Trade Mark Use?

As such, the first question is whether the inclusion of a protected trade mark into a CAD file – like in the LEGO example above – constitutes 'sufficient trade mark use', which is necessary for a trade mark infringement.[459]

Some authors argue that the inclusion of a trade mark into a CAD file does not constitute trade mark use as the CAD file does not include the trade mark in a visible form. The CAD file would only include a description of how a product bearing trade marks should be printed.[460]

While this argument has some merits, there is a growing body of literature which suggests that the inclusion of product bearing a trade mark into a CAD file as trade mark use.[461]

We are of the latter opinion and find that the inclusion of a trade mark into a CAD file constitutes trade mark use. This is for the following reasons:

- It needs to be borne in mind that trade mark use pursuant to Art. 9 EUTMR, Art. 7 TM Directive is recognised by the CJEU in cases where the trade mark is used to distinguish goods of one undertaking from the goods of another undertaking including for the purpose of product identification.[462] Accordingly, a trade mark use may be found, if the marks assist in distinguishing products as to their *origin and quality*. Trade marks, which are part of a product (design data) incorporated into a CAD file file, will differentiate the CAD file from other CAD files, which incorporate other products. One example is the LEGO example above: CAD files with design data bearing the LEGO trade mark may be differentiated from other CAD files as to their origin and quality.

- Also, including a trade mark into the design data of a CAD file seems to be comparable to affixing a trade mark to a product. Affixing a trade mark to a product is one of the recognised trade mark uses in Art. 9 (3) lit. a EUTR and Art. 10 (3) lit. a TM Directive.[463]

- Further it does not seem correct that a trade mark included in a CAD file is not visible; it can be viewed through the usual software to display CAD files.

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[459] CJEU of 23.3.2010, C-236/08 to C-238/08 para. 75 – *Google France/Louis Vuitton*.

[460] Taina Pihlajarinne in Rosa Maria Ballardini, Markus Norrgard & Jouni Partanen*, 3D printing, Intellectual Property and Innovation* (Alphen aan de Rijn; Wolters Kluwer; 2017), p. 313.

[461] Same opinion: Andreas Wiebe in *Leupold/Glossner, 3D Printing,* (Munich, C.H. Beck; 2017), part 8, chapter 4 note 100; Jan Bernd Nordemann/Michael Rueberg/Martin Schaefer, ‚3D-Druck als Herausforderung für die Immaterialguetterrechte', (2015) *Neue Juristische Wochenschrift (NJW),* 1265 at 1268; Also with a strong tendency in favour of a trade mark use: Dukki Hong and Simon Bradshaw, *"Digital trade mark infringement and 3D printing implications: What does the future hold?"* in Dinusha Mendis, Mark Lemley & Matthew Rimmer, (eds.) (Cheltenham and Northampton; Edward Elgar; 2019), Chapter 4 at 3.1. and more clear 4.1.

[462] CJEU of 23.3.2010, C-236/08 to C-238/08 para. 70 – *Google France/Louis Vuitton*.

[463] Dukki Hong and Simon Bradshaw, *"Digital trade mark infringement and 3D printing implications: What does the future hold?"* in Dinusha Mendis, Mark Lemley & Matthew Rimmer (eds.) (Cheltenham and Northampton; Edward Elgar; 2019), Chapter 4 at 3.1. and 4.1.

As a result, in particular word and figurative trade marks are used as a trade mark, if they are part of the printable object.[464]

Consequently, the same must also be true for three-dimensional trade marks. Such three-dimensional trade marks will also be used as a trade mark, in case the identical form of the trade mark has been registered.[465] Some commentators, however, think that even in the case of a design data (printable object) represented through a CAD file, there will be a lack of infringement of a three-dimensional trade mark, if for the average consumer the shape would not serve to identify the origin of the product.[466] This is not convincing. Where a three-dimensional trade mark is registered, the registered three-dimensional shape would represent a sufficient distinctive character as to the origin.[467] The only way to avoid infringement in case of identical use is to challenge the EUIPO's or the national trade mark office's decision to register. This can be, however, different if the shape of the design represented in the CAD file is somewhat different from the three-dimensional trade mark and the shape used is outside the scope of protection of the three-dimensional trade mark. In these cases – also outside 3D printing scenarios – there may be a lack of trade mark use.[468]

In any case, the open question of trade mark use in CAD files will likely only have a limited practical relevance. Those offering the (unauthorised) CAD file with the trade marks e.g. on internet platforms or other websites will usually use the trade marks to advertise the CAD file for download. Such use will constitute trade mark use. This is shown for example in connection with the above mentioned LEGO CAD file offered; the word mark LEGO is used to advertise the CAD file as 'Lego Brick 3D Model', which should constitute a trade mark use of LEGO:

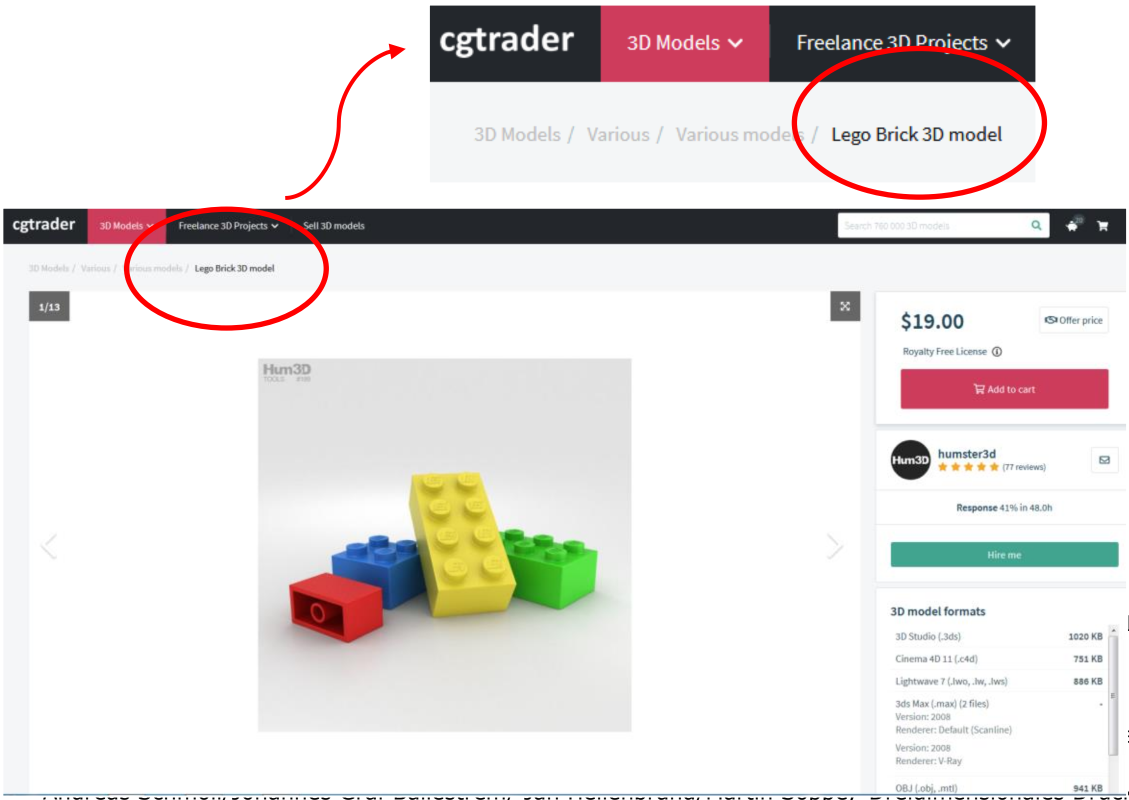

Figure 24 (Source: CGTrader)

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und die vier Dimensionen des Immaterialgüterrechts', (2015) *Gewerblicher Rechtsschutz und Urheberrecht (GRUR)*, 1041 at 1050.

467 See for this protection requirement of 3-dimensional trade marks above.

468 See below 4.5.3.

se offering CAD files may opt for generic descriptions (e.g. in the Lego example, 'famous toy bricks'). Consequently, the issue of trade mark use in CAD files will continue to have some practical relevance in trade mark enforcement.

If no trade mark use can be found, the inclusion of trade marks into a CAD file should at least be seen as a preparatory act to trade mark infringement pursuant Art. 10 EUTMR and Art. 11 TM Directive. The definition of preparatory acts is quite openly drafted in both lit (a) and lit (b) of Art. 10 EUTMR and Art. 11 TM Directive. In so far, the definition of preparatory act includes packaging, labels, tags or any other means, to which the trade mark is affixed. This is meant to include in particular, means bearing the trade mark, which are later affixed to the product as such. This scenario seems comparable to including a trade mark into the CAD file.[469] The CAD file includes the trade mark, which is used to print a product substituting the original product. Against this background, this should come under Art. 10 EUTMR and Art. 11 TM Directive.

4.5.1.2. Miniature Model Privilege?

As the CAD file does not constitute a miniature model, the case law of the Court of Justice of the European Union (CJEU) on the permissibility of the manufacture and distribution of miniatures[470] will not apply in this context.[471] The relevant case law states that in case of miniature cars, even if it bears the original trade mark, the buyer would not assume a licensing deal for miniature cars in connection with the manufacture of the automotive in question. Consequently, if the CAD file is only used to print miniatures models, a trade mark issue should not arise.[472] This seems, however, to be different for CAD files, where the CAD file is primarily used to make (print) a substitute copy.[473]

However, this may be different if the CAD files are too complex to print and can therefore solely be (electronically) used for other purposes than printing. Such non-printing uses could be electronic games. For example a smartphone offered as a CAD file could not be used to print an operational smatphone, as the technology inside could not be 3D printed. But the smartphone CAD file could be used in a computer game to supply game characters with this smartphone. This could lead to an argument comparable to the miniature cars case law (as also outlined above) that no trade mark infringement could be regarded. However, where the average user assumes licensing ties, the situation will be different. As original equipment manufacturers (OEM) begin to license such CAD files, such scenarios as discussed above, should be taken into consideration.[474]

4.5.1.3. Different Infringement Scenarios: Dual Identity, Likelihood of Confusion, Well-Known Marks

Delving deeper into the above issues, the report will now explore various infringement scenarios arising out of the inclusion of trade marks within CAD files.

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[469] Jan Bernd Nordemann/Michael Rueberg/Martin Schaefer, '3D-Druck als Herausforderung für die Immaterialguetterrechte', (2015) *Neue Juristische Wochenschrift (NJW)*, 1265 at 1268.

[470] CJEU 25.01.2007, C-48/05 - *Opel-Logo*; see also German Federal Supreme Court (BGH), *Gewerblicher Rechtsschutz und Urheberrecht (GRUR)* 2010, 726 - *Opel-Blitz II*.

[471] Other opinion: Dukki Hong and Simon Bradshaw, *"Digital trade mark infringement and 3D printing implications: What does the future hold?"* in Dinusha Mendis, Mark Lemley, & Matthew Rimmer (eds.) (Cheltenham and Northampton; Edward Elgar; 2019), Chapter 4 at 3.1.

[472] Andreas Wiebe in *Leupold/Glossner, 3D Printing*, (Munich, C.H. Beck; 2017), part 8 chapter 4 note 112.

[473] Jan Bernd Nordemann/Michael Rueberg/Martin Schaefer, '3D-Druck als Herausforderung für die Immaterialguetterrechte', (2015) *Neue Juristische Wochenschrift (NJW)*, 1265 at 1268; Andreas Wiebe in *Leupold/Glossner, 3D Printing,* (Munich, C.H. Beck; 2017), part 8 chapter 4 note 111, 112.

[474] See above *Ford* example, figures 17 and 19.

Dual identity: Under European law standards, a direct trade mark infringement through dual identity, namely the use of an identical mark for identical goods[475] would likely be excluded, as the CAD file merely constitutes the (printing) blueprint for the final product.[476] It is not the printed product.

This would only be different, in case the trade mark owner also enjoys trade mark protection for the CAD file as such in class 9.[477] In case of protection for CAD files in class 9, a direct infringement due to dual identity is possible.

Likelihood of confusion: In the case of a printable object bearing a registered trade mark and the trade mark only being registered for the printed product, the relevant possibility in this context would be a trade mark infringement due to a likelihood of confusion.[478] This will be the case as the CAD file will be classified as a 'similar' good in comparison to the printed product:

- The CAD file is an upstream (pre-)product; such products are usually seen as similar compared to the end-product.[479]

- OHIM (now EUIPO) has found design services for the product in question to be similar with the product itself.[480]

- Similarity of products has been recognised, even if one product is outside the same product family. In such cases, the finding of similarity requires that the average buyer assumes a responsibility of the end-manufacturer also for other products outside the usual product family. This will be the case, if there exists a settled practice for the average buyer that the usual family of products is extended to products normally not included.[481] Original Equipment Manufacturers (OEMs) may offer 3D models, whilst others (such as Ford, see above)[482] at least license the use of their trade marks for CAD files. This speaks in favour of including CAD files into the product family of the scanned object.[483]

Nonetheless, there is a some uncertainty here. This is linked to the level of control that can be asserted by a trade mark owner to control the printing of products with the trade mark. In the 3D world, there may be trade marks, which are only used by the owner to offer CAD files for 3D printing, but the owner does not itself print (and sell) the products itself. 3D printing technology allows a 'liberalisation' of the production process.[484] The production process is disseminated and allows the trade mark owner to merely provide the CAD file, but leave the printing e.g. to the purchaser of the downloaded CAD file. In particular in cases, where the consumer assumes that the trade mark owner will not be

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[475] Art. 9 (1) a EUTMR.
[476] Jan Bernd Nordemann/Michael Rueberg/Martin Schaefer, '3D-Druck als Herausforderung für die Immaterialguetterrechte', (2015) *Neue Juristische Wochenschrift (NJW)*, 1265 at 1268; Andreas Wiebe in *Leupold/Glossner, 3D Printing,* (Munich, C.H. Beck; 2017), part 8 chapter 4 note 111, 112.
[477] See above, Chapter 2.
[478] Art. 9 (1) b EUTMR.
[479] CFI 12.11.2008, T-242/07 - *Qweb/Q2Web*.
[480] EUIPO (OHIM) 13, BK R 1540/11-4.
[481] CFI of 16.5.2007, T-158/05 para. 64 – *TrekBicyle/Audi*.
[482] See above, Chapter 2.
[483] Jan Bernd Nordemann/Michael Rueberg/Martin Schaefer, '3D-Druck als Herausforderung für die Immaterialguetterrechte', (2015) *Neue Juristische Wochenschrift (NJW),* 1265 at 1268.
[484] Nina Natalia Baranowska, 'The Intersection of 3D Printing and Trademark Law', 9 (2018) *JIPITEC* 251 para. 24 et seq.

able to control the print of the CAD file, it will be difficult to argue sufficient likelihood of confusion between the registered trade mark (for the printed good) and the use for CAD files. As such, a protection gap is envisaged in this context, which could require legislative action. But it needs to be awaited, whether such a consumer assumption will ever become reality.

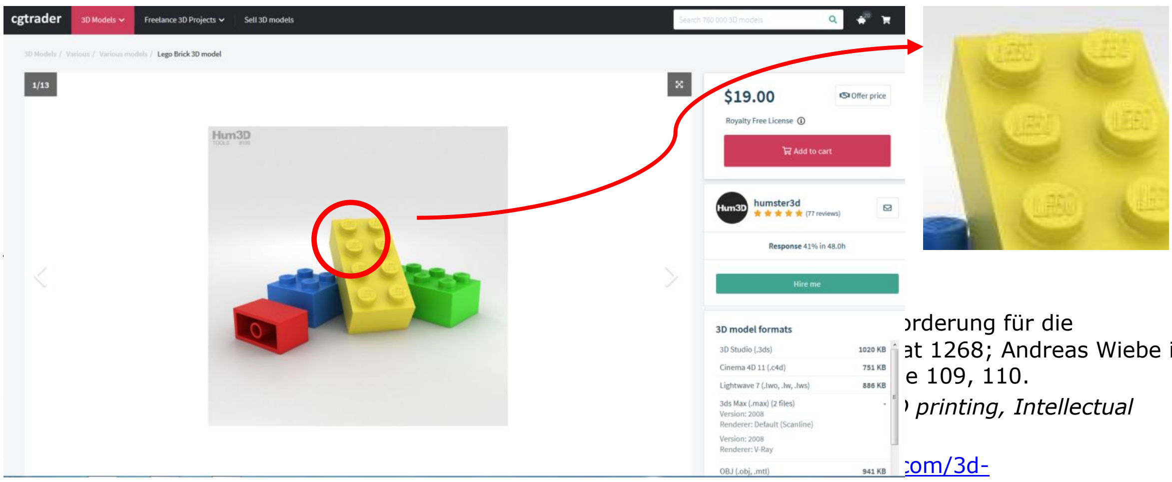
As a recommendation, original manufacturers who are considering offering their own legal CAD files for 3D printing should also register their marks in international goods class 9 as 'downloadable electronic publications' in order to secure a comprehensive trade mark protection with no gaps (see above 3.2. Protecting 3D printed related marks: Implications for Trade Mark Law). Manufacturers who are not planning to use the CAD files themselves could also benefit from this option, if the respective jurisdiction allows registration in such cases. But they would have to bear in mind the limited period of 5 years due to the compulsory use provisions.

Well-known marks: For proprietors of (well-known) marks with reputation, protection through Art. 9 (1) (c) EUTMR, Art. 10 (1) (c) TM Directive is also possible. This protects the so-called investment function of a trade mark. In case of a well-known trade mark, the scope of protection is extended in order to reward the owner for its investment into making the trade mark well-known. For owners of such well-known marks invoking Art. 9 (1) c EUTMR, Art. 10 (1) (c) TM Directive would have the advantage that they do not need to show a risk of confusion. Rather, it is sufficient that the CAD file uses the well-known trade mark and – without due cause – takes unfair advantage of the reputation of the mark, where it is detrimental to the distinctive character or the repute of the mark. This should be regularly the case, as the CAD file will draw its value from the increased attention a well-known trade mark creates[485] thereby drawing interest from the average consumer. Lending support to this argument, authors have rightly pointed out that the protection of well-known trade marks will gain increasing importance in the field of 3D printing.[486] In any case, owners of well-known trade marks seems to enjoy a much stronger protection against the use of their marks in CAD files than owners of 'regular' marks.

4.5.2. Trade Mark Infringement through Sharing the CAD file

In a lot of cases, the CAD file will be offered publicly (e.g. on the internet).

Again, one example is a CAD file of toy bricks, which contains the LEGO trade mark. The example file was offered for download against remuneration of USD19.00 on the 3D printing file platform 'CGTRADER':[487]



…rderung für die
…at 1268; Andreas Wiebe in
…e 109, 110.
…) printing, Intellectual

…com/3d-models/various/various-models/lego-brick-d312ca17-330f-469e-b589-6e6275b9a034

Figure 25 (Source: CGTrader)

According to Art. 9 (3) (b) EUTMR and Art. 10 (3) (b) TM Directive, the owner may also prohibit the 'offering the goods, putting them on the market, or stocking them for those purposes under the sign, or offering or supplying services thereunder'. This right to prohibit is another case group of possible acts of infringement. So public offers of CAD files – e.g. against remuneration on platforms like 'CGTRADER' – will come under this right to prohibit, in case the trade marks included into the printable object are used as a trade mark in an infringing way. The same issues will arise as stated above for creating the CAD file. Please see under 4.5.1. for details.

Trade mark use: If CAD files are offered to the public, it is an open question if this constitutes a use of the trade marks included into the CAD file. But we think that this is the case.[488] At least, this should constitute a relevant preparatory act.[489]

In case of offering in public there is an additional scenario which needs to be taken into account: Those offering the (unauthorised) CAD file with the trade marks e.g. on internet platforms or other websites will usually need to use the trade marks to advertise the CAD file for download. Here, for example, word and figurative trade marks will be used. Such use will constitute trade mark use in any case as the file will be advertised under a certain trade mark. Please see above.[490]

Miniature model privilege: The miniature model case law should not apply to CAD files offered to the public, which are meant to substitute the original. For other scenarios it may be more difficult to find trade mark use.[491]

Double identity, likelihood of confusion, well-known marks: In case of CAD files offered to the public, double identity of the trade mark used has to be ruled out, in case the trade mark is not protected in class 9 for electronic files (but merely in the respective class of the printed product). But there seem to be various arguments that a risk of confusion may be assumed.[492] Trade mark owners are advised to seek protection also in international class 9 for electronic files.[493] For well-known trade marks, a possible gap in protection is less likely, as according to Art. 9 (2) c) EUTMR, Art. 10 (2) (c) TM Directive no confusion needs to be shown and their use to identify CAD files should come within the scope of protection.[494]

4.5.3. Trade Mark Infringement through Printing the Object and Distributing it

The actual printing of a competing product which contains the protected mark constitutes a clear trade mark infringement, irrespective of the material used. It is a case of affixing the mark to a product (Art. 9 (3) (a) EUTMR and Art. 10 (3) (a) TM Directive). The way of producing trade marked products through 3D printing processes – in contrast to traditional production – does not change the legal assessment. The usual

488 See above 4.5.1.1.
489 See above 4.5.1.1. at the end.
490 See above 4.5.1.1.
491 See above 4.5.1.2.
492 See in detail above 4.5.1.3.
493 See 4.5.1.3.
494 See above 4.5.1.3.

assessment for an infringement, which has been developed outside the 3D printing world, applies.

The subsequent distribution of the print-out is also an infringement of the protected mark (Art. 9 (3) (b) EUTMR and Art. 10 (3) (b) TM Directive).

It may become an issue, however, that the print-out is not identical to the trade marks protected.

- For word and figurative trade marks, the usual rules apply to determine a likelihood of confusion.

- For three-dimensional trade marks, the question is whether a slight change to the shape will exclude infringement. The scope of protection of three-dimensional trade marks seems rather limited. This is because the shape is only eligible for trade mark protection in case the shape has a distinctive character. As the perception of the relevant public in relation to a three-dimensional trade mark consisting of the appearance of the product itself is not necessarily the same as it is in relation to wordmarks or figurative marks (logo), it will be more difficult to show the distinctive character of a three-dimensional mark compared with a wordmark.[495] In those circumstances, only a mark which departs significantly from the norm or costumes of the sector and thereby fulfils its essential function of indicating origin is not devoid of any distinctive character.[496]
  Even if the lack of initial distinctiveness acquired through use may be overcome, smaller changes in the shape may result in the scope of protection not applying any longer. This is also true for 3D printed products.[497] But these aspects are not special to 3D printing and are not further explored here.

4.5.4. Relevance of 'Post-Sale' Confusion: Avoiding Infringement through Disclaimers that the product is a non-authorised product?

The person offering the file or the printed product could try to avoid an infringement by an explicit notice stating that the product is not the original but a non-authorised print-out.

In such scenarios, the question of 'post-sale' confusion comes up. While the buyer is not confused as to the origin of the trade mark (e.g. because he or she has been informed through the notice/disclaimer), consequent buyers may be confused. Under EU case law, a statement that the products are not licensed cannot rule out a trade mark infringement.[498]

Some authors claim, however, that in 3D printing scenarios the post-sale confusion doctrine would need to be questioned. 3D printing technology would 'profoundly affect how the origin function of a trade mark is generally understood'.[499] In particular the

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[495] CJEU of 22.06.2006, C-25/05 para. 18 – *Storck/HABM*; CJEU of 7.10. 2004, C-136/02 para. 38 – *Henkel/OHIM*.
[496] CJEU of 22.06.2006, C-25/02 para. 28 – *Storck/OHIM* with further references from the CJEU case law.
[497] Taina Pihlajarinne in *Rosa Maria Ballardini/Markus Norrgard/Jouni Partanen, 3D printing, Intellectual Property and Innovation* (Alphen aan de Rijn; Wolters Kluwer; 2017), p. 309.
[498] CJEU of 12.11.2002, C- 206/01 para. 57 – *Arsenal Fooball Club*; same opinion German Federal Supreme Court (BGH) 30.4.2008 - I ZR 73/05 para. 60 – *Internetversteigerung III (Internet Auction III)*.
[499] Taina Pihlajarinne in Rosa Maria Ballardini/Markus Norrgard/Jouni Partanen*, 3D printing, Intellectual Property and Innovation* (Alphen aan de Rijn; Wolters Kluwer; 2017), p. 310.

potential for private manufacturing may increase the blurring of the lines between the trade mark used and the actual origin of goods.[500]

Yet, it must be pointed out that such arguments only seem convincing in some scenarios.

In scenarios, where 3D printing technologies are extensively used, consumers may change their current anticipation that a trade mark represents a certain origin and quality.[501] In the 3D world, there may be trade marks, which are only used by the owner to offer CAD files for 3D printing, but the owner does not itself print (and sell) the products itself. 3D printing technology allows a 'liberalisation' of the production process.[502] The production process is disseminated and allows the trade mark owner to merely provide the CAD file, but leaves the printing e.g. to the purchaser of the downloaded CAD file. In this case, a post-sale confusion by consumers – as to the 3D printed product – can be indeed ruled out.

But in scenarios where trade mark owners do not offer 3D printing files themselves, post-sale confusion should remain an argument, as otherwise owners would be deprived of trade mark protection without choosing to enter the 3D printing world.

Trade mark owners who offer 3D printing files can avoid such change of consumer anticipation by ensuring a certain quality of the print-out. One example would be a tying of the print-out to certain authorised shops or alike, where the owners maintain the possibility of guaranteeing a certain origin and quality.

Industry Opinion: Printing Authorised and Non-Authorised Products

Infringement arising from a non-authorised use of a trade mark was a concern for companies, particularly so when printing products on behalf of their customers with the customer's trade mark. Interviewee 28, representing a large multi-sector company explained: '*we'd leave that to the customer, there's no reason why they couldn't 3D print a trade mark onto a product that they're producing. I think if we had to do that we would just make sure that we weren't infringing someone's trade mark. We'd want to be sure that, you know, it was a legitimate use, but that effectively would be pushed on to the customer to make sure they had the rights necessary to print what they want to print. And we'd probably do that with a contractual clause' (Int.28).*

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4.5.5. Infringement of Unfair Competition Law

A violation of the Unfair Competition Law through the making of an CAD file and offering the CAD file and the 3D printed object is also possible, albeit insofar as a 'commercial act' is involved (see below).

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500 Taina Pihlajarinne in Rosa Maria Ballardini/Markus Norrgard/Jouni Partanen*, 3D printing, Intellectual Property and Innovation* (Alphen aan de Rijn; Wolters Kluwer; 2017), p. 310.

501 Taina Pihlajarinne in Rosa Maria Ballardini, Markus Norrgard, Jouni Partanen*, 3D printing, Intellectual Property and Innovation* (Alphen aan de Rijn; Wolters Kluwer; 2017), p. 310.

502 Nina Natalia Baranowska, 'The Intersection of 3D Printing and Trademark Law', 9 (2018) JIPITEC 251 para. 24 et seq.

4.5.5.1. *Application limited to marketing activity*

The protection awarded to the object through law of unfair competition may to a certain extent be similar to intellectual property protection. But there are also significant differences.

The most important difference is that law of unfair competition is widely understood as a law to regulate market behaviour.[503] This will lead to many countries merely applying the rules of unfair competition law to market activity as such and not to activity only preparing market behaviour.

For example, under German law, it is recognised that the law of unfair competition (German act against unfair competition – 'UWG') does not regulate the manufacturing of imitation products. Therefore, it can only serve to regulate the marketing (distribution) of such products.[504] As such, in the context of 3D printing it will not be possible to use unfair competition law against the making of the CAD file as such (creation of the CAD file) or against 3D printing as such. Only the marketing of the object/design (CAD) file and the distribution of the printed object can be subject to regulation of unfair competition law.[505]

4.5.5.2. *Passing-off*

One scenario in which the scanned object could be protected is through the law of passing-off. The term 'passing off' derives from English law, where it is seen as a tort and therefore, is hesitant to class it under the law of unfair competition.[506] Nevertheless, it may be grouped in this manner, in considering unfair competition as a collection of laws in both statutory and case law, which serves the purpose to repress unfair market practices[507] under which passing off may also be considered.

Passing-off requires (1) goodwill or reputation, (2) misrepresentation and (3) damage.[508] It can be invoked in circumstances where a false representation about the origin of a product is made. The consumer needs to be deceived about the origin of a product and this can apply, amongst others, to its shape and/or the packing of the product. This includes the scenario, where the defendant misrepresents that there is a trade connection between them and the claimant, for example that the goods are licensed or endorsed by the claimant. In English law, this would be considered a tort breaching common law,[509] while continental law would usually have a written provision in its

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503 See Frauke Henning-Bodewig in Bodewig, *International Handbook on Unfair Competition*, (Munich, C.H. Beck/Hart Publishing; 2013), § 1 Introduction notes 20 et seq.

504 German Federal Supreme Court (BGH), *Gewerblicher Rechtsschutz und Urheberrecht (GRUR)* 2011, 436 para. 16 et seq. – *Hartplatzhelden.de* with further references.

505 Jan Bernd Nordemann/Michael Rueberg/Martin Schaefer, ‚3D-Druck als Herausforderung für die Immaterialguetterrechte', (2015) *Neue Juristische Wochenschrift (NJW)*, 1265 at 1270.

506 Jennifer Davis in *Henning-Bodewig, International Handbook on Unfair Competition*, Munich, C.H. Beck/Hart Publishing; 2013), § 25 note 22, citing Lord Oliver in *Reckitt & Coleman Products Ltd. V. Bordon Inc.* (1990): "This is not a branch of the law in which reference to other cases is of any real assistance except analogically."

507 Frauke Henning-Bodewig in *Henning-Bodewig, International Handbook on Unfair Competition* (Munich, C.H. Beck/Hart Publishing; 2013), § 1 Introduction notes 14, 20.

508 Dukki Hong and Simon Bradshaw, *"Digital trade mark infringement and 3D printing implications: What does the future hold?"* in Dinusha Mendis, Mark Lemley & Matthew Rimmer (eds.) (Cheltenham and Northampton; Edward Elgar; 2019), Chapter 4 at 5.

509 Christopher Wadlow, *The Law of Passing off: Unfair Competition by Misrepresentation*, 5th ed. (Sweet & Maxwell, 2016); *See also*, Jennifer Davis in *Henning-Bodewig, International Handbook on Unfair Competition* (Munich, C.H. Beck/Hart Publishing; 2013), § 25 note 16 et seq.

national law of unfair competition.[510] Sometimes, misappropriation (without a deceptive element) is also included in passing-off.[511] As passing-off laws are not harmonised on the European scale, the report will focus mainly on 'classic' passing-off which is understood as cases of misrepresentation (consumer deception).

Applying passing-off to the present context, the publicly making available of the CAD file – for example through specialised internet platforms – brings up the question if a CAD file is a sufficient imitation of the scanned object to produce a relevant misrepresentation. This question will in particular arise if the manufacturer of the scanned object does not itself offer an authorised CAD file to print the original product.

- For example, under German law of unfair competition, the imitation of a product in a different form may constitute unfair passing-off pursuant Sec. 4 no. 3 UWG. However, according to the standing case law of the German Federal Supreme Court 'no generous requirements' would apply.[512] For example, the organiser of a football match would not get protection against the filming of the match and its exploitation on the internet.[513] Also, in case of carnival costumes of the famous literature character 'Pippi Longstocking' the BGH did not establish an unfair passing-off, in view of the fact that the carnival costume was not a detailed copy of the literature character 'Pippi Longstocking'. Consequently, only the offering of a CAD file, which contains the relevant details of the scanned object, will in general qualify for protection under passing-off in Germany. In particular, this will be the case if the CAD file is meant to print a product which would directly substitute the original object and would open up direct competition with the original scanned object.

- The same reservations have been brought forward in English law against invoking unfair passing-off concerning a CAD file. Neither the mere construction of a CAD file nor sale or sharing of a CAD file were likely to suffice as a cause of action unless there clearly exists misrepresentation (essentially confusion or deception) coupled with the probability of dilution or erosion of goodwill.[514]

Also with regard to unfair competition law and passing-off, the issue of miniature models comes up.[515] Some member states have quite extensive law on passing-off and the distribution of unauthorised miniature models. According to the German case law, the marketing of miniature models will usually not be unfair passing-off even if miniature models, very similar to the original, are distributed. The consumer would not assume any ties to the original manufacturer. The only exception is the explicit naming of the original manufacturer or otherwise the abuse of the reputation of the original product to

[510] For example, German law in the Act against Unfair Competition ('UWG') in § 4 No. 3 lit. a).

[511] See in English law, see Christopher Wadlow, *The Law of Passing off: Unfair Competition by Misrepresentation*, 5th ed. (Sweet & Maxwell, 2016); Jennifer Davis in *Henning-Bodewig, International Handbook on Unfair Competition* (Munich, C.H. Beck/Hart Publishing; 2013), § 25 note 22, citing *Taittinger v Albev* at 669. German law recognises misappropriation in § 4 No. 3 lit. b) UWG.

[512] German Federal Supreme Court (BGH), Gewerblicher Rechtsschutz und Urheberrecht (GRUR) 2016, 725 para. 8 – Pippi-Langstrumpf-Kostüm II; BGH, Gewerblicher Rechtsschutz und Urheberrecht (GRUR) 2011, 436 para. 16 f – Hartplatzhelden.de.

[513] BGH *Gewerblicher Rechtsschutz und Urheberrecht (GRUR)* 2011, 436 para. 16 – *Hartplatzhelden.de.*

[514] Dukki Hong and Simon Bradshaw, *"Digital trade mark infringement and 3D printing implications: What does the future hold?"* in Dinusha Mendis, Mark Lemley & Matthew Rimmer (eds.) (Cheltenham and Northampton; Edward Elgar; 2019), Chapter 4 at 5.

[515] See above trade mark law at 4.5.1.2.

foster distribution.[516] This may apply to CAD files, which can only print miniature models or at least cannot print the original product because that would be too complex for the most recent printer generation. Such CAD files are too complex to print and can be used for example for computer games. In this case, the distribution of CAD files will only violate German law of unfair competition following the German case law mentioned above, if the CAD files are offered in abuse of the reputation of the goods of the original product or the original manufacturer.

4.5.5.3. Article 6 (2) Unfair Commercial Practices Directive 2005/29

Under European law, it is also necessary to consider possible deception pursuant Art. 6 (2) lit. a EU Unfair Practises Directive 2005/29 ('Directive 2005/29'), which includes deception by '*any marketing of a product, including comparative advertising, which creates confusion with any products, trade marks, trade names or other distinguishing marks of a competitor*'.

In this context, misleading of consumers pursuant Article 6 (2) Directive 2005/29 will follow the same rules as national passing-off law, although Article 6 (2) provides for a system independent of the trade mark system.[517]

For example, in Germany, the case law of the German Federal Supreme Court has confirmed that there is a strong connection between a risk of confusion pursuant trade mark law and a risk of misleading the consumers pursuant Article 6 (2) Directive 2005/29. In case no risk of confusion under trade mark law could be recognised, there would also not be a misleading of consumers pursuant Article 6 (2) Directive 2005/29.[518] The likelihood of confusion in trade mark law is discussed above.[519] Also, the German case law for unfair passing-off due to an avoidable deception as to the origin will run parallel with the standard of misleading of consumers pursuant Article 6 (2) Directive 2005/29.[520]

It should also be noted that No. 13 Annex I Directive 2005/29 (so-called 'Blacklist') prohibits the promoting of a product similar to a product made by a particular manufacturer in such a manner as deliberately to mislead the consumer into believing that the product is made by the same manufacturer when it is not.[521] For a CAD file, this may only be the case if the CAD file is deliberately advertised as a CAD file of the original manufacturer of the scanned product or at least as a licensed file. With regards to the 3D printed product, No. 13 Annex I Directive 2005/29 (so-called 'Blacklist') may

[516] German Federal Supreme Court (BGH), *Gewerblicher Rechtsschutz und Urheberrecht (GRUR),* 1994, 732 – *McLaren*; BGH, *Gewerblicher Rechtsschutz und Urheberrecht (GRUR)* 1996, 57 - *Spielzeugautos.*

[517] German Federal Supreme Court (BGH), *Gewerblicher Rechtsschutz und Urheberrecht (GRUR)* 2013, 1161 para. 60 – *Hard Rock Café*.

[518] German Federal Supreme Court (BGH), *Gewerblicher Rechtsschutz und Urheberrecht (GRUR)* 2011, 828 para. 36 – *Bananabay II*; Joachim Bornkamm/Joern Feddersen in *Köhler/Bornkamm/Feddersen, Gesetz gegen den unlauteren Wettbewerb*, 36*th* ed. (Munich, C.H. Beck; 2018), Sec. 5 UWG note 9.9.

[519] See 4.5.1.3. above.

[520] Joachim Bornkamm, *Gewerblicher Rechtsschutz und Urheberrecht (GRUR)*, 2011, 1 at 7; Joachim Bornkamm/Joern Feddersen in *Köhler/Bornkamm/Feddersen, Gesetz gegen den unlauteren Wettbewerb (German Act Against Unfair Compeition),* 36th ed. (Munich, C.H. Beck; 2018), Sec. 5 UWG note 9.23; Axel Nordemann/Jan Bernd Nordemann/Anke Nordemann-Schiffel in *Nordemann*, *Wettbewerbsrecht, Markenrecht (Competition Law, Trade Mark Law)*, 11th ed. (Baden-Baden, Nomos; 2012), note 229 et seq.

[521] No. 13 Annex I to Directive 2005/29; so-called Blacklist ("Commercial practices which are in all circumstances considered unfair").

become relevant, in case the 3D printed product is deliberately sold as the original product, although it is an unauthorised print.

Summary

- In relation to the creation of CAD files and their making available to the public, it is an open question if they use the trade marks included into the CAD file. But at least this should constitute a relevant preparatory act because including a trade mark into a CAD file is meant to (later) affix the trade mark on the 3D printed product. In any case, for word and figurative trade marks at stake, this issue of trade mark use by inclusion into the CAD file should only have some relevance, in particular in cases where the advertisement of the files on the internet does not include such trade marks. If the trade mark is also used to advertise the CAD file offered, such use in advertising constitutes a sufficient trade mark use.

- The miniature model case law should not apply to CAD files, which are meant to substitute the original. For other scenarios it may be more difficult to find trade mark use.

- In case of CAD files created and/or offered in public, double identity of the trade mark used has to be ruled out, if the trade mark is not registered for electronic files (but only for the printed good). But there seem to be various arguments that a risk of confusion may be assumed. Trade mark owners are advised to seek protection also in international class 9 for electronic files. For well-known trade marks, a possible gap in protection is less likely, as no confusion needs to be shown and their use to identify CAD files should come within the scope of protection.

- Under the current trade mark case law, a trade mark infringement may not be excluded by stating that the CAD file is not authorised, as post-sale confusion is recognised as an infringement scenario. This may change in case 3D printing beyond the control of the seller of the CAD file becomes an extensive practice.

- The 3D printing and distribution of products will constitute trade mark infringement concerning the trade marks included in the product. For three-dimensional trade marks minor variations to the registered trade mark could avoid infringement; but this is not a specific feature of 3D printing.

- Unfair competition law may offer additional protection against confusion. This is true for any national passing-off concept and pursuant Art. 6 (2) Unfair Commercial Practices Directive 2005/29.

4.6. Intermediaries’ Liability

Various online platforms facilitate 3D printing, among other activities, by enabling the sharing of CAD files, which are required for printing out virtual items in tangible form. There are opportunities for companies to benefit from such user participation. However, many questions about IPR arise in relation to the digitisation of protected products and the dissemination of CAD files. These questions concerning the potentially infringing nature of some 3D printing activities include the liability of online platforms in mediating such activities. For instance, it is likely that unauthorised CAD files will be disseminated on the Internet. Moreover, liability of non-digital intermediaries, such as, for instance, public places that host 3D printers and where end users print illegitimate items, might also be relevant. This section will focus on the intermediaries’ liability in both these contexts.

A report by Dumortier *et al.* for the European Commission in 2015 suggested that enforcing IP rights against unauthorised 3D printing will focus on two main areas: 'the end-user and the intermediaries involved in facilitating the download and eventual reproduction by the end-user'.[522]

With regards to end-users, the report by Dumortier *et al* acknowledged that it can be challenging and costly to enforce rights against end-users, due to the decentralised nature of the activity. Attempts to do so through UK's *Digital Economy Act 2010* and France's HADOPI has led to many challenges and limited success.[523]

As such, the report suggests that 'pursuing intermediaries, particularly online hosting sites, may provide a more streamlined enforcement option for rightsholders',[524] through the mechanism of injunctions although there are not yet any examples of such injunctions being granted in respect of 3D printing. With online platforms such as *Shapeways* (as mentioned above) having already experienced the issuance of court orders requesting the takedown of infringing files, it may become more relevant, at least from a legal perspective, to focus on intermediaries which are positioned upstream of the ultimate domestic printing.[525]

That said, in the 3D printing world, there are some limitations in holding intermediaries responsible for IPR infringements committed by their users. In some 3D printing scenarios, the the focus on intermediaries is not the way forward. It has been suggested that 'the strategy of targeting intermediaries could become obsolete if users have access to technology which enables them to make a scan of the object in their own home, and then print'.[526]

Nevertheless, intermediaries will remain an important party in the 3D printing world to adress in case of IP infringing activity. Against this background, it seems noteworthy to outline the legal basis for intermediarY liability in 3D printing. Two main topics have to be differentiated here: (Mere) injunctive relief (see below 4.5.1.) and full liabiliy of intermediaries (see below 4.5.2.), where the service of the intermediary is used to infringe.

4.6.1. Injunctive relief

Specifically, in the context of online intermediaries and liability for IPR infringement, in Europe, the provisions of Art. 8 (3) Copyright Directive 2001/29 (for copyright) and of Art. 11 3rd sentence EU Enforcement Directive 2004/48 (for other IP rights) provide a good starting point for injunction claims against internet intermediaries.

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522 J Dumortier *et al., Legal Review on Industrial Design Protection in Europe* (MARKT2014/083/D) (European Commission; 2016); See also, *Economic Review of Industrial Design in Europe* (MARKT2013/064/D2/ST/OP) (Europe Economics; 2015), p. 131.

523 D Mendis, 'Digital Economy Act 2010: Fighting a Losing Battle? Why the Three-Strikes Law is Not the Answer to Copyright Law's Latest Challenge' (2013) 27(1–2) *International Review of Law, Computers and Technology,* 60. See also, P Yu, The Graduated Response (2010) *62 Florida Law Review,* 1373.

524 ibid.

525 D Mendis D and D Secchi, *A Legal and Empirical Study of 3D Printing Online Platforms and an Analysis of User Behaviour* (UK Intellectual Property Office, 2015), pp. 43-44. See also, D Mendis, Fit for Purpose? 3D Printing and the Implications for Design Law: Opportunities and Challenges in T Aplin (ed.) *Research Handbook on Intellectual Property and Digital Technologies* (Edward Elgar, 2019) (Forthcoming).

526 ibid. Also J Dumortier *et al,* p. 133.

All EU member states must provide respective injunction claims in their national law. Art. 15 E-Commerce-Directive[527] limits the duties arising for online intermediaries, because it prohibits an imposition of general monitoring duties. Art. 12, 13 and 14 E-Commerce-Directive, however, with their liability privileges for access, cache and hosting, respectively, do not apply to injunction claims against intermediaries pursuant Art. 8 (3) Copyright Directive 2001/29 and of Art. 11 3rd sentence EU Enforcement Directive 2004/48.[528]

Art. 8 (3) Copyright Directive 2001/29 (for copyright) and of Art. 11 3rd sentence EU Enforcement Directive 2004/48 (for other IP rights) provides a legal basis for the widely adopted practice of 'notice and stay down' (NSD) Furthermore, the intermediaries' duties may also comprise 'notice and stay down' (NSD). NSD is not explicitly provided by any legislation at the moment, but, an expanding body of case law (mainly drawn from Germany)[529] has assisted in its analysis and interpretation.[530] Furthermore, as article 8(3) InfoSoc Directive and Art. 11 3rd sentence Enforcement Directive 2004/48 impose prevention duties on intermediaries,[531] they could both form the legal basis for NSD in the EU.[532] NSD requires not only the need to remove the information, but also to take additional measures to ensure that it is not subsequently reposted, either by the same user or by other users.[533] This requirement can be satisfied by manual supervision or automated systems. Either way, the intermediaries must filter the entirety of content to detect a re-posting of the removed content. The mechanism, therefore, requires mandatory filtering initiated by the first notification.[534] This should also be in line with

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527 E-Commerce Directive, 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market (E-Commerce Directive).

528 CJEU of 15.9.2016 – C-484/14 para. 19 - Tobias McFadden/Sony Music Entertainment Germany GmbH.

529 Examples from German case law: German Federal Supreme Court (Bundesgerichtshof – BGH) of 15 August 2013, I ZR 79/12, para. 56 – FileHosting-Dienst II; BGH, I ZR 85/12 , para. 61 – File-Hosting-Dienst III; Court of Appeal of Hamburg of 1 July 2015 2015, 5 U 87/12, juris para. 547. Same opinion in Italy: Court of Rome, Verdict no. 8437/16; see for further case law from Germany: Jan Bernd Nordemann in Nordemann, A Nordemann J B, Czychowski, C, in Fromm/Nordemann, Urheberrecht (Copyright Law), 12th ed. (Stuttgart, Kohlhammer; 2018) § 97 para. 162.

530 A Kuczerawy, From 'notice and take down' to 'notice and stay down': Risks and Safeguards for Freedom of Expression in G Frosio (ed.), *Oxford Handbook of Intermediary Liability Online* (Oxford, 2020) (Forthcoming); Jan Bernd Nordemann, Liability of Online Service Providers for Copyrighted Content – Regulatory Action Needed? (February 2018) at http://copyrightblog.kluweriplaw.com/2018/02/23/liability-online-service-providers-copyright-protected-content-regulatory-action-needed/; Jan Bernd Nordemann, Liability for Copyright Infringements on the Internet: Host Providers (Content Providers) - The German Approach, 2 (2011) *JIPITEC*, 37.

531 CJEU of 12 July 2011, C-324/09 paras. 127, 128 to 134 – L'Oréal/eBay; CJEU of 24 November 2011, C-70/10 para. 31 – Scarlet/SABAM; CJEU of 27 March 2014, C-314/12 para. 37 - UPC Telekabel Wien; CJEU of 15 September 2016, C-484/14 para. 81 – McFadden/Sony Music

532 Jan Bernd Nordemann, Liability of Online Service Providers for Copyrighted Content – Regulatory Action Needed? (February 2018) at http://copyrightblog.kluweriplaw.com/2018/02/23/liability-online-service-providers-copyright-protected-content-regulatory-action-needed/

533 A Kuczerawy, From 'Notice and Take Down' to 'Notice and Stay Down': Risks and Safeguards for Freedom of Expression in G Frosio (ed.), *Oxford Handbook of Intermediary Liability Online* (Oxford, 2020) (Forthcoming). See also, C Angelopoulos and S Smet, Notice-and-fair-balance: how to reach a compromise between fundamental rights in European intermediary liability (2016) 8(2) *Journal of Media Law*, 266–301 at pp. 294–300; G Frosio, Reforming Intermediary Liability in the Platform Economy: A European Digital Market Strategy [2017] 112 *Northwestern University Law Review*, 19. Jan Bernd Nordemann, Liability of Online Service Providers for Copyrighted Content – Regulatory Action Needed? In-depth analysis for the IMCO-Committee of the European Parliament, (February 2018) at http://copyrightblog.kluweriplaw.com/2018/02/23/liability-online-service-providers-copyright-protected-content-regulatory-action-needed/

534 ibid.

Art. 15 E-Commerce Directive and its prohibition to impose general monitoring duties on the online intermediary.[535]

That said, despite the common legal basis in Art. 8 (3) Copyright Directive 2001/29 (for copyright) and of Art. 11 3rd sentence EU Enforcement Directive 2004/48 (for other IP rights), the national practice in member states varies. The European Commission provided a Communication in 2016 to guide online platforms on the ways in which they can live up to their responsibility as regards tackling the illegal content they host and has outlined a European approach to address illegal content for online platforms, combining the need for fast and effective removal of illegal content as well as prevention and prosecution.[536] This Communication was followed in 2018 by a Recommendation by the European Commission which encouraged the platforms to take effective, appropriate and proportionate measures to tackle illegal content online, in accordance with the principles set out in the 2018 Recommendation and in full compliance with the fundamental rights laid down in the Charter of Fundamental Rights of the European Union, in particular the right to freedom of expression and information, and other applicable provisions of Union law (Chapter I item 1. Recommendation). Against this background, the 2018 Recommendation in particular contains proposals for submitting and processing notices, informing content providers and counter-notices out-of-court dispute settlement, transparency, proactive measures and cooperation between hosting services providers and trusted flaggers (see Chapter II).[537]

But in some cases, legal activity against platforms will not be sufficient. In such cases, access providers may be approached to implement website blocks.

Only national website blocks will help against illegal business models in the long term, however – like in the case of the platform, 'The Pirate Bay' mentioned above – because they cannot be switched off at the source. Art. 11 3rd sentence EU-Enforcement Directive 2004/48 and Art. 8 (3) Copyright Directive 2001/29 allow such website blocking claims at least under European law.[538] In Great Britain, that practice is applied not only in the case of copyright infringements but also in the case of trade mark infringements.[539]

Against this background, in the 3D printing world, Art. 8 (3) Copyright Directive 2001/29 and Art. 11 3rd sentence EU-Enforcement Directive 2004/48 will be important tools to stop infringement of interlectual property rights when sharing CAD files online.

But Art. 8 (3) Copyright Directive 2001/29 and Art. 11 3rd sentence of EU-Enforcement Directive 2004/48 do not only apply in the online environment. They also apply to offline scenarios, where infringements are committed through intermediaries. One example relates to offline market places, e.g. the tenants of market halls who sublet the various sales points situated in those halls to market-traders, some of whom use their pitches in order to sell counterfeit branded products. Such a tenant falls within the concept of 'an intermediary whose services are being used by a third party to infringe an intellectual

[535] See opinion of Advocate General Szpunar, delivered on 4 June 2019; Case C-18/18 [2019] ECLI:EU:C:2019:821 Eva Glawischnig-Piesczek/ Facebook Ireland Limited (3 October 2019).
[536] European Commission, Communication Tackling Illegal Content Online – Towards an enhanced responsibility of online platforms, of 28.9.2017, COM(2017) 555 final.
[537] European Commission, Recommendation on measures to effectively tackle illegal content online, of 1.3.2018, C(2018) 1177 final.
[538] See for Art. 8 (3) Copyright Directive 2001/29 CJEU of 27.03.2014, C-314/12 – *UPC Telekabel Wien/Constantin – "kino.to"*.
[539] High Court of Justice London (Chancery Division) of 17.10.2014 – [2014] EWHC 3354 (Ch).

property right' within the meaning of Art. 11 3rd sentence EU-Enforcement Directive 2004/48.[540]

On these grounds, products illegally 3D printed and illegally distributed on such offline marketplaces may face injunction claims pursuant Art. 8 (3) Copyright Directive 2001/29 and Art. 11 3rd sentence EU-Enforcement Directive 2004/48. As far as 3D print shops are concerned, it also seems possible that they are covered by these provisions. Providing printing facilities seems to be a role comparable to a tenant of a marketplace, subletting market stands to infringers. This is in particular true if the printing facilities are let to the infringer, who e.g. brings the CAD file to the 3D printing shop and illegally prints the products on the shop's 3D printer.

4.6.2. Full liability of intermediaries

In relation to infringements of IPRs in the world of 3D printing which are committed through internediaries, these intermediaries will usually only provide an indirect contribution to the infringement. It is the user of the intermediary who directly infringes the IP rights. Nevertheless, intermediaries, when indirectly contributing to infringements, may be fully liable. Full liability in particular means that they cannot only face injunction claims, but also damage claims.

The national law of the EU Member States on full liability of intermediaries varies. This is because of the different national legal concepts of e.g. accessory liability or joint tortfeasership. For the 3D printing sector, this applies to both online and offline intermediaries. Commercial offline services, such as 3D printing cafes, or educational services, such as libraries, schools or universities, allowing private users directly to print (infringing) objects themselves could be held liable according to these national law concepts. It should be noted that several EU member states have developed ample case law for copyshops in the 1960s, 1970s and 1980s, which could serve as a reference for the liability of the 3D printing shops of today.

What has been harmonised for all IP rights, however, is the so-called 'safe harbour' for certain online intermediaries. Even if national law provides for full liability, such 'safe harbour' would shield the online intermediary from liability. According to Articles 12–15 of the E-Commerce Directive[541] access providers (Art. 12), cache providers (Art. 13) and hosting providers (Art. 14) profit from such liability shield. As hosting providers, most online platforms, which share CAD files, will benefit from the safe harbour provision providing immunity from liability pursuant Art. 14 E-Commerce Directive, as long as such intermediaries act 'expeditiously to remove or to disable the information' upon obtaining knowledge of infringement.[542]

In relation to copyright, harmonisation at the EU level goes even further. For example, harmonisation will (as far as it reaches) replace national concepts providing the basis (claims) for full liability.

First, according to the CJEU, there may be full liability for intermediaries for copyright infringements of the right of communication to the public in Art. 3 Copyright Directive 2001/29. According to the CJEU case law, two factors have to be met:

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[540] CJEU of 7.7.2016 – C-494/15 - Tommy Hilfiger Licensing LLC ua/Delta Center a. s.

[541] E-Commerce Directive, 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market (E-Commerce Directive).

[542] Article 14, E-Commerce Directive.

1) A person's full knowledge of the consequences of their actions, in order to provide third parties' access, which requires an active role – with the specific wording: 'deliberate nature of his intervention';[543] and

2) Violation of the obligation (duty) not to facilitate unlawful acts of communication to the public, through the provision of access to third parties.[544]

Accordingly, in copyright law, platforms like 'ThePirateBay', which only publish links to works illegally communicated to the public by third parties but administer these links actively, can face full liability.[545] This is particularly true, if platforms, which deliberately intervene to make works available to the public, publish third party content in the form of 3D printing files.

Second, in copyright law, Art. 17 (1) DSM Directive 2019/790[546] provides for a comparable approach for 'online content-sharing service providers'. Art. 2 No. 6 DSM Directive 2019/790 defines them as provider of an information society service of which the main or one of the main purposes is to store and give the public access to a large amount of copyright-protected works or other protected subject matter uploaded by its users, which it organises and promotes for profit-making purposes. In case this definition is met, such online content-sharing service providers perform an act of communication to the public or an act of making available to the public when it gives the public access to copyright-protected works or other protected subject matter uploaded by its users (Art. 17 (1) DSM Directive 2019/790).

It is of course possible that this scenario will be relevant in the 3D printing world. Platforms storing and giving the public access to a large number of copyright protected CAD files uploaded by their users and organising and promoting them for profit-making purposes, will be fully liable for copyright infringing CAD files uploaded pursuant Art. 17 (1) DSM Directive 2019/790. But they may escape liability in particular if they meet the requirements of Art. 17 (4) DSM Directive 2019/790. Art. 17 (6) provides limited duties for start-up platforms.

It is also important to note that Art. 17 DSM Directive 2019/790 Directive provides some exceptions for online content sharing which may be applicable in the 3D printing scenario. Article 17(7) of the Copyright Directive states that 'Member States shall ensure that users in each Member State are able to rely on any of the following existing exceptions or limitations when uploading and making available content generated by users on online content-sharing services *(a) quotation, criticism and review and (b) use for the purpose of caricature, parody and pastiche'.* Recital 77 of the Directive stipulates that such an exception in the online world is needed to strike a balance between the fundamental rights laid down in the Charter of Fundamental Rights of the European Union in recognising the freedom of expression and the freedom of the arts, and the right to property, including IPR. As such, under the Directive these exceptions are to be made mandatory in order to ensure that users receive uniform protection across the

[543] CJEU of 14.6.2017, C-610/15 para. 26, 36 – *Brein/Ziggo "The PirateBay".*

[544] CJEU of 14.6.2019, C-610/15 para. 40 – *Brein/Ziggo "The PirateBay".*

[545] See Ohly ‚The broad concept of "communication to the public" in recent CJEU judgments and the liability of intermediaries: primary, secondary or unitary liability?' (2018) GRUR Int. 517; Jan Bernd Nordemann, ‚CJEU Judgments GS Media, Filmspeler and ThePirateBay: A new European concept of liability' (2018) JIPLP 744.

[546] DIRECTIVE (EU) 2019/790 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 April 2019 on copyright and related rights in the Digital Single Market and amending Directives 96/9/EC and 2001/29/EC.

Union.[547] In reflecting on the recent developments, there is no reason why these exceptions cannot apply to the 3D printing sector. However, this implies that where such exceptions do not apply, platforms which come under Art. 17 DSM Directive 2019/790 could be held liable for copyright infringing CAD files uploaded by its users.

The difficulty with 3D printing is that it encompasses all IP rights (as opposed to music, films and videos) and whilst the Copyright Directive 2001/29 and the DSM Directive 2019/790 in particular, tackle the issue of full liability, this is limited to copyright – whilst CAD files and 3D objects extend to all IPRs.

In contrast, EU Design Law does not provide for any specific harmonisation in relation to indirect infringement leading to full liability. Hence, with regards to physical commercial services providing the required equipment and materials allowing private users to directly print (infringing) objects themselves, only general civil and eventually criminal liability rules plus any additional contractual arrangements would apply, according to each applicable national law.[548]

In trade mark law, the same is currently true. Under the relevant statutory EU law (EUTMR and TM Directive) and the current CJEU case law, EU trade mark law does not provide for any specific harmonisation in relation to indirect infringement leading to full liability. Commercial services providing equipment, materials and services allowing private users to directly print (infringing) objects themselves, only general civil and eventually criminal liability rules plus any additional contractual arrangements would apply, according to each applicable national law. Besides, Art. 11 3rd sentence EU Enforcement Directive 2004/48 only provides for a harmonised system for injunction claims against intermediaries, who have facilitated infringement, as already indicated above.

As previously mentioned, infringement liability can also be found when physical commercial services, such as 3D printing cafes, or educational services, such as libraries, schools, or universities, provide the required equipment and materials allowing private users directly to print (infringing) objects themselves. These services may be found liable for facilitating infringement and thus for contributory liability. They may try to find 'safeguards' by requiring indemnification clauses in their terms of service or even by ensuring that private users do not use their services to print out protected objects (for example, by using specific scanning technologies or by including contract clauses). However, this does not provide them with possibilities to waive their liability for IPR infringement. For instance, in the context of patent law, due to the fact that liability under indirect patent infringement gives rise to an independent cause of action (no finding of direct infringement is necessary under the interpretations of most European jurisdictions) and due to the fact that those who knowingly supply third parties benefiting from the private use exception may still be liable for indirect patent infringement, such an indemnification clause will not avoid liability.[549]

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547 See Article 17 and Recital 77 at https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32019L0790&from=EN

548 Ana Nordberg and Jens Schovsbo, in Rosa M. Ballardini, Marcus Norrgård and Jouni Partanen (eds), *3D Printing, Intellectual Property and Innovation – Insights from Law and Technology* (Wolters Kluwer, 2017), para. 13.03[B].

549 For more detailed see Rosa Ballardini and Nari Lee, "Limitations and Exceptions in European Patent law – Challenges from 3D Printing Technology" in Rosa Ballardini, Marcus Norrgård & Jouni Partanen, (eds), *3D Printing, Intellectual Property and Innovation – Insights from Law and Technology*, (Kluwer Law Int, 2017).

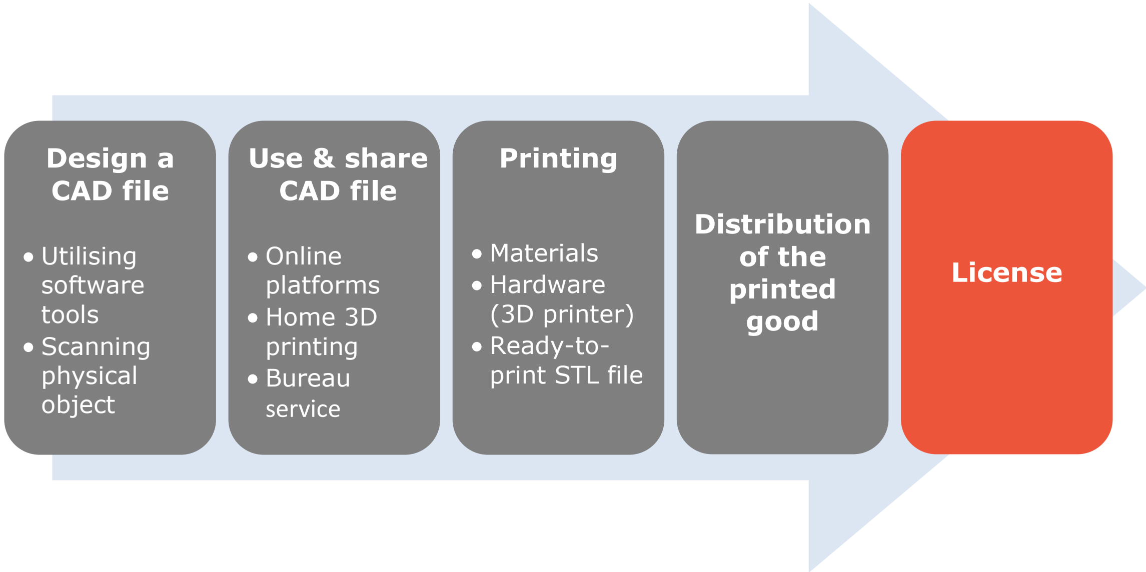
4.7. Summary of 3D Printing and Application of IPR to Infringement: At-A-Glance Table

PATENT LAW		
DESIGN	**SHARE**	**PRINT**
The relationship with CAD files and the patented objects that they represent is unclear under current rules. Thus, it is questionable whether scanning a patent protected object, creating a digital representation of it, would give rise to patent infringement liability (direct or indirect).	The relationship with the CAD files and the patented objects that they represent is unclear under current rules. Thus, it is questionable whether sharing a digital representation of a patent protected object over the Internet would give rise to patent infringement liability (direct or indirect). Moreover, in this regard, and in relation to indirect infringement, the main challenge refers to how the concept of 'means' is interpreted under European patent doctrines. Should 'means' continue to be interpreted, as it traditionally has, only as something 'physical' or 'tangible', then this would radically limit possibilities for pursuing indirect type of infringement activities in many contexts relating to 3D printing.	Even though it is a clear infringement to reproduce someone else's existing invention (e.g. via printing a protected object), it is unclear, after the first sale of a physical product, to what extent modifying or repairing the physical embodiment of a patented invention (e.g. printing out only same parts of the protected object) is also allowed without reaching the level of 'making' it (thus infringing) (in the context of product-types of claims). Different interpretations on this exist at European and national level, while harmonisation in this regard is lacking.
COPYRIGHT LAW		
DESIGN	**SHARE**	**PRINT/DISTRIBUTE**
Designing a CAD file from inception through the use of open-source modelling software, is unlikely to infringe copyright. In terms of scanning, if there is sufficient authorial input and personal touch of the author, differentiating it from the antecedent work, then the scanned work could attract copyright in its own right, with its own distribution rights. This point is discussed in the literature with different	Online platforms sharing and hosting copyright material without the author's consent and doing so with actual or constructive knowledge in return for a financial gain, will be involved in an act of reproduction/ communication to the public and could be held liable for copyright infringement. The application of this criteria will depend on the size of the platform, the	Printing the design file and distributing it has the clear potential to infringe copyright. This is particularly relevant where there has been an act of 'sale'. However, if the scanned and printed product is substantially modified, reflecting authorial input, it can potentially attract

outcomes and therefore clarity on this point is recommended. In this context, the Copyright Directive should be borne in mind in relation to Article 14 (out of copyright works) and the faithful reproduction of public domain art – which states that such work will not be protected due to the inconsistency with the copyright term.	turnover (10 million euros) and monthly users (more than 5 million monthly users). Furthermore, Article 17 of the Copyright Directive (‘upload filter’) requires platforms to monitor uploads through content recognition technologies, whilst Article 2(6) of the Directive provides some exceptions to this rule.	new copyright, as a derivative work, with the possibility for Article 4(1) to apply to the new work. Where there has been no commercial sale, but where the CAD file has been distributed to the public as in the case of online sharing platforms dedicated to 3D printing, it will infringe Article 4(1).
DESIGN LAW		
DESIGN	**SHARE**	**PRINT/DISTRIBUTE**
Designing a CAD file from inception does without any doubt not constitute an infringement of the rights conferred by EU design law. Customising existing designs will pose the traditional difficulties associated with delimiting the scope of pre-existing design rights and is a matter of design protection rather than infringement. Whether scanning a protected design constitutes an infringement is controversially discussed A clarification to this effect is therefore recommended.	Uploading to a publicly accessible website, downloading and hosting are to be regarded as infringements although the latter is controversially discussed.	Printing and Distributing the 3D Model are both acts which have to be considered an infringement of the rights conferred by EU Design law.
TRADE MARK LAW		
DESIGN	**SHARE**	**PRINT**
Trade mark use necessary for infringement: Including trade mark into CAD file: open question if trade mark use. But relevant preparatory act arguable. In case of advertisement of the files with trade mark:	See left under DESIGN.	3D printing and distribution of products: trade mark infringement concerning the trade marks included in the product. For three-dimensional trade marks: minor variations to the registered trade mark

sufficient trade mark use. Miniature model exemption does not apply to files, which print a substitution to the original. For other scenarios open issue. Infringement scenarios: a) Double identity of the trade mark used ruled out, if no trade mark for electronic files (but only for the printed good). Various arguments in favour of likelihood of confusion. For well-known trade marks (for the printed product), use to identify CAD files should be infringing. Trade mark infringement not excluded by stating that the CAD file not authorised (post-sale confusion). This may change in case 3D printing beyond the control of the seller of the CAD file becomes extensive practice.		could avoid infringement; but this is not a specific feature of 3D printing.

CHAPTER FIVE:
LICENSING AND NEW BUSINESS MODELS IN THE 3D PRINTING SECTOR



5. Introduction

Licensing is an integral part of IP laws – it allows companies to trade and sell their IP and reach wider audiences. As such, licensing IPR represents a vital component of a company's business strategy. For instance, licensing can be an effective tool for starting a new business, or, for established firms, for expanding an existing business by extending the territory or the nature of operation, or for improving the quality of the goods or services and, thus, the market position of the company.

One of the aims of this Study was to understand licensing and new business models in the 3D printing sector. In this context, licensing activities were seen as a common strategy for large companies but rather exceptional among small and medium sized companies interviewed in the Study, although some of the interviewees were open to the idea of getting licenses to reinforce their core technology, as detailed below.

The interviewees referred to various types of licences in illustrating their licensing practices. These are outlined below. First, this chapter sets out a theoretical explanation of the different types of licences and their applicability to the 3D printing industry, before presenting examples from industry.

5.1. An Overview of Licences and their Applicability to the 3D Printing Sector

Broadly speaking, IPR licensing consists of an agreement between IP owner (i.e. the 'licensor') and another party who is authorised to use such rights (i.e. the 'licensee') upon an agreed payment (i.e. 'royalty'). A variety of such licensing agreements are available, which may be broadly categorised as follows:

- Technology Licence Agreements, for inventions protected by patents, utility models or trade secrets;
- Trade mark and Franchising Licensing Agreements. and
- Copyright Licensing Agreements.

A **technology licensing agreement** is a free, revocable contract between the parties (namely, the licensor and the licensee), where the licensor authorises the licensee to use the technology under certain agreed terms and conditions.[550] For instance, via patent licensing, a patent owner can transfer or license interest in a patent. There are two types of patent licences: exclusive licences and non-exclusive licences. If the licence is of an exclusive nature, no person or business other than the named licensee can use the patent right during the period where the licence is in force. All patent owners must agree to an exclusive licence. On the other hand, a non-exclusive licence allows the licensee to produce the invention, even though the licensor, as well as other parties can also produce the invention. Only one patent owner has to agree to a non-exclusive licence. Examples relating to the technology licence agreements are set out below.

A **trade mark licensing agreement** will be relevant for (a) marketing a product or service where the brand of that product is owned by others and/or (b) entering or expanding the existing market for the product or service for which a SME owns the rights conferred by a trade mark.[551] The function of a trade mark or service mark is to distinguish goods and services from that of another and licensing a trade mark or service may compromise that although it opens up the brand to a wider market. Generally, the trade mark owner will contact close contact with the licensee, through a contractual agreement, to ensure that the quality standards are maintained and the consumer is not deceived.[552]

A franchise agreement allows a trade mark owner who already has gained a reputation with the use of a trade mark or service mark (franchiser) to expand their business by teaming up with another enterprise (franchisee) who can bring in expertise of their own in progressing the business. Similar to a trade mark licensor, a franchiser will keep in close contact with the franchisee, through contactual agreements, to ensure that quality and standards are maintained.

In the context of 3D printing, there have been some examples of trade mark licensing, although at the moment it is not widespread. For example, although the car manufacturer *Ford* does not seem to offer CAD files with *Ford* cars itself (i.e. 3D model of a *Ford* car), *Ford* licenses its *Ford* and other trade marks for use, for CAD files offered

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[550] Technology Licensing at https://www.wipo.int/sme/en/ip_business/licensing/technology_license.htm

[551] Trade mark or Franchise License Agreement at https://www.wipo.int/sme/en/ip_business/licensing/franchise_license.htm

[552] ibid.

on certain Internet platforms.[553] Furthermore, the participants of this Study were asked whether '3D printing adds value to brands' and it generated the strongest level of agreement with almost all participants strongly agreeing that embracing 3D printing can add value to brands. Nobody disagreed.

A **copyright licensing agreement** will be applicable for those who wish to (a) manufacture, distribute or market results of literary and artistic efforts of creators and/ or (b) those wish to expand the current market.[554] In relation to 3D printing, copyright licensing is widely used by online platforms, in facilitating the distribution of CAD files to their users. Qiute often, end-users will simply sign up to the online platform's standard user agreement (i.e. their licensing terms) which then allows users to access and share the CAD files available on these online platforms.

A Study carried out by Mendis and Secchi for the UK Intellectual Property Office, provided an insight into licensing on online platforms and identified the different types of licences that are used (see Figure Figure 10) and concluded that Creative Commons licences such as Attribution ShareAlike and GNU Public Licence were used on 3D printing online platforms. The data revealed that 35 per cent of users who do license their work are more inclined to use Creative Commons licence, followed closely GNU Public Licence.[555]

Creative Commons licences[556] have increased in popularity over the years in the copyright industry and provide an alternative to to the 'all rights reserved' setting adopted in traditional licences. Creative Commons (CC) licensing is applicable for those who are happy to for others to share their work in certain specific ways and the licensing mechanism makes this possible through easy-to-understand simplified terms. It does not require complex negotations nor legal representation – the reason why it has been attractive for those in the creative industries. There are six main types of CC licences. These range from those which are more restrictive such as *'Attribution-NonCommercial-NoDerivs' (CC BY-NC-ND)*[557] which allows downloading and sharing of a protected work, without any modifications for non-commercial use as long as the copyright owner is credited to those which are very flexible such as *Attribution ShareAlike* (CC BY-SA)[558] to *Attribution (CC BY)*[559] which is the most flexible of all licences.

Attribution ShareAlike lets others remix, tweak and build upon a protected work, even for commercial purposes, as long as the copyright owner is credited and the new work is licensed under identical terms. This licence is often compared to 'copyleft' free and open source software licences and is popular on 3D printing online platforms as revealed by the 2015 Study mentioned above.

GNU GPL licences, commonly known as open source software, is used by those in the software industry and gives designers the freedom to share and change versions of a program, if they decide to do so. As such, 'free' applies to freedom, not price as developers will assert copyright on the software thereby giving permission to copy,

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553 Available at https://www.turbosquid.com/3d-models/3d-model-mustang-2018/1132944
554 Copyright Licensing Agreement at https://www.wipo.int/sme/en/ip_business/copyright/copyright.htm
555 Dinusha Mendis and Davide Secchi, *A Legal and Empirical Study of 3D Printing Online Platforms and an Analysis of User Behaviour* (UK Intellectual Property Office; 2015) at pp. 43-44.
556 Creative Commons licences at https://creativecommons.org/
557 CC Attribution-Non-Commercial-No Derivatives License at https://creativecommons.org/licenses/by-nc-nd/4.0/legalcode
558 CC Attribution ShareAlike License at https://creativecommons.org/licenses/by-sa/4.0/
559 CC Attribution Licence at https://creativecommons.org/licenses/by/4.0/legalcode

distribute and/or modify it whilst ensuring that the same rights are preserved in all derivative works.[560] Case Study 6 (Licensing), set out below illusrates this point further.

A final point to note is that rights holders cannot always manage the distribution and licensing of works themselves and often look to **Collective Management Organisations** (CMOs) for assistance. In the future, these organisations may play a more vital role in the 3D printing sector. For example, collective licensing could be significant for both rightsholders and users in a future with increased 3D printing with regard to copyright and related rights. CMOs already provide a service to the creative sector for the effective management of their rights and thereby ensure an adequate source of income.[561] In some Member States CMOs are the only means for rights holders to obtain compensation for certain private uses which are exempted from protection. Moreover, CMOs are required to be transparent and non-discriminatory when granting rights for users. Recently, the European lawmaker facilitated the possibility for Member States to implement extended collective licensing schemes and thereby making it possible for users to operate in legal certainty even if no licensee is obtainable.[562] With a potential rise of 3D printing all these aspects of collective licensing could be of great assistance to this novel industry.

Having provided a theoretical overview of the different types of licences and their applicability to 3D printing, the rest of this chapter will make reference to the empirical study and quotes from interviewees to further demonstrate the above points.

5.2. Licensing and Cross-Licensing: Examples from the Patent Industry

In the patent industry, when small and medium-sized companies were asked about the licensing practices of other companies, two of them responded that to their knowledge there was hardly any licensing activity in their immediate circle of partners and competitors. Only two start-ups had licensing agreements for patents owned by universities where the co-founders were previously conducting research in 3D printing topics. One of them explained that such licensing agreements were comparable to the licensing contracts that could be established with other industrial actors: 'there has been a lot of recursive work in our field by the university. Some of the inventions have been made by people now working in our company, so there are licence contracts between the university and us to use the technology in some fields. The contracts have to be market-conformed. Universities in (an EU country) can license IP and make business. ... The university has its own lawyers, it's a very professional process' (Int.33). A company (Int.36) explained that they collaborate in research and development projects with universities, and patents are part of the outcomes of the project. Depending on the research agreement, the ownership of the patent might be shared or fully owned by one of the parties, and in case the university owns the patent, the company has the right to license it from the university.

One small company noted that, in comparison with patented hardware or materials, patented methods embedded into software are more difficult to license because they are also more problematic to enforce – i.e. the prevention of patent infringement impacts

[560] M O'Sullivan, The Pluralistic, Evolutionary Quasi Legal Role of the GNU General Public License in free/libre/open source software (FLOSS) [2004] 26(8) *European Intellectual Property Review*, 348.

[561] For details on the EU-wide standards of CMOs *see* Directive 2014/26/EU of the European Parliament and the Council of 26 February 2014 on collective management of copyright and related rights and multi-territorial licensing of rights in musical works for online use in the internal market.

[562] Article 12 of the Directive (EU) 2019/790 of the European Parliament and of the Council of 17 April 2019 on copyright and related rights in the Digital Single Market and amending Directives 96/9/EC and 2001/29/EC.

the licensing activity, and vice-versa. In the case of this company, their patented method was embedded in CAD software. Since such software is rarely open source, this company had no means to inspect the source code and the inner workings of the allegedly infringing software to determine if the patented method was being used. Therefore, the infringing companies 'are not so willing to pay licensing fees because they are not so worried about being sued, and they may just go ahead and copy your idea if they like it' (Int.29).

Large companies reported that thy had more experience in licensing. Particularly, cross-licensing was described as an important way of commercialising intellectual property. One company explained that the cross-licensing activity may even be more intense than other kinds of licensing: 'we tend to cross-license when a third party has a patent that covers something that we're interested in …, we grant them a licence under some of our patents and they give us the licence under some of their patents and that gives both of us the opportunity to work within that area. I don't think we have any licences where we get a royalty at the moment' (Int.28).

Two large companies reported that cross-licensing agreements have been critical (not necessarily negative) to the company in one or more occasions. For both companies, such agreements served to settle patent infringement lawsuits and had a profound impact in the consequent business of both companies and gave them the opportunity to develop and grow their current business. One of them described this experience as follows: 'a large foreign competitor sued us and they sued us in various countries with patent infringement lawsuits. That was a big financial and legal struggle for us for several years and in the end, we did a settlement agreement. That was a very important milestone that basically opened the way for further development of our company as we acquired patents on a technology which is now our core business' (Int.26).

Currently, in the opinion of the representative of this large company, there are not many patent disputes as the 3D printing market has entered 'a phase where all our competitors are trying to get the best patents in order to negotiate a competitive advantage with each other or just so that everybody is demonstrating their innovation by having patents' (Int.26).

5.3. Licensing Examples from the Copyright Industry

Licensing can be used in various ways, and in the context of copyright, the researchers identified several types of licensing in various situations, involving different actors. In the following discussion, we present three contrasting empirical examples of licensing practices from the companies interviewed in this Study.

5.3.1. Licensing May Not Always Be the Answer

While licensing is a standard practice in granting access and rights to other parties, there are instances when they are far from being an ideal or viable approach. For example, one interviewee pointed out that licensing may not be the answer for all scenarios as first-to-market for an SME might be more beneficial and cheaper. This was elaborated by an interviewee who gave an example of a company fabricating accessories for the automotive industry: *'if you are generic car company and you have been making a lot of money on a kind of aftermarket accessory business and someone comes in and starts making those aftermarket accessories via 3D printing you might have the ability to license something to them but they may not need anything from you.* On the other hand, they may believe that *'it's really valuable to have licence … in order to say [that they are] an official partner of some company … so I don't think it is a blanket yes or blanket no, it really depends on what you are making' (Int.41).* It appears that companies are mindful of licensing and question for which activities they need a licence.

However, as Int.41 stated *'if you are not an IP lawyer that question is not always an intuitive question'.*

A representative from a large company also pointed that licensing may not be for everyone – especially when licensing involves a large payment up-front. *'If you want to make a licensed consumer good, if you want to make a video game character, something like a doll out of a Pokémon or something, one of the things you need to do … [is to] give the company upfront cash. Like tens of thousands if not hundreds of thousands of dollars, you know, pounds euros or whatever you want to be using and so one of the reasons why regular Joe isn't in the license object business is because they have to give up front cash which they do not have access to' (Int.40).*

5.3.2. Third-Party Licensing: 3D Printing Online Platforms, the Toy and Hobby Sector and End Users

However, licensing can be beneficial in certain other instances and for different actors. Online platforms facilitating the distribution of CAD files, license these files in a variety of ways and involving different actors in the process. For instance, one interviewee from a SME spoke about the use of licensing when accessing his company's online platform for uploading 3D designs for 3D printing. He explained that licensing can be used in various ways: '*it depends on how broadly you define licensing. Obviously, every user who uploads something is licensing it to the service [platform] and so that is a day to day focus … If someone wants to use the service and uploads the file to be … printed by the service then what they have is … a file that is protected by a number of … actual property rights. There could be copyrights, there could be patents, there could trade marks' (Int.41).*

One of the interviewees provided some very interesting and positive examples in this context. One example involved the opportunity for end users to design and create features for *Hasbro* toys by being a member of a 3D printing platform. In this scenario the 3D printing platform and the toy company had a licence which was extended to the end users who signed up and were 'approved' to participate. The interviewee pointed out that this was *'fairly labour intensive'* because '*as an artist [you] had to apply and then get manually approved and then once you were in the program you had access to a limited number of properties and you could do a pretty circumscribed set of things with them although still it was within those boundaries'.* Unlike the standard licences which were mentioned earlier, this scenario involved a bespoke licence which was drawn up for this particular activity between the platform and *Hasbro*.

Another example illustrated the opposite side of the spectrum. Again, the example involved an end user interacting with a 3D printing platform as well as a third company (games company). However, in this scenario, the end-user simply signed up to the online platform's standard user agreement which then allowed consumers to access a number of games and content as made available by the games company. These ranged from *'players, characters from the game … fan art ... jewellery based on the game … all sorts of things'.* It gave end-users freedom to create and modify the games content, with 'a cut' going to the games company. At the same time, the games company reserved the right to take things down although they did not have an extensive set of rules in addition to the generic content rule of the online platform.

5.3.3. The Use of Creative Commons Licensing in the 3D Scanning Sector

Since scan data is prone to modification or substantial remodelling, licences that do not require complex negotiations or legal representation are very convenient. Reflecting on what will and can be done with scan data, one of the interviewees went on to provide an opinion on the type of licensing that may be relevant: '*If we are enabling content to be produced that is going … to be potentially remixed, so if you consider that you know the* *original digital scan could then be edited and modified in a certain way by a digital artist, that's ultimately going to end up in a high value production of some sort, then I guess that creative commons ethos could come into that'. (Int.39)*

Whilst it was interesting to note the mention of creative commons licensing in the 3D scanning context, it should be pointed out that this was also the only mention of it in the Study's interviewee sample.

These examples are illustrative of licensing in the 3D printing sector and demonstrate that licensing is certainly thriving in this sector in many different ways, but, at the same time demonstrate the challenges that licensing may sometimes pose.

5.4. Case Study 6: Licensing

Case Study and Overview

Licensing permits creators to incorporate existing intellectual property into their works, in return for a fee, or it can be used for wide distribution of their innovation. Licensing is used in a number of industrial sectors and this case study will explore licensing mechanisms used by 3D printing companies. In particular, the case study will question whether licensing within the 3D printing sector is different to other sectors and will query the differences for different actors within the supply chain.

Issues and Relevant IPRs

Licensing provides various benefits for all types of IPRs and can act as a solution when businesses collaborate with other businesses (B2B) or businesses and consumers collaborate (B2C). Particularly, in a B2B scenario, a company's background or foreground IP is highly relevant.

At the same time, bureau services within the 3D printing sector is heavily reliant on licensing when interacting with their clients who design, upload and utilise the company's 3D printing services. However, it remains the responsibility of the end user to ensure that *'all the rights which are necessary to manufacture and distribute the item have been cleared and if not, the end user takes responsibility to indemnify the bureau service' (Int.41).*

A key feature that was apparent in the 3D printing industry was the use of open source software and therefore the willingness by those in the industry to publish open source without resorting to licensing in return for a fee.

Examples

'Bureau service requires the user to grant various rights including 'the right … to manufacture the good … [sometimes] the rights to display the good, make derivative works … [and] the right to promote the works in various places' (Int.41).

'I mean in terms of IP… I've published a lot of work open source and I think that's been very beneficial to me because there's a lot of other people that really appreciate open source things and if you publish something that's useful to a lot of people, you end up as a soft leader in that sort of area. So I've published work on both 3D printing on laser cutting … and published useful techniques and tools … because it will bring clients to me' (Int.22).

'Licensing might not always be an option … you may wish to license something [to a party] but … they may not need anything from you … on the other hand, there might be strategic reasons to get a licence' (Int.41).

Solutions and Recommendation

- Licensing is clearly an answer in the field of 3D printing and participants in this Study were of the same opinion, particularly in reducing the barriers to entry for start-ups and SMEs. For example, licensing of CAD files has the potential to create new business models reducing the barriers to entry for start-ups and SMEs and affecting diverse types of actors and different types of companies. This could be achieved by (a) commercialisation of CAD files through intermediaries; (b) democratisation of access to design and manufacture; and (c) innovation by experimenting with current technologies.

Case Study 6 Licensing

5.5. New Business Models in the 3D Printing Sector

It has been suggested that the 3D printing sector can benefit from new business models. Some of these have already been discussed above – such as the licensing of CAD files through intermediaries. The industry opinion on this question was sought from interviewees who strongly agreed this to be the case as illustrated below.

Apart from the above example, new business models based on watermarks and the blockchain have also been suggested for the 3D printing industry, particularly in the context of tracing CAD files and determining authorship and ownership. The impact of such business models within 3D printing is illustrated through an industry opinion and Case Study 6.

Industry Opinion: Do New Business Models in the 3D Printing Sector Reduce Barriers for Start-Ups and SMEs?

Most companies interviewed in this Study agreed that 3D printing opens new business models reducing barriers for start-ups and SMEs.

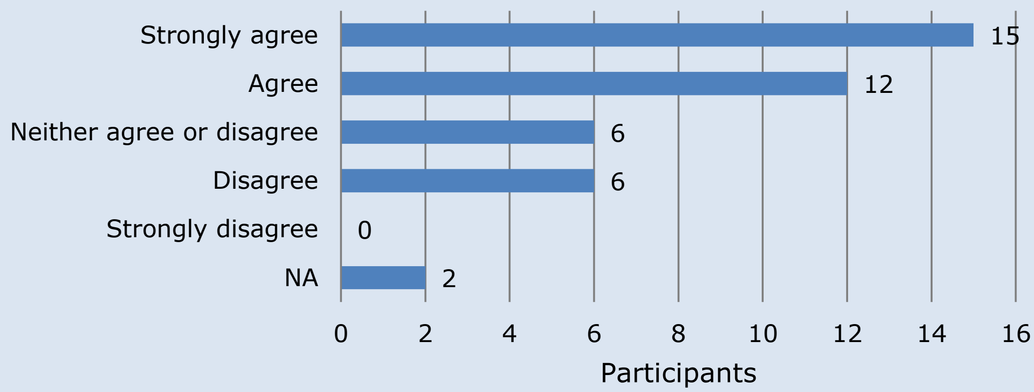

Figure 26 Interviewees' assessment of 3D printing enabling new business models and reducing barriers for start-ups and SMEs

About two thirds of interviewees either agreed or strongly agreed that the licensing of design files has the potential to create new business models which has reduced the barriers to entry for start-ups and SMEs, affecting diverse types of actors and types of companies. They highlighted the following trends:

- **Commercialisation of CAD files through intermediaries:** anyone who can create a 3D model represented through a CAD file can use intermediary platforms to sell them as a project. This reflects a change to how CAD files are commercialised, but at the same time, it implies a change to the business model of customers purchasing a commercial licence for such designs. Prior to 3D printing coming into being, such customers had to commission unique designs and find manufacturers to manufacture it, which imposed severe limitations due to the high costs and complexity to coordinate the process. This cost can now be significantly lowered with the purchase of 'off-the-shelf' CAD files through intermediaries and the use of 3D printing technology.

- **Democratisation of access to design and manufacture:** This reduces the barriers for SMEs and start-ups although it does not completely eliminate it. For instance, the use of 3D printing requires skills and competencies in order to create and manage the design files, and therefore, only those companies with established procedures and the required skilled workforce will be able to handle this market effectively.

- **Innovation by experimenting with current technology:** Another interviewee suggested that there is a need for reducing restrictions established by machine manufacturers and the 3D printing environment (e.g. allowing modifications to the firmware, usage of raw materials offered by third-party companies) before the barriers to entry can be removed for companies in specific parts of the value chain *(Int. 25).* Otherwise, if a start-up wants to explore the boundaries of 3D printing without restrictions from the machine manufacturers, they additionally need to invest in research projects on how to break the restrictions of the manufacturers.

Notwithstanding, two interviewees noted that new business models based on the licensing of CAD files through intermediaries were regarded as potentially troublesome for designers. They argued that CAD files commercialised via intermediaries are usually not sufficiently protected by current IP laws. Therefore, designers offering their work through intermediaries may face a higher risk of infringement.

The few who disagreed with this statement argued that the complexity of the sector still acted as a barrier to entry. For example, an interviewee from a large company commented: *'just having a file doesn't necessarily mean that you can print and produce the object … you need a lot of know-how, you need specialised software, so just having the file alone or just getting the licence to that alone doesn't necessarily mean that you will be successful in 3D printing' (Int.3)*. In addition, two SMEs also disagreed with this statement. They observed that 3D printing is resulting in new business models, but that does not necessarily make it easier for start-ups nor SMEs to enter the market; or as another interviewee observed: *'I don't believe 3D printing is a panacea for every business start-up becoming a manufacturing company, I think there are still financial barriers to bringing products to market even if they are 3D printed' (Int.41).*

Industry Opinion 13 Do new business models in the 3D printing sector reduce barriers for start-ups and SMEs?

Industry Opinion: Traceability, is it Important from both an IP and Product Liability Perspective?

Another inquiring statement asked for interviewees' opinion on the technological solutions for CAD traceability: 'Traceability of CAD and print files is extremely important both from an IP and product liability perspective. At the moment, the means of achieving traceability remains under-developed. Watermarks, digital rights management and even the blockchain have been suggested. Clear and affordable technological solutions in this area would help SMEs and industries.'

Regarding CAD files, the concept of traceability targets different aspects along the value chain. In the stage of developing the CAD file, traceability comprises the capability to save and follow the history of changes made to the file by one or more individuals. Later on, in the production chain, traceability becomes more complex to fulfil the information needs of different actors (i.e. commercial customers, private individuals), contexts (e.g. within the company, sharing of design through online platforms), and activities (e.g. keeping track of in-house fabrication, tracing downloads and print-outs done by third-parties, managing rights over designs, etc.). Despite the breadth of the concept and its different possible interpretations of traceability, most interviewees agreed that traceability of design files is a key issue to audit the legal ownership of IP.

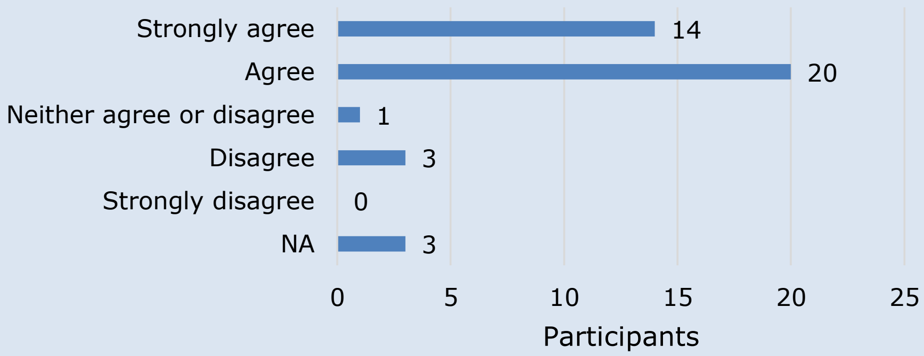

Figure 27 Interviewees' assessment on whether technological solutions for CAD traceability would help SMEs and industries

Given the breadth of the concept of traceability, it is not surprising that interviewees discussed it focusing on different aspects, and often based on their own traceability needs. For example, a designer working as a freelancer elaborated on the system used by individual designers to organise changes in CAD files. This interviewee stated that, when working individually, a good strategy is to name the files (e.g. use of descriptive name + date + time) in order to keep track of the development and modification to the design. On the other hand, when working in groups or on a file that will be modified by different actors, tracking becomes increasingly complex and also necessary, especially if the file is not open source. In certain sectors and applications, traceability of the design development is regarded as a critical issue. For example, in regulated industries like the aerospace or medical sectors, a small detail without a high IP value may be subject to liability, and many of these small details may add up to a valuable innovative design. Another example can be seen from the hearing aid industry where the interviewee agreed with the statement in general, but explained how they had solved this issue by printing a serial number on every hearing aid device: '*when it comes back for repairs or any issue, we know exactly to whom it belongs… we can track who modelled the device … we can chase everything we need* *to know'*. More importantly one of the interviewees observed the critical need for traceability within their industry: '*a question of fraud ... How can you prove that this is actually approved by someone who knows what they are doing and didn't just copy a CAD file*?' *(Int.15).*

Regarding the state of the art of traceability systems, most interviewees believed that traceability systems are still under-developed. Furthermore, even CAD files might not have the necessary features to allow traceability: *'There are CAD file formats where it is impossible to even place a watermark, where there is no metadata of changes or where the changes cannot be traced because [the] source code is encrypted' (Int.22).* Against this backdrop, several interviewees believed that what is required is a clear and inexpensive system that works in practice.

One of the interviewees identified their work as involving the development of a system to trace and use CAD and print files. This interviewee noted that although the machines are more digital than before, there are no suitable legacy systems in place. As such, this interviewees' team is working on a software that can track the entire production process from design development to product shipment. Their goal is to enable fully digital quality assurance, to enable remote fully traceable production and distributed manufacturing. In the meantime, a few interviewees mentioned that in the industrial environment there are already practices in place that aim to avoid legal problems when the origin and modification of a CAD] file cannot be traced. For example, companies offering 3D printing services have contractual arrangements with customers whereby the customer is required to confirm that they own the file. An issue that potentially could arise from the absence of traceability is liability. One interviewee expressed their nervousness as they are exposed when they '*cannot verify that the CAD file belongs to the person who is giving it to us*' *(Int.4).* This nervousness results from a lack of clarity on where they would legally stand.

These answers also reveal that most companies rely on contractual agreements; however, where these arrangements are not in place, various issues are bound to arise.

Regarding the second part of the statement, most participants agreed that SMEs and industries, in general, would benefit from having affordable solutions to trace CAD files. Otherwise, '*it is difficult to maintain an overview of the legal status of the digital files' (Int.23).* Moreover, this problem not only relates to additive manufacturing but to other manufacturing processes based on digital design files.

Looking towards the future, three interviewees agreed that traceability will become more relevant and receive more attention in the coming years as the use of 3D printing is likely to spread in both the industrial and the private use settings. However, two of them emphasised that the industry has some important technical issues to address, such as quality management/assurance, simplicity/reliability of production, or material reliability. Once such issues are solved, decentralisation will increase, leading to distributed additive manufacturing. At that point, the issue of digital traceability of designs files and ready-to-print files will be paramount.

Industry Opinion 14 Traceability, is it important from both an intellectual property and product liability perspective?

5.6. Case Study 7: From Watermarks to the Blockchain: Technical Solutions for the 3D Printing Sector

Case Study and Overview

Traceability of product parts and data is becoming more of an issue in the world of digital manufacturing as discussed above. From an industry perspective, some companies utilise traceability mechanisms such as serial numbers (for hearing aids) in order to distinguish between counterfeits and originals. However, it is not always a straight-forward process to determine IPR and legal ownership particularly in digital manufacturing and distribution. This case study explores how 3D printing companies approach traceability and the mechanisms which are used to achieve it.

Issues and Relevant IPRs

The interviewees in this Study were of the opinion that traceability systems are still under-developed, pointing to limitations within CAD files which simply do not have the necessary features to allow traceability, such as the placing of a watermark, for example. In this context, several interviewees emphasised the need for a clear and inexpensive system that works in practice. However, an issue that could potentially arise from the absence of traceability is liability and this can be especially true in regulated industries such as the aerospace and the medical sectors, where every piece of detail is relevant for innovative design and safety. Furthermore, as digital manufacturing continues to grow, traceability within the production chain will become harder to detect amongst different (a) actors (i.e. commercial customers, private individuals), (b) contexts (i.e. within the company, sharing of designs on online platforms) and (c) activities (i.e. keeping track of in-house fabrication, tracing downloads and print-outs done by third-parties, managing rights over designs, etc.). Despite these challenges, most interviewees agreed that traceability of design files is a key component to audit the legal ownership of IP and therefore is a significant element.

Examples

'There are CAD file formats where it is impossible to even place a watermark, where there is no metadata of changes or where the changes cannot be traced because [the] source code is encrypted' (Int.22).

Responding to watermarks and blockchain as a solution

'I don't really know enough about how that works but I think that's a good solution because these files really don't have any information embedded in them on who created them and who modified them last, so I think that would be a good addition to the files themselves to have some kind of metadata embedded in them to say who the original author was' (Int.24).

'So I think this is a very good idea so that you simply can prove that you came up with a design at a certain point in time. I think that this could be … an interesting way, for sure' (Int.29).

'I think that's a very likely solution. I would rate that very likely' (Int.31).

Solutions and Recommendations

- As examples from industry demonstrate solutions such as the blockchain as well as watermarks are seen as the future of traceability.

- However, as one of the interviewees pointed out that there are CAD file formats which make it impossible to place a watermark due to the source code being encrypted. Therefore, although machines are more digital than before, there are no suitable legacy systems in place at the moment, even though solutions such as watermarks and the blockchain have been suggested.

- A suggestion, as highlighted by one of the participants of this Study, would be to produce a software that could potentially track the entire production process from design development to product shipment with the goal being to enable quality assurance, as well as fully traceable production and distributed manufacturing, remotely.

Case Study 7 From Watermarks to the Blockchain: Technical Solutions for the 3D Printing Sector

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6. INTRODUCTION

This chapter sets out the conclusions and recommendations based on the research detailed in chapters 2–5, including the expert workshop that was held in the framework of this Study.

6.1. 3D Printing and IP Protection

Defining a subject matter that can be protected by IPRs seems to be a major difficulty when discussing 3D printing. Indeed, it appears from the interviews with the industry that the difference between different elements one could protect when working with a 3D model and/or a CAD file is unclear.

For the purposes of this study, three main components were considered: (i) the CAD file, (ii) the 3D model and (iii) the design data (the two latter being examined together). We will review below these three components

A **CAD file** is understood as the 'vessel' that carries the 3D model. It is of paramount importance for the 3D printing process: without a CAD file, a 3D printer is unable to print anything. A CAD file can be created by using CAD software or by scanning an object. The study shows that there is a lack of clarity as to the protection of a CAD file under the current IP regime. The assessment of the law was further reflected in the views from the industry, with more than half of the interviewees stating that there is indeed a lack of clarity in relation to the protection of CAD files.[563]

The study has reached the following conclusions:

- Under *patent law,* it remains unclear how claims attempting to protect the CAD files could be formulated in patent applications and whether Patent Offices could accept them as valid.

- Under *copyright law,* the study takes the view that it is important to consider the legal status of the CAD file separately from the 3D model. Against that background, the question arises whether a CAD file (or its elements) can be considered a computer program; this remains controversial in the literature. This study considers that where software is used to generate or run a CAD file, and where this software is embedded in a CAD file, it may be capable of attracting copyright protection. However, the validity of this approach has not yet been confirmed by EU or national jurisprudence.

- Under *design law*, the study reaches the conclusion that the CAD file as such is not eligible for protection under EU Design law.

- Under *trade mark law*, it is important to indicate that trade marks can be used for goods and services relating to CAD files. In that context, the study concludes that a CAD file itself can be considered a 'good' under Class 9 if it is downloadable,

[563] See *supra* pp. 23-24, Industry Opinion: Seeking Clarity in Relation to the Protection of CAD Files.

and services around CAD files can be considered a 'service' under Class 41 (also where the CAD file itself cannot be downloaded).

Recommendations: The main problem as regards the protection of a CAD file is the uncertainty around what can be protected. We recommend therefore clarifying what elements of a CAD file can constitute subject matter of protection, and for which IPRs, including by considering a separate legal assessment of the CAD file and the 3D model it encompasses.

Under copyright law, we recommend clarifying that software embedded in a CAD file can be considered a 'computer program' in accordance with the EU copyright law.

Design data are another component used for 3D printing that needs to be considered. Design data include for instance data generated by the scanning of a product (a *numerical* representation of how a given model looks and what it consists of). Interestingly, the interviewees found the protection of design data as such to be confusing, stating that there was insufficient legal clarification at the moment. Interviewees called for further clarification on the application of IP law to design data.[564]

In general, IP regimes do not appear a well-suited solution to protect data. However, some IP regimes can provide some indirect protection to data. For instance, databases can be protected under the *sui generis* database right as long as the criterion of substantial investment is met. In case of protection, there can be multiple makers of the database (e.g. persons scanning the object, persons 'cleaning' the CAD file, etc.). Other, non strictly IP, means of protection include trade secrets and contractual mechanisms. As showed in the study, trade secret protection is considered a good tool for protecting designs data.

Finally, the **3D model** (a *graphical* representation of how a given model looks and what it consists of) may receive protection under IPR. The 3D model is part of the CAD file (see *supra*, the CAD file being the 'vessel' of the 3D model). In other words, it consists of the design or drawing component of a CAD file. The study considers that the 3D model can in principle be protected under copyright, designs and trade mark law.

- Under *patent law,* we consider that a 3D model as such does not fulfil the protection criteria. From the current practice of the patent offices it is unclear whether a 3D model included in a CAD file can be accepted as a digital representation of an invention in the same way as the textual description of a claim.

- Under *copyright law*, a 3D model can receive protection under copyright law. Application of the conditions of protection for a 3D model does not prove particularly controversial (with, in some cases, the need to take into consideration the utilitarian nature of the works). However, the question arises as to whether a 3D model can attract copyright protection separate from the conceived tangible product.

- Under *design law*, the question centres around the possibility for a digital model to be eligible for designs protection. As explained in the study, 3D models encompassed (solely) by a CAD file may fulfil the requirement of being a

[564] See *supra* pp. 26-27, Industry Opinion: Is there a Lack of Clarity in Relation to Ownership of Design Data?

'product', having an 'appearance' and hence be eligible for protection under EU design law.

- Under *trade mark law*, although a 3D model can qualify for a protection as a three-dimensional trade mark, only few will reach the threshold for trade mark protection, given the strict case law requirements in respect of 3D trade marks.

Recommendations: We do not recommend changing the law to include the protection of data *per se* as there is no practical need to do so at the moment. In addition, other areas of law, such as trade secrets and contracts are better equipped to provide adequate protection. In this context, it is important to distinguish between the 3D model (reflecting design data) and the CAD file, which could potentially be considered a computer program.

We recommend making designers more aware of the possibility of design protection via registration. Such measures could include regulatory authorities resourcing design-applications and design-enforcement agencies in the future.[565]

In terms of copyright, the 3D model should be seen as a distinct 'work' separate from the resulting physical product. The law in this regard should be clarified.

Regarding protection of **3D printing hardware** such as 3D printers and 3D scanners, applicable IPRs such as *patent, design and trade mark laws* clearly apply – to inventions, appearance of the product and sign used respectively and therefore do not need further development. In addition, *trade secrets* also apply in this regard and are widely used in the industry.

The law in relation to the protection of **3D printing materials**, has also been developed over many years and once again current *patent, trade mark and trade secret laws* apply. In the context of *patent law,* the possibilities to apply patent protection to bio-printing related innovations might be challenged due to the possible morality and ethical claims that these inventions may carry. In *design law,* 3D printing materials may be a feature of the appearance of a product or a part of a product.

From an *industry perspective,* the interviewees agreed that the IP framework is sufficiently developed to deal with 3D printing *hardware* but were divided on the issue of the protection of *materials.*[566] Materials and 'digital materials' (where the arrangement is decided by a computer algorithm) transform shape during the printing process. This is unique to 3D printing and the lack of clarity in this area was highlighted. The participants also cited the importance for the development of technical standards, rather than IP protection as aerospace and health sectors are particularly reliant on standards.

Recommendations: The law is well developed in the area of *hardware* and therefore it is recommended that policy makers retain the current rules. In the context of *materials*, it is recommended that the technical standards be reviewed and addressed to progress the development of 3D printing. In view of the fact that

[565] See also, *Economic Review of Industrial Design in Europe* (MARKT2013/064/D2/ST/OP) (Europe Economics; 2015), p. 134.

[566] See *supra* pp. 44-45, Industry Opinion: Clarity and Development of the IP Framework of 3D Printing Materials; and Industry Opinion: Protection of Hardware in the 3D Printing Process.

materials and digital materials transform shape during the printing process, which is unique to 3D printing, it is recommended that the IPR framework, in particular patent law, be reviewed in addressing the lack of clarity and the gap in protection.

6.2. 3D Printing and Exceptions and Limitations

As regards applicable exceptions, the study has considered several scenarios, which will be the most common scenarios in the case of 3D printing. We have envisaged the application of the private and non-commercial exception in each scenario.

Home 3D Printing: Home 3D printing activities can in principle benefit from the 'private use' exception. As illustrated in the report, private use exceptions exist in patent law, copyright and designs:

- In *patent law*, the private and non-commercial use exception can apply to home 3D printing. Questions may arise concerning a person who engages in 'home printing' and routinely uses it, for instance, as part of their professional activity. However, other than these specific cases home 3D printing usually is excused from infringement.

- In *copyright law*, if a user prints a CAD file at home for his/her consumption and does not share it nor disseminate it, then this activity will qualify for the private use exception under Article 5(2)(b) of the InfoSoc Directive. However, the exception will not apply if the user engages in any commercial activity, such as sharing a printed object in return for a remuneration.

- In *designs law*, the private and non-commercial use exceptions within the meaning of Articles 20(1)(a) of the Design Regulation and 13(1)(a) of the Design Directive will apply to home 3D printing carried out by private individuals in their personal, non-commercial capacities.

Printing at a Bureau or Other Public Service: 3D printing or scanning by 3D printing bureaus services will likely fall outside the private use exception:

- In *patent law*, under the current understanding of the private and non-commercial use exception in Europe, using a third party to engage in conduct permitted under the exception would not be allowed. Another question relates to whether the private use defence can be invoked when commercial or educational services provide the required equipment and materials to enable private users to print out (infringing) objects themselves. Under indirect patent infringement doctrines, those who knowingly supply third parties who are benefiting from the private use exception may still be liable for indirect patent infringement.

- In *copyright law*, the private use exception will not apply to 3D printing bureau services, which are commercial entities. Furthermore, a person commissioning a 3D printing bureau to carry out a service on their behalf, will also not be able to benefit from the private use exception, as it will be deemed to be a commercial act.

- In *designs law*, the study considers that the exception for private and non-commercial use will not apply to 3D printing bureau services. The study further considers that a person commissioning a 3D printing bureau cannot benefit from the exception. It is indeed considered that paying for a manufacturing process constitutes a commercial action. However, this remains controversial.

Sharing of CAD Files: In accordance with the current IPR framework, sharing CAD files encompassing 3D models (designs) with a family member can likely be considered private use, although uploading to a publicly accessible website will defeat the exception.

- In *patent law*, the application of the private use exception will largely depend on the intrinsic link between the CAD files and the patented objects that they represent (see *infra*). This is unclear under the current rules and therefore a different interpretation of this relationship might lead to different outcomes in the application of the private use exception.

- In *copyright law,* the private use exception will only apply to those who upload CAD files to a small group of friends. As regards downloading, the private use exceptions will only apply to downloading from a lawful source for private use.

- In *designs law*, one has to make a distinction between uploading and downloading acts. The study takes the view that an uploader is not acting privately when uploading the design to a publicly accessible website. The downloader, however, will currently fall under the private use exception.

- As regards *trade mark law*, activities carried out for purely private, non-commercial activities will not constitute an infringement.

As the above shows, protection of different elements by multiple rights may be possible throughout a 3D printing process. These different layers of rights can make the application of exceptions difficult. Some interviewee participants highlighted that this complexity may lead to a lack of clarity for users as to when they can rely on exceptions. This can impact the uptake of 3D printing and also the possibility for citizens to rely on 3D printing e.g. repairing products.

Recommendations: It is recommended that the private use exception be applied in a balanced manner, taking into account both rights and exceptions, in the same way it applies to other subject matter. However, as the 3D printing process encompasses a multitude of IP rights, the application of exceptions can be complex and unclear. For this reason, it is recommended that the private and non-commercial use exception, be limited to cover ‘acts which do not unduly prejudice the normal exploitation of the design’ as reflected in copyright law. This can be achieved by interpreting both the ‘commissioner’ and the ‘commissioned’ of acts carried out in a 3D printing service bureau in a manner which does not fall under the private and non-commercial use limitation whilst also extending it to distinguish between lawful and unlawful sources being 3D printed or 3D scanned in printing bureaux.

Principle of Exhaustion: With regard to *copyright and trade mark laws,* the study considers that there is no exhaustion when trading CAD files containing design data (although the exhaustion of the distribution right is possible for physical 3D print-outs). This should however be nuanced should we consider CAD files as computer programs. Indeed, in such case, the UsedSoft case law would apply to CAD files.

As regards patents, the exhaustion principle also covers the ordinary repair of a product. Ordinary repair is allowed insofar as it does not equate to making the invention. As shown in the study, there is a lack of agreement on the interpretation of legitimate ‘repair’ – as opposed to illegitimate ‘reconstruction’ – of the protected invention, under patent law in the EU. 3D printing further complicates the already uncertain interpretation of the exhaustion doctrine in patent law. CAD files indeed allow easy modification, making it more difficult to determine how much modification is allowed before it could be considered patent infringement. This further blurs the line between making and repairing. This is an important issue for spare parts.

Recommendations: It is recommended that further clarity be provided in relation to the limits between permissible 'repair' and impermissible 'reconstruction' under patent law, thereby removing the present confusion which exists between making and repairing in the 3D printing sphere.

6.3. 3D Printing and IP Infringement

Directive 2004/48 provides instruments enabling rightholders to protect their rights and fight infringing activities. These tools remain applicable in the context of 3D printing. However, some questions remain as regards IP infringement and 3D printing. Therefore, the study has examined different scenarios that are specific to 3D printing.

Designing a CAD File: Designing a CAD file from inception (without thus copying any existing protected creation or invention), through the use of modelling software, is *unlikely to infringe patent, copyright or design laws.*

The same is not true when *scanning, copying or customising existing creations, products or inventions*. The mere fact of scanning a protected work can result in a reproduction act under copyright law, which is subject to the author's authorisation. As regards customisation, this will pose the traditional question, under copyright and designs law, of the pre-existing rights (e.g. to what extent the customisation includes the use of original elements of a work or of elements reflecting the individual character of a design).

In this context, it is questionable whether scanning, customising or copying a protected object and creating a digital representation of it would give rise to patent, copyright or design infringement. As such, the law in relation to 3D scanning needs further clarity.

If this should not be considered an infringement, the question arises whether the designing of a CAD file e.g. representing an invention or including a trade mark, can be considered a first step towards an infringement. As regards trade marks, this does not fall at the moment within the meaning of a preparatory act, as provided by Article 11 of the trade mark directive. As regards patent law, the question might arise as to whether a CAD file could be considered as a means for putting the invention into effect. At the moment the interpretation of 'means' in the doctrine seems to go against such interpretation.

Sharing a CAD File: Working on the assumption that the CAD file includes, represents or reproduces a protected invention or creation, the study envisages whether the sharing of a CAD file can constitute an infringement.

- Under *patent law*, as stated above, the intrinsic link between the CAD files and the patented objects that they represent is unclear. If CAD files were to be considered a digital representation of an invention in the same way as the textual description of a claim, then, at least theoretically, it is possible to argue that commercial CAD-file sharing may be viewed as an act of 'offering' or 'offering for sale' of an invention, thereby leading to an infringement. As regards the concept of 'means', it is unclear how it should be interpreted. If 'means' continues to be interpreted, as it traditionally has, as relating to something 'physical' or 'tangible', it would radically limit the possibilities for pursuing indirect infringement activities relating to 3D printing.

- Under *copyright law*, online platforms hosting and sharing copyright material without the author's consent and doing so with actual or constructive knowledge in return for a financial gain, will be involved in an act of reproduction and/or communication to the public and could be held liable for copyright infringement.

- Under *designs law*, it is controversially discussed whether uploading, hosting and downloading a CAD file to a publicly available platform constitutes an infringement. However, the more compelling arguments suggest that these acts be considered a 'use' within the meaning of EU design law.

- Under *trade mark* law, the question remains open as to whether the sharing of a CAD file including a trade mark can constitute an infringement. However, this question appears at the moment of minor importance. Indeed, a CAD file which includes a trade mark, will in general use the trade mark to advertise the CAD file on the platform. This will clearly constitute a trade mark infringement.

Printing a CAD File: The final step of any 3D printing process is the printing of the CAD file. Printing can be considered an infringing act for many IPRs, as shown in the Study:

- Under *patent law*, printing a protected invention can clearly constitute an infringement. However, it remains unclear, after the first sale of a physical product, to what extent modifying or repairing the physical embodiment of a patented invention (e.g. printing out only same parts of the protected object) is also allowed without reaching the level of 'making' it (thus infringing). Different interpretations on this exist at European and national level.

- Under *copyright law and designs law*, both printing and distributing a protected work or a design without authorisation constitutes an infringement.

- Under *trade mark* law, printing and distributing in the course of business and without authorisation 3D printed products including or consisting of a trade mark constitutes an infringement.

ISP Liability: Intermediaries will be well placed to effectively stop infringements and prevent new infringements in most cases, where illegal CAD files or illegal 3D prints are disseminated. The study has shown the instruments which exist in the EU legislation that allow actions to be undertaken, in the field of 3D printing, against intermediaries (i.e. injunctive relief and liability of intermediaries). However, the study has also highlighted gaps as regards indirect infringement and liability of intermediaries in the field of trade mark law.

Recommendations: 3D printing has given rise to some infringement issues although they have not yet led to any court cases in the EU. Similarly, current practices within the 3D printing and scanning sectors do not point to a market failure, which the IPR framework cannot address at this moment in time. At the same time, sharing CAD files on 3D printing platforms continues to be increasingly popular, with the potential to cause substantial commercial damage. This could be out-of-reach of the IPR framework particularly in relation to the unauthorised use of *trade marks,* if such sharing of CAD files is considered non-commercial activity. Therefore, whilst no action is required at present, it is recommended that policy makers monitor infringements arising in the 3D printing and scanning landscape, especially in the trade mark context.

6.4. Licensing, Traceability and New Business Models

Under *patent law,* licensing of 3D printed inventions was viewed as comparable to other industry sectors. A notable exception was the licensing of patented methods embedded into software which were seen as more difficult to license because they were also more problematic to enforce. Furthermore, the cost of licensing was identified as prohibitive for some (smaller) organisations – however, this is not specific to the 3D printing industry. With regards to *copyright law,* third party licensing arising from online platforms was seen to be very prevalent. Also, the use of creative commons licensing was noted in the 3D printing and scanning sector, as another form of licensing. *Trade mark* owners of consumer products (e.g. cars) have engaged in licensing the use of design data contained in CAD files, but this is not a widespread practice.

The views established through a review of the law were further enhanced by *views from industry.* For example, licensing of CAD files was recognised as having the potential to create new business models reducing the barriers to entry for start-ups and SMEs and affecting diverse types of actors and different types of companies.

Traceability: was considered to be important from both an intellectual property and product liability perspective. However, most interviewees believed that traceability systems are still under-developed with the potential to become more important in the future as 3D printing continues to grow. In the meantime, the interviewees indicated that clear and affordable technological solutions would help SMEs and industries.

Recommendations: Licensing of CAD files has the potential to create new business models reducing the barriers to entry for start-ups and SMEs and affecting diverse types of actors and different types of companies. Commercialisation of CAD files through intermediaries; democratisation of access to design and manufacture; and innovation by experimenting with current technologies are a few options in this area.

In terms of traceability, there are no suitable legacy systems in place at the moment, even though solutions such as watermarks and the blockchain have been suggested. A suggestion, as highlighted by one of the participants of this Study, would be to rely on a software that could potentially track the entire production process from design development to product shipment with the goal being to enable quality assurance, as well as fully traceable production and distributed manufacturing, remotely.

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APPENDIX

1. Mapping exercise

1.1 Objectives of the work package

3D Printing and Additive Manufacturing technologies are being used across a wide range of industries, each with their own distinct value chain. Value chains can differ significantly based upon the type of 3D Printing technology platform being used, the end use application or the design methodology that is employed. For example, the value chain for dental aligners that are personalised to each patient is completely different to the value chain for the manufacture of metallic brackets for commercial airlines. This diversity presents a challenge to researchers looking to understand the IP implications presented by 3D Printing, as there are many scenarios that must be taken into consideration.

The purpose of this work package was to provide the IP experts working on this project with deeper context about the supply chains that have formed around 3D Printing. Through this industrial insight, it is intended that the IP experts will have a deeper appreciation of the technical subtleties of each sector and the IP considerations that could occur at each stage.

This work package also provides the basis for *Work Package 4 – Qualitative Research and Case Studies*; through the WP3 mapping exercise, key supply chain actors within each industry are identified, ensuing that the companies interviewed in WP4 are most relevant.

1.2 Methodology

Led by the Industry Expert team, this work package identified fourteen case studies across seven sectors, namely: Healthcare, Aerospace, Industrial, Automotive, Consumer Products, Energy and Construction.

When selecting suitable case studies, a range of criteria were considered including: the current market size for the application; the potential impact of the application on future markets; the complexity of the current supply chain and; if the application presents novel IP challenges.

The case studies were compiled through a combination of insight from the industry expert team and desk-based research. For consistency, the format of the value chains were based upon those presented by the AM-Motion group in the FoFAM Roadmap report[567]. These value chains consider: Data Capture, Design, File Preparation, Material, Process, Post Process, Product and End of Life. By assessing each case study with respect to these points in the value chain, the Industry Expert team identified where IP was considered to be by industrial users. It should be noted that this is a subjective approach, with the intention of providing the IP Expert team with insight into the industrial perspective. These case studies were shared were with the IP Expert team to inform their research and identify areas for further investigation.

[567] Additive manufacturing roadmap: gaps and actions on market driven value chains, www.am-motion.eu

2. Findings

A summary of the findings is presented here. Further information is presented below.

Intellectual Property is not constrained solely to design

As a rapidly developing industry, there is significant emphasis on IP within 3D Printing value chains. This IP is involved at all stages of the design and manufacture of 3D Printed products, from printing algorithms to proprietary finishing processes. In many cases, it appears that the most valuable IP is not necessarily within the design of a product, but in the manufacturing processes.

Value chain actors are involved at multiple stages in 3DP value chains

The mapped value chains show that the same companies are often involved at multiple stages; they may supply machines, materials and software to users. This has become especially prevalent in recent years, as large companies have sought to vertically integrate 3D Printing businesses in to their portfolio. This may mean that separating the IP ownership in an end product is a complex process, as various parties may own IP at different points in the value chain.

Involvement of consumers in the design and manufacture process raises questions over IP

Additional IP considerations must be made in situations where consumers are involved in the design and manufacture process, either actively or passively. For example, consumers are actively involved in the design process of customised car components as they use software tools to design a product to their requirements. Consumers can also have passive involvement, such as where design data is collected from them with the intention of manufacturing personalised products such as dental aligners.

3. Healthcare

The healthcare industry has created some of the most disruptive AM-enabled business models over the last 20 years. There are many drivers to using AM for the healthcare industry, including patient specific devices, the production of highly complex products and reduced manufacturing costs for low-volume component. There is a growing AM medical supply chain including a relatively wide library of biocompatible materials for AM and CAD software that designs devices from Computer Tomography (CT) scan data.

4.1 Hearing Aids

In-the-ear (ITE) hearing aids have been manufactured using AM since the early 2000s and are considered a success story for the industry. The move away from traditional copy-milling techniques represented a seismic shift from a labour-intensive cottage industry to high-tech manufacturing. It is now estimated that over 12-million hearing aid shells are printed annually[568].

Polymer AM hearing aids are manufactured using stereolithography and vat photopolymerization techniques; these processes result in extremely accurate polymer shells that only need minor post-processing to remove support structures and stair-stepping.

Figure 28: Hearing aid shells, © Envisiontec

[568] 3D Printing & AM in the Medical and Healthcare Marketplace, 2013, 3D Printing Industry / Econolyst, https://3dprintingindustry.com/news/3dpi-publishes-industry-leading-report-3d-printing-medical-sector-19482/

	Description	Involved Actors	IP Considerations
Data Capture	Hearing healthcare provider takes a silicone impression of the patient's ear. The impression is 3D scanned to create digital data. There has been recent developments in direct scanning of the ear canal to eliminate the requirement for impression taking.	Patients, Hearing healthcare providers (Hospitals and Health Services, Audiologists), 3D Scanning providers (3Shape, 3D Systems, Otmetrics) Hearing Aid Manufacturers (e.g. Sonova, GN Resound, Starkey, Sivantos, Widex, Oticon).	Ownership of patients' data. Scan conversion process.
Design	Converting the point cloud data to a hearing aid shell model. This will include modelling the placement of electronics, which differs for each patient. This process can be automated or manual.	Hearing Aid Manufacturers (e.g. Sonova, GN Resound, Starkey, Sivantos, Widex, Oticon), AM software providers (Materialise Rapid Shell Modelling, 3Shape).	Automated design algorithms.
File Preparation	To make the design suitable for print; this can involve adding build supports, part identifiers and slicing. This process is dependent on the technology configuration; in most instances, file preparation is done by the manufacturer in the AM software. Some technologies require design data to be submitted to system manufacturer for build preparation.	AM software providers (Materialise Magics, 3Shape, Netfab), AM system providers (EnvisionTEC, Carbon3D, 3D Systems).	Print algorithms, support geometries, build strategies.
Material	The vast majority of hearing aids use a vat-photopolymerisation method; this means that photocurable resins are typically used. Resins specifically tailored for hearing aid production are available. However, Sonova launched titanium aids in 2017.	AM system providers (EnvisionTEC, Carbon, 3D Systems), Material manufacturers (DSM Somos, Henkel, etc.).	Formulation of hearing aid specific resins. Machine parameters for specific resins.

Process	Parts are printed using chosen technology. In the vast majority of hearing aids, this is SLA or DLP due to the high resolution achievable, however SLM can be used for metal aids. Shells are generally printed in-house by the hearing aid manufacturer, however this work can be outsourced to external service bureaus.	AM system providers (EnvisionTEC, Carbon3D, 3D Systems), Hearing Aid Manufacturers (e.g. Sonova, GN Resound, Starkey, Sivantos, Widex, Oticon).	Machine parameters, Conversion of digital data into physical product.
Post Process	Parts require post-processing to remove support structures, uncured or loose material and surface defects. This is done by a variety of manual, automated and mass-finishing techniques.	Hearing Aid Manufacturers (e.g. Sonova, GN Resound, Starkey, Sivantos, Widex, Oticon).	Post-processing methodologies.
Product	Shell forms part of the hearing aid assembly that is supplied to the patient.	Hearing Aid Manufacturers (e.g. Sonova, GN Resound, Starkey, Sivantos, Widex, Oticon).	The IP involved in the manufacture of the shell only represents a small proportion of the IP in the assembled hearing aid; there is significant IP in the electronics, software and fitting.
End of life	Entire hearing aid enters waste electronic disposal stream. Shell is personalised to patient so cannot be reused.	Local governments, private waste management companies.	N/A

4.2 Dental Aligners

Like hearing aids, dental aligners are a key example of mass customisation enabled by AM technologies. In this case, AM technologies are used to manufacture a former, over which clear plastic is vacuum formed to produce the final product. Pioneered by Align Technologies in 1997 and enabled by digital dentistry, the product offers patients a more discreet option to conventional metal-wire braces. Today, over 100-million dental aligners are manufactured each year.

Figure 29: Dental Aligner, (C) Clear Correct

	Description	Involved Actors	IP Implications
Data Capture	Data capture can be done in two ways: intraoral scanning or scanning a dental impression. Intraoral scanning involves capturing a 3D scan of the patient's mouth in real time, which can be directly used to create the design data. Alternatively, an impression can be taken using an alginate mould into which the patient's bites. Plaster is then cast into this mould, which is subsequently scanned using a 3D scanner.	Patients, Dental care providers (Dentists, Hospitals and Health Services, 3D Dental Scanning providers (Align Technologies iTero, ClearCorrect, 3Shape, Sirona, 3M, etc.)	Ownership of patients' data. Scan conversion process.
Design	The dental practitioner or aligner manufacturer uses software to model the desired outcome based on the existing patient's data. Specialist software is then able to iterate the design of the required dental aligners to achieve the desired results over the course of the treatment.	Dental Aligner manufacturers (Align Technologies ClinCheck, Clear Correct, Clear Smile).	Significant IP in the automated design algorithms.
File Preparation	Proprietary software used to convert designs to printable files suitable for forming the dental aligners. This may include applying offsets, serialisation or support structures.	Dental Aligner manufacturers (Align Technologies, Clear Correct, Clear Smile).	IP in the preparation of files to ensure printability.

Material	Wide range of materials available for manufacturing moulds; generally proprietary to the AM system manufacturer. The formers do not come into contact with the patient, therefore there are lower biocompatibility requirements than hearing aids.	Material manufacturers (3D Systems, Stratasys, DSM Somos, Formlabs, Carbon3D etc.).	Materials can be designed specifically for dental applications, to improve accuracy - there will be IP in these materials.
Process	A range of processes can be used to manufacture the formers - generally vat photopolymerisation techniques (stereolithography or digital light projection) is used, however material jetting (Polyjet®) can also be used.	AM system providers (3D Systems, EnvisionTEC, Carbon3D, Formlabs, Stratasys etc.).	Machine parameters can be specialised for dental applications - there may be IP in these parameters.
Post-Process	Minimal manual post-processing of formers - this is a highly automated process.	Dental Aligner manufacturers (Align Technologies, Clear Correct, Clear Smile).	Manufacturing process proprietary to each manufacturer.
Product	The aligner material is formed over the top of the printed former, creating the product.	Dental Aligner manufacturers (Align Technologies, Clear Correct, Clear Smile).	Same as a conventionally manufactured product.
End of Life	Disposal by waste or medical waste.		

4.3 Orthopaedic Implants

One of the most significant uses of AM within Healthcare is in the manufacture of orthopaedic devices. Common implants such as hip, knee and spinal replacements are manufactured using metallic AM processes, by manufacturers such as DePuy and Stryker.

The primary driver for using AM to manufacture implants is not personalisation, as is often assumed, but the ability to economically create highly complex surfaces on products manufactured in relatively low production volumes. Trabecular surfaces that encourage osseointegration can be easily designed and printed, without the need for the secondary powder coating techniques that are conventionally used. An exception to this is in trauma or reconstructive surgery, where personalised implants such as cranial plates are used to rebuild damaged bone; the devices are designed using data from medical scanning techniques such as Computer Tomography (CT) scan data.

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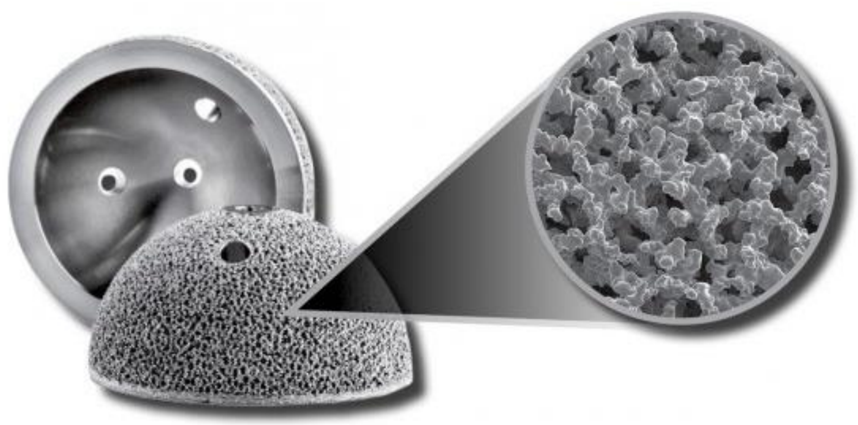

Figure 30: Acetabular cups with trabecular structures, © Arcam

	Description	Involved Actors	IP Implications
Design	Generic orthopaedic implants are designed using specialist medical CAD software. Proprietary features (such as surface patterns) may be incorporated.	Medical Device OEMs (Stryker, De Puy, Medtronic, Boston Scientific, etc.), Medical Device Design Software (Materialise, Siemens, 3D Systems, Autodesk).	Significant IP in the design of orthopaedic implants – very high value products.
File Preparation	Proprietary software used to convert designs to printable files. This may include applying offsets, serialisation or support structures.	AM software providers (Materialise, Autodesk, etc.).	IP in the preparation of files to ensure printability.
Material	Typically medical grade alloys, such as Commercially Pure Titanium.	AM Material Providers (LPW, Oerlikon, Sandvik, GKN Hoeganaes, Carpenter, Norsk Titanium, Arconic, etc.).	At present, AM metal powders are based upon existing alloys, therefore there is low IP in the alloy. However, there is a move towards AM-specific alloys, which will create new IP. There can also be IP in the material handling and traceability.
Process	Metallic powder bed processes such as Electron Beam Melting and Selective Laser Melting are most commonly used.	AM System Providers (EOS, Renishaw, GE Arcam, SLM Solutions, GE Concept Laser), AM Service Bureaus (Citim, FIT, 3T RPD, etc.).	There may be IP in the machine parameters used.
Post-Process	Extensive post-processing to ensure parts are clean and free of powder. Machining of interfacing surfaces.	Medical Device OEMs (Stryker, De Puy, Medtronic, Boston Scientific, etc), AM Service Bureaus (Citim, FIT,	This can be a complex task, therefore there may be IP involved.

	Sterilisation of parts.	3T RPD, etc.).	
Product	Product is shipped to hospitals, where it is implanted into patient.	Dental Aligner manufacturers (Align Technologies, Clear Correct, Clear Smile).	Same as a conventionally manufactured product.
End of Life	Disposal by medical waste; recycling of metal.	Orthopaedic recycling companies (OrthoMetals).	-

4. Aerospace

The aerospace industry was one of the earliest adopters of AM technology; as such, the technology has been FAA-approved for a variety of applications and benefits from a relatively mature supply chain. Both polymer and metal technologies are used, although the most common processes are Powder Bed technologies and Material Extrusion.

The drivers to using AM within the aerospace industry are numerous. Whilst the potential weight savings – and thus fuel savings - enabled by AM often attract media headlines, industry insiders largely agree that the more significant business driver is the ability to manufacture highly complex parts in expensive materials in low production volumes. The use-case applications detailed below all exploit this advantage; often utilising geometric complexity to improve performance.

The barriers to AM adoption within the Aerospace sector are predominantly related to process and material regulation. Very few polymers are as certified flight-safe due to fire, smoke and toxicity regulations. Whilst the commonly-used metallic materials such as titanium and Inconel are familiar to aerospace engineers, the properties that are achieved using AM are often very different from their conventionally-made counterparts; as such the aerospace typically takes a conservative approach to AM.

5.1 Heating, Ventilation and Air Conditioning Ducting

Fused Deposition Modelling (FDM) has found widespread use in the Heating, Ventilation and Air Conditioning (HVAC) systems of aircraft. Aircraft HVAC ducting is comprised of a network of highly complex geometries, with very low structural requirements, which transport air for environmental control within the cabin. HVAC systems would traditionally be fabricated from pipework, joined together using conventional connectors and fittings; AM offers multiple benefits including:

- Pipework consolidation results in a lower requirement for connectors or fittings; as such, there is a reduced risk of failure and a reduced inspection and maintenance requirement. This reduces maintenance costs for the aircraft operator and downtime for the aircraft.
- Airflow can be optimised throughout the system, reducing pressure loss and improving overall system performance

Whilst exact figures for HVAC adoption are not known, it has been reported that the Airbus A350 uses over 1000 Ultem components per aircraft, manufactured via the Stratasys FDM process[569] [570]; it is understood that many of these components are located within the HVAC system.

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[569] 3D Printing 2.0: From Prototyping to Manufacturing, Fred Fischer, Inside 3D Printing Conference 2016, https://www.slideshare.net/RMEvents/fred-fischer-stratasys

[570] Airbus A350 XWB takes off with over 1000 3D Printed Parts, 3D Printing Industry, 6th May 2015. https://3dprintingindustry.com/news/airbus-a350-xwb-takes-off-with-over-1000-3d-printed-parts-48412/

Figure 31: Ultem 9085 ducting manufactured via FDM, © Stratasys

	Description	Involved Actors	IP Implications
Design	Air Ducts are designed using conventional CAD techniques, as well as simulation tools such as Computational Fluid Dynamics (CFD) to assess fluid flow performance and Finite Element Analysis to assess mechanical requirements.	Aerospace OEMs (Boeing, Airbus, BAE Systems, Bombardier, Embraer etc), Design and Simulation Software Providers (Dassault Systémes, Siemens, Ansys, Autodesk, MSC Software, etc.) Engineering and Design Providers.	Simulation modelling will require extensive customer data which is highly sensitive and likely to contain significant IP.
File Preparation	Optimisation for print, including addition of support structures and file slicing.	Engineering and Design Providers AM Service Bureaus, AM software providers (Materialise, Autodesk).	IP in the development of suitable build strategies to ensure parts meet required specifications. Aerospace tolerances are typically high, requiring service bureaus to use background IP to achieve optimum build conditions.
Material	There are limited materials approved by the Federal Air Authority as materials must be flame retardant. Most aerospace ducting is printed using Ultem® filaments, however certain powders are available, such as flame-retardant Nylon-12, PEEK and PEK.	AM Material Providers (Sabic, Stratasys, EOS, HP, Arkema, Evonik, etc.).	The AM materials that are used in aerospace are often the most costly materials, with significant IP in the filaments and powders used.
Process	Predominantly Fused Deposition Modelling, however Polymer Powder Bed Fusion technologies can also be used.	AM System Providers (Stratasys, EOS, HP, Arkema, Evonik, etc.) AM Service Bureaus.	IP in the parameters required to print high temperature materials.
Post-Process	Minimal Post processing of ducting. There may be some light surface	AM Service Bureaus.	Very low IP, as post-processing uses

	finishing of interfacing parts.		conventional methods.
Product	Product is assembled into HVAC systems of aircraft.	Aerospace OEMs (Boeing, Airbus, BAE Systems, Bombardier, Embraer etc.)	IP involved in assembly will likely be proprietary to OEM.
End of Life	Products is disposed of via industrial waste streams.	-	-

5.2 Brackets

Although relatively benign parts, major aerospace manufacturers see significant opportunity in using AM to manufacture brackets and mounting components. These components can be used in a variety of situations, including fixing panels, wiring and pipework to the structure of the aircraft. As such, there is extremely high product variety between the brackets and mounting components on a given aircraft.

Boeing and Airbus have both previously announced that they are using AM for non-structural mounting components and, in 2017, both manufacturers announced FAA-approved structural brackets would be included on their planes. The Airbus A350 XWB will feature a bracket manufactured from titanium in collaboration with Arconic; the bracket is part of the aircraft pylon - the junction section between wings and engine[571]. The Boeing Dreamliner 787 will also feature a structural component, manufactured by Norsk Titanium[572].

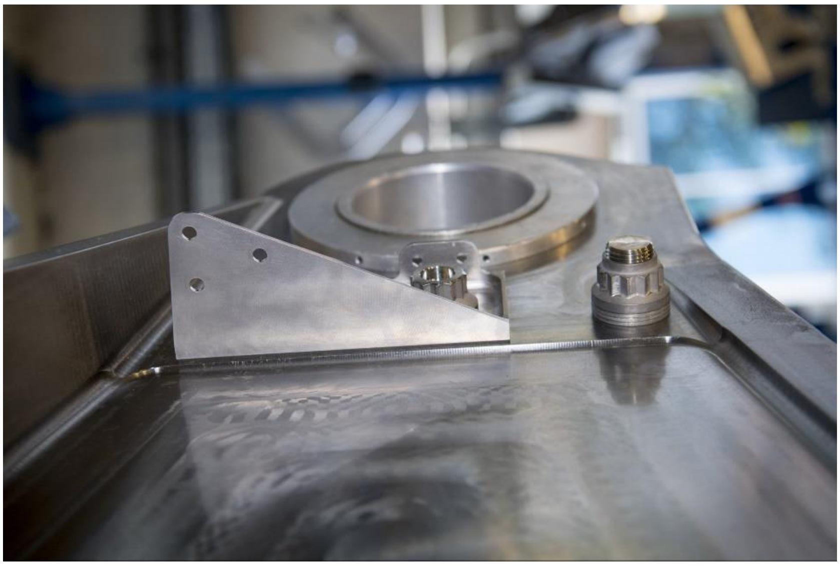

Figure 32: 3D Printed bracket installed on A350 XWB Pylon, © Airbus 2017

[571] First titanium 3D-printed part installed into serial production aircraft, Airbus, 13th September 2017, http://www.airbus.com/newsroom/press-releases/en/2017/09/first-titanium-3d-printed-part-installed-into-serial-production-.html

[572] Norsk Titanium Delivers First FAA-Certified, Additive Manufactured Ti64 Structural Aviation Components, 19th June 2017, http://www.norsktitanium.com/media/press/norsk-titanium-delivers-first-faa-certified-additive-manufactured-ti64-structural-aviation-components

	Description	Involved Actors	IP Implications
Modelling	Brackets are designed using conventional CAD techniques, as well as simulation tools such as Finite Element Analysis (FEA) to assess mechanical requirements.	Aerospace OEMs (Boeing, Airbus, BAE Systems, Bombardier, Embraer etc), Design and Simulation Software Providers (Dassault Systémes, Siemens, Ansys, Autodesk, MSC Software, etc.) Engineering and Design Providers.	Simulation modelling will require extensive customer data which is highly sensitive and likely to contain significant IP. Algorithms used for simulation can also contain significant amounts of IP.
Design	Optimisation for print, including addition of support structures and file slicing. Metallic processes require a considerable degree of Design for AM optimisation to ensure a successful build.	Engineering and Design Providers AM Service Bureaus (Citim, FIT, 3T RPD, Materials Solutions, etc.) AM software providers (Materialise, Autodesk).	IP in the development of suitable build strategies to ensure parts meet required specifications. Aerospace tolerances are typically high, requiring service bureaus to use background IP to achieve optimum build conditions.
Material	Aerospace-grade metallic alloys, including titanium and Inconel, which have typically been prepared into feedstock that is suitable for AM.	AM Material Providers (LPW, Oerlikon, Sandvik, GKN Hoeganaes, Carpenter, Norsk Titanium, Arconic, etc.).	At present, AM metal powders are based upon existing alloys, therefore there is low IP in the alloy. However, there is a move towards AM-specific alloys, which will create new IP. There can also be IP in the material handling and traceability.
Process	Metallic processes used are: Powder Bed Fusion (Predominantly Selective Laser Melting and Electron Beam Melting) and Direct Energy Deposition.	AM System Providers (EOS, Renishaw, GE Arcam, SLM Solutions, GE Concept Laser, Arconic, Trumpf, DMG Mori), AM Service Bureaus (Citim, FIT, 3T RPD, Materials Solutions, etc.).	IP in the parameters required to print high temperature materials.

Post-Process	Extensive post processing is required, including machining and surface finishing. The poor surface finish of AM components can result in fatigue of components, therefore this is an essential step for loaded components.	AM Service Bureaus (Citim, FIT, 3T RPD, Materials Solutions), Aerospace OEMs (Boeing, Airbus, BAE Systems, Bombardier, Embraer etc.).	Very low IP, as post-processing uses conventional methods.
Product	Brackets are mounted as components into the aircraft.	Aerospace OEMs (Boeing, Airbus, BAE Systems, Bombardier, Embraer etc.).	IP involved in assembly will likely be proprietary to OEM.
End of Life	Products are likely recycled due to their high material value. They are unlikely to form feedstock for future AM processes at present.	Specialist recycling and material recovery companies.	-

5. Automotive

Although the automotive industry has used AM technologies for prototyping since the early 1990s, the industry has been extremely slow to adopt AM for production applications. The reasons for this include unsuitable materials for high-temperature underbody applications, poor surface finish for external applications and high production costs when compared to conventional manufacture. Additionally, the fuel-saving benefits enjoyed by the aerospace industry that result from light-weight components are generally not found in the automotive industry. As such, there are currently very few examples of AM components of mass produced vehicles and the industry is still dominated by prototyping.

6.1 Personalised Components

Personalised automotive components have attracted media attention recently, with BMW announcing personalised components for the Mini in December 2017. Designed via an online configurator tool and manufactured using the Carbon vat photopolymerisation process, the highly visible components represent a marked shift in AM usage.

Figure 33: Personalised Mini headlight components, © BMW

In addition to these highly visible body components AM has been used to manufacture personalised vehicle components for many years; for example, Bentley's customisation house, Bentley Mulliner, have previously used AM to manufacture customised cabin components, such as dashboards. Once covered with leather and trim, they are indistinguishable from conventionally manufactured alternatives.

The market for customised automotive components is still very niche; “the automotive customisation market accounts for only a small fraction of the global aftermarket; it is estimated that the US customisation market was worth £2.9-billion in 2012, with a large part of this driven by demand for premium electronic systems such as sound systems, satellite navigation systems and Bluetooth connectivity”[573]. However, if the trend towards visible AM components continues, there will inevitably be a requirement for automated surface finishing techniques; hand-finishing of such components is unlikely to be an economically viable option.

[573] Reeves, P. & Mendis, D, The Current Status and Impact of 3D Printing Within the Industrial Sector: An Analysis of Six Case Studies, (UK Intellectual Property Office, 2015) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/413673/The_Current_Status_and_Impact_of_3D_Printing_Within_the_Industrial_Sector_-_Study_II.pdf

	Description	Involved Actors	IP Implications
Design	In the case of BMW Mini, the OEM provides a constrained design, where the customer can modify certain parameters. Customer uses OEM's online design tool to customise their part, selecting surface finishes, patterns, colours, etc. Alternatively, customisation houses such as Bentley Mulliner can provide bespoke design services to create personalised components.	Automotive OEM (e.g. BMW Mini, Bentley), Vehicle owners	There are IP implications as the customer is modifying a design created by the OEM. This could create new IP or infringe other parties IP. In the case of BMW Mini, the Terms and Conditions of purchase state that BMW Mini will not manufacture designs that infringe others' IP rights, although it is not clear how this is determined.
File Preparation	The OEM, or a third party, prepares the file for print. This could include adding support structures and slicing.	Automotive OEMs (e.g. BMW Mini, Bentley), Engineering and Design Providers, AM Service Bureaus (Citim, FIT, 3T RPD, Materials Solutions, etc.), AM software providers (Materialise, Autodesk).	There may be IP in the development of suitable build strategies to ensure parts meet required specifications.
Material	Materials used are typically standard AM materials.	AM Material Providers (Sabic, Carbon, Stratasys, EOS, HP, Arkema, Evonik, etc.).	IP in materials is held by material provider.
Process	Typically, existing polymer AM systems have been used, such as Carbon or EOS SLS systems. These AM systems may be operated by the Automotive OEM or by a third-party service bureau.	AM system providers (3D Systems, Carbon, EOS, Stratasys etc.) AM Service Bureaus (Citim, FIT, 3T RPD, Materials Solutions, etc.), Automotive OEM (e.g. BMW Mini, Bentley).	Machine Parameters for optimum production.

Post-Process	As customised components are typically highly visible, post-processing is likely required. This could be to add colour to the parts, or to improve the surface finish. Mass finishing techniques for customised components are being developed, which will be necessary if large numbers of parts are being developed.	Automotive OEM (e.g. BMW Mini, Bentley), AM Mass finishing technology providers (DyeMansion, Additive Manufacturing Technologies Ltd etc.) AM Service Bureaus (Citim, FIT, 3T RPD, Materials Solutions, etc.).	The emerging AM-specific mass finishing technologies often have IP associated with them.
Product	Customised components are either assembled in to the vehicle by the OEM, or by the customer.	Automotive OEM (e.g. BMW Mini, Bentley), Vehicle owners.	IP involved in assembly will likely be proprietary to OEM.
End of Life	Car is dismantled for spare parts, recycling and disposal, however personalised parts may be kept by owner.	Car disposal companies, Vehicle owners.	

6. Energy

There has been limited adoption of AM within the energy sector; this may be due to this being a highly conservative industry, typically requiring large components operating in demanding conditions. However, the industry is gradually beginning to adopt the technology more widely as large players push AM down through their supply chains.

7.1 Repair of turbine components

Siemens has published details of their work to repair the tips of gas burners, used within gas turbines. Traditionally, Siemens had to repair these components by removing a large section of the burner, and then welding a replacement section into place. Using AM technologies, Siemens can remove a much smaller section and print a new tip directly onto the burner.

	Description	Involved Actors	IP Implications
Design	The component is repaired to the original geometry. This requires knowledge of what the geometry should be, and what the geometry of the component currently is; this may involve 3D scanning the component to establish the current geometry.	Energy component OEMs (Siemens, GE, Rolls-Royce etc), 3D Scanning companies (Faro, Artec, Zeiss, etc), Design Software Providers (Dassault Systėmes, Siemens, Autodesk, etc.).	Significant IP implications: either the original CAD data will be required to achieve the repair, or the part will require reverse engineering (using scanning, or manual techniques). If this is undertaken by anyone other than the OEM (i.e. Siemens) it could infringe IP.
File Preparation	File preparation depends on the process to be used – proprietary software may be required if the machine has been custom-built for the application.	Energy component OEMS (Siemens, GE, Rolls-Royce etc), AM Service Bureaus (Citim, FIT, 3T RPD, Materials Solutions, etc), AM software providers (Materialise, Autodesk).	There may be IP involved if software is proprietary to the machine or application.
Material	High temperature metal alloys, especially Super Nickel Alloys such as Hastelloy X.	AM Material Providers (LPW, Oerlikon, Sandvik, GKN Hoeganaes, Carpenter, Norsk Titanium, Arconic, etc.).	At present, AM metal powders are based upon existing alloys, therefore there is low IP in the alloy. However, there is a move towards AM-specific alloys, which will create new IP. There can also be IP in the material handling and traceability.
Process	A range of metal AM processes could be used; in the case of Siemens' burner tip repair, a bespoke machine modified by EOS is used.	AM System Providers (EOS, GE Concept Laser, SLM Solutions, Renishaw), AM Service Bureaus (Materials Solutions, FIT etc.) Energy component OEMS (Siemens, GE, Rolls-Royce etc.).	High IP considerations; the machine that is used by Siemens is customised by EOS for their specific requirements.

Post-Process	Post-processing will likely always be required due to the performance requirements. This may be manual, such as hand finishing, or automated, such as machining.	Energy component OEMS (Siemens, GE, Rolls-Royce etc.).	Although post-processing techniques are likely to be conventional, there may be IP considerations as the surface finish will be important to the component's performance.
Product	Components are typically part of much larger assemblies; in the case of Siemens, burners are reassembled into the gas turbine which is returned to the customer following the repair.	Energy component OEMS (Siemens, GE, Rolls-Royce etc.).	Extremely high IP in the final product.
End of Life	Repaired if possible, as above; metal will be recycled if not.	Specialist recycling and material recovery companies.	

7. Consumer Goods

Adoption of AM within the Consumer Goods sector has been slower than in other industries; this may be due to a number of factors, including the high cost of AM-produced parts when compared with mass-manufacturing techniques, a limited materials library and the poor surface finish of printed parts. However, the market is slowly growing and a number of novel business models for the production of Consumer Goods using 3DP technologies have emerged. Intermediary services such as online portals providing designers with access to industrial AM technology are used to manufacture products such as jewellery, art, homewares, toys and games. Consumer brands are also investigating the possibility of using AM within their conventional manufacturing supply chains; as the cost of AM technology continues to fall, it is expected that this will become increasingly common place.

8.1 Sports Shoes

Sports apparel, especially footwear, has long been an area identified that AM can make in-roads into. The ability to create personalised footwear via AM offers an opportunity to add value to products, through improved comfort and performance. Major brands such as Nike and New Balance have launched personalised products for elite athletes, offering improved performance for sports such as American football and athletics.

In 2017, Adidas announced the Futurecraft 4D shoes, with a latticed midsole produced using Carbon’s technology. In this case, the advantage of using AM is not to create a personalised product, but to create a sole that would be difficult to manufacture using conventional techniques.

	Description	Involved Actors	IP Implications
Design	Soles of shoes designed using specialist design software and proprietary design tools.	Sportswear Manufacturers (Adidas, Nike, New Balance, Puma, etc.) Specialist design software (Atom Shoemaster, etc.).	High levels of IP in design of shoe.
File Preparation	Optimisation for print, including addition of support structures and file slicing. This may be undertaken by the AM System provider, involving transmitting data to them.	Sportswear Manufacturers (Adidas, Nike, New Balance, Puma, etc.), AM system providers (Carbon, 3D Systems EOS, Stratasys etc.), AM software providers (Materialise, Autodesk etc.).	There may be IP in the development of suitable build strategies to ensure parts meet required specifications.
Material	In the case of Adidas, material was developed specifically for the application by the AM system provider.	AM system providers (3D Systems, Carbon, EOS, Stratasys etc.), AM Material Providers (Sabic, Carbon, Stratasys, EOS, HP, Arkema, Evonik, etc.).	Proprietary materials may include significant IP.
Process	Historically, polymer AM systems have been used for shorts shoes, such as the Carbon systems used by Adidas. These AM systems may be operated by the Sportswear manufacturer or by a third-party service bureau.	AM system providers (3D Systems, Carbon, EOS, Stratasys etc.), Sportwear Manufacturers (Adidas, Nike, New Balance, Puma, etc.).	IP in the machine Parameters for optimum production.
Post-Process	Post processing will likely involve removal of support structure and surface finishing to improve the aesthetics. Mass-finishing and colouring techniques may be used.	Sportswear Manufacturers (Adidas, Nike, New Balance, Puma, etc.) AM Mass finishing technology providers (DyeMansion, Additive Manufacturing Technologies Ltd etc.).	The emerging AM-specific mass finishing technologies often have IP associated with them.

Product	AM components are assembled into shoe, as part of the conventional shoe manufacturing process.	Sportswear Manufacturers (Adidas, Nike, New Balance, Puma, etc.)s	IP involved in assembly will likely be proprietary to OEM.
End of Life	Shoes disposed of via household waste or recycling.	-	

8.2 Jewellery

3D Printing is often described as enabling the democratisation of manufacturing, through individuals being able to access manufacturing capability without the need for significant capital or inventory. The emergence of online, intermediary manufacturing platforms such as Shapeways and iMaterialise has enabled individuals to access industrial-grade AM technologies, building novel business models where products can be manufactured on-demand. Jewellery is a common application area for such business models, where high-value products are only manufactured once they are purchased by a customer.

In such business models, jewellery designers upload their designs to the intermediary's website, defining the custom print options that are available to customers, such as material, colour or size. Customers can then purchase the designs through the website, selecting their preferred customisation options. Products are printed by the intermediary and shipped directly to the customer. Typically, the intermediary takes payment from the customer and passes a proportion of this to the designer.

Variations on this business model also exist, where the sale is conducted through the designer's own website, which is connected to the intermediary's manufacturing capability through an Application Programming Interface (API).

Figure 34: Paul Liaw, Shapeways

	Description	Involved Actors	IP Implications
Design	Individual designers produce custom designs using digital design tools.	Individual designers CAD software (Autodesk, Dassault, Trimble, FreeCAD, OpenSCAD).	Designers may infringe other parties' designs rights through the designs that they create.
File Preparation	Individual designers upload their CAD files to the online portal. Online portal often has a tool to check suitability for print. Design is hosted on the portal's website until purchased by a customer. Once submitted, portal will use either proprietary software or commercial software to prepare for print.	AM online platforms (iMaterialise, Shapeways, etc.) AM software providers (Materialise, Autodesk, etc.).	Could be IP implications; intermediary may modify original design to make suitable for print.
Material	Wide range of materials available, including metals, plastics and ceramics. Customers are often able to select from a range of materials for their part to be printed.	Individual designers, consumer customers, material providers, AM Material Providers (ExOne, LPW, Sabic, Stratasys, EOS, HP, Arkema, Evonik, etc.).	Industrial-grade materials used, therefore there is likely to be IP in the materials. There can also be IP in the material handling and traceability.
Process	When the design is purchased by a customer, the parts are printed by the portal's service bureau.	AM online platforms (iMaterialise, Shapeways, etc), AM system providers (3D Systems, Carbon, EOS, Stratasys etc.).	Significant IP implications. The portal must verify that they are not infringing design rights when they manufacture the part; this is very difficult to do.
Post-Process	Substantial post-processing; mostly automated, mass finishing techniques such as dying or tumbling.	AM online platforms (iMaterialise, Shapeways, etc.) AM Mass finishing technology providers (DyeMansion, Additive Manufacturing Technologies Ltd etc.).	The emerging AM-specific mass finishing technologies often have IP associated with them.

Product	Product is shipped directly to the customer from the portal's manufacturing facility.	AM online platforms (iMaterialise, Shapeways, etc)	Significant IP in the final product.
End of Life	Disposal depends upon material used	-	-

8.3 Toys and Games

Online platforms such as Shapeways and Thingiverse host large libraries of printable toys and games. These vary from bespoke items, such as custom dice or counters, to copies or "remixes" of protected products such as Lego or Warhammer models. In such cases, protected products are modified to meet the designers individual requirements. These printed products are often intended to be used in conjunction with existing gaming products.

In the case of online services such as Shapeways, consumers can purchase products that are printed by the service provider; these products may reference the original protected product in the product description or contain protected design features and elements. In the case of online repositories such as Thingiverse, consumers can download CAD files for free; these files can then be printed at home or using a service bureau.

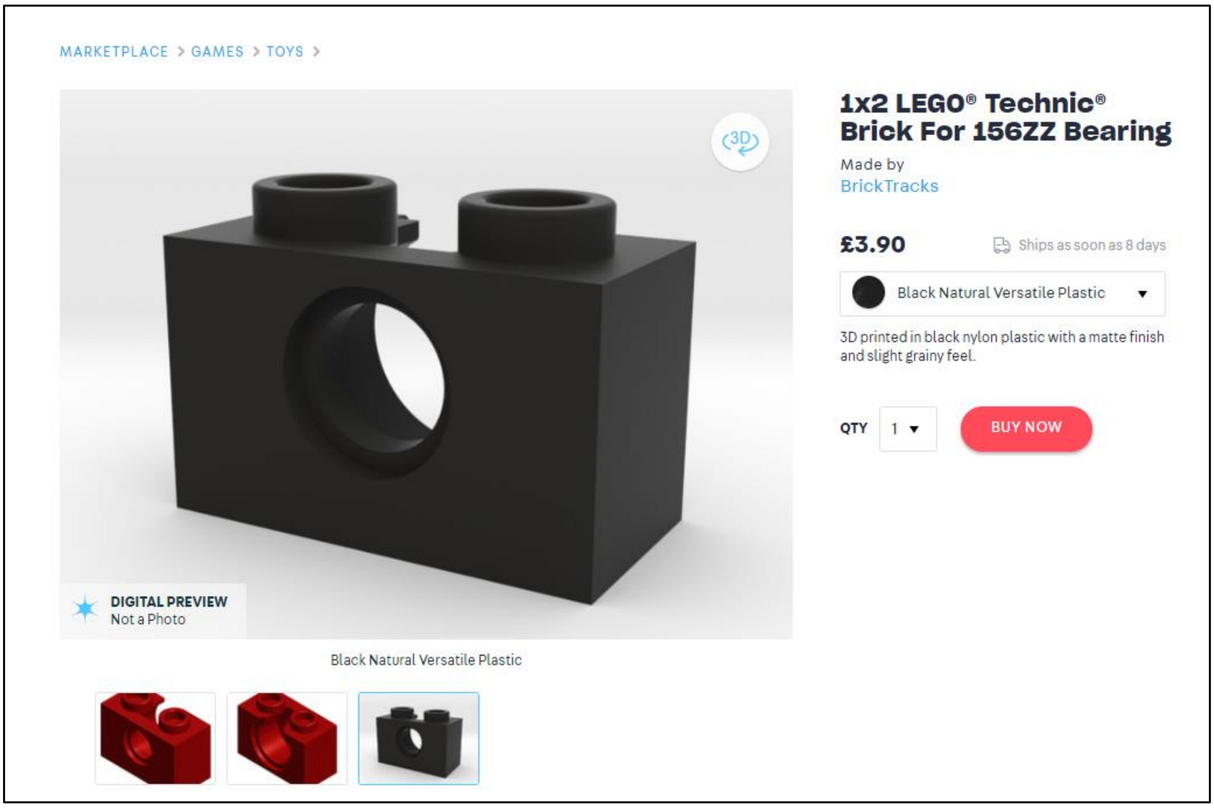

Figure 35: Products available for sale on Shapeways, referencing trademarks

	Description	Involved Actors	IP Implications
Design	Individual designers produce designs for games and toys using digital design tools.	Individual designers CAD software (Autodesk, Dassault, Trimble, FreeCAD, OpenSCAD).	Unless the toy or game is of a completely novel design, there is a high risk of copyright infringement as designers seek to replicate elements of existing products.
File Preparation	Individual designers upload their CAD files to the online portal. Online portal often has a tool to check suitability for print. Design is hosted on the portal's website until purchased by a customer. Once submitted, portal will use either proprietary software or commercial software to prepare for print.	AM online platforms (iMaterialise, Shapeways, etc.) AM software providers (Materialise, Autodesk, etc.).	Very low IP considerations.
Material	Wide range of materials available, including metals, plastics and ceramics. Customers are often able to select from a range of materials for their part to be printed.	Individual designers, consumer customers, material providers, AM Material Providers (ExOne, LPW, Sabic, Stratasys, EOS, HP, Arkema, Evonik, etc.).	Industrial-grade materials used, therefore there is likely to be IP in the materials. There can also be IP in the material handling and traceability.
Process	When the design is purchased by a customer, the parts are printed by the portal's service bureau.	AM online platforms (iMaterialise, Shapeways, etc), AM system providers (3D Systems, Carbon, EOS, Stratasys etc.).	Significant IP implications. The portal must verify that they are not infringing design rights when they manufacture the part; this can be difficult, especially in the context of "remixing".

Post-Process	Substantial post-processing; mostly automated, mass finishing techniques such as dying or tumbling.	AM online platforms (iMaterialise, Shapeways, etc.) AM Mass finishing technology providers (DyeMansion, Additive Manufacturing Technologies Ltd etc.).	The emerging AM-specific mass finishing technologies often have IP associated with them.
Product	Product is shipped directly to the customer from the portal's manufacturing facility.	AM online platforms (iMaterialise, Shapeways, etc.).	The final product may directly infringe existing trademarks or copyrights.
End of Life	Disposal depends upon material used.	-	-

8. Construction

Additive Manufacturing within the construction industry has attracted much media attention in recent years, with several printed buildings and pieces of infrastructure being commissioned around the world. These are generally demonstration pieces, created to show the potential of the technology. There has also been research into the possibility of using such techniques for extra-terrestrial habitations, where buildings could be printed on other planets, using the raw materials that are found there.

Although attracting much less media attention, AM is widely used by the architectural community, to create prototype models of buildings. Smaller architectural practices typically use service bureau facilities to enable them to access industrial quality machines, while larger practices may have their own machines in house.

Figure 36: The "Yhnova" house, printed by Batiprint 3D

9.1 Printed Buildings

Several teams around the world are looking to commercialise technology that is able to print large structures, such as houses. These are typically based on extrusion processes that are mounted onto large gantry systems or robotic arms. Construction material such as concrete or expanding foam is extruded, building the structure of the building. Conventional building techniques are then used to finish the building, through the addition of utilities, fixtures and fittings. The objective of such designs is often to reduce the cost associated with building houses, through a reduction in labour. One such example is a house printed in Nantes, France by Batiprint 3D, which aimed to improve social housing.

	Description	Involved Actors	IP Implications
Design	Architects design building using conventional design tools.	Architects/ structural engineers (e.g. Arup, EDG, CLS Architetti, DUS Architects etc.) Architectural Design Software (Autodesk, Dassault, Rhino, etc.).	There may be high levels of IP in the design of the building, especially if it is a novel design for printing.
File Preparation	Likely proprietary software developed by the system manufacturer.	Construction 3D Printing companies (D-Shape, Cybe Construction, Bati Print, WASP, Win Sun, etc.).	Proprietary software may contain IP.
Material	Existing construction materials, including concrete, expanding foam and sand.	Construction materials companies (Cemex, Lafarge, Holcim, HeidelburgCement etc.).	It's unlikely there will be IP in the materials unless they have been modified specifically or the application.
Process	The AM systems used are typically developmental systems integrated by research teams, incorporating existing technology such as commercial robotic arms.	Construction 3D Printing companies (D-Shape, Cybe Construction, Bati Print, WASP, Win Sun, etc.).	There may be multiple IP owners within the AM system.
Post-Process	Printed buildings are finished in a similar way to conventional buildings, including painting and decoration.	Builders and tradesmen.	-
Product	Final product is a building.	Users of building (homeowners etc.)	-
End of Life	It is unknown how printed building could be disposed of – it may not be possible to dismantle them in the same way as brick or wood-built	Reclamation companies.	-

	buildings.		

9. Industrial and Tooling

The use of AM technologies within manufacturing organisations is well-established. Although there is limited usage of AM for the manufacture of end-use products, AM is widely used as an indirect or secondary method of manufacturing a product. As seen in Figure 37, secondary applications (tooling components, patterns for metal castings and patterns for prototyping tooling) account for just under a quarter of all uses of AM. Wohlers estimates that the *AM Secondary Service Market*, which includes "tooling produced from AM patterns, tooling produced directly using AM systems and moulded parts and castings from this tooling" was worth $1.86-billion in 2015[574].

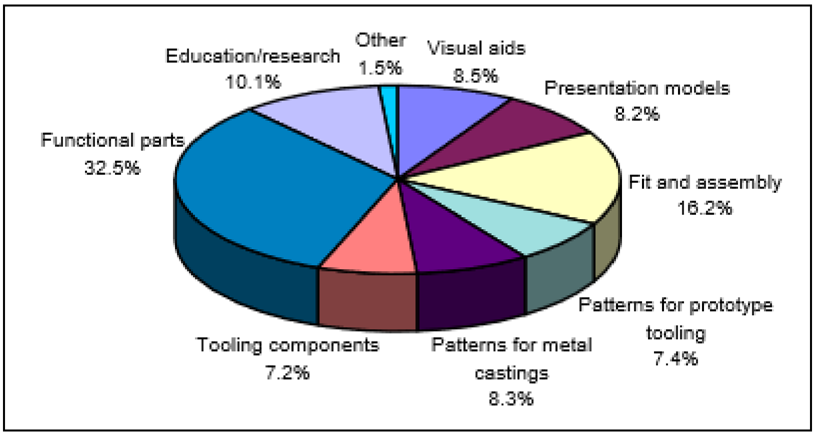

Figure 37: Applications of AM, © Wohlers Associates Inc. 2016

10.1 Sand Casting Moulds

Sand-casting is a well-established manufacturing technique, used to cast metal components. Typically, a mould is prepared from sand, using removable patterns of the product to create a negative of the shape that is to be cast. Molten metal is then poured into the sand mould and allowed to cool, forming the desire object. Additive Manufacturing can be used to directly print sand moulds directly from the CAD model, removing the need for patterns and cores, and increasing the complexity that can be achieved.

The advantage of this technique is that it enables production of complex metallic components at low production volumes in known materials, without the challenges associated with metallic components manufactured directly via AM.

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[574] Wohlers Report 2016, Wohlers Associates Inc., https://wohlersassociates.com/2016report.htm

Figure 38: Sandcasting pattern and casting, © Voxeljet

	Description	Involved Actors	IP Implications
Design	Design for the final part created using conventional design tools, including CAD or 3D Scanning. A negative of this design is used to create the design for the mould, with additional features such as gates and risers added to facilitate the casting process. Specialist foundry software may be used to optimise mould design.	Industrial designers, Service Bureaus and Foundries (Voxeljet UK, Grainger & Worrall), Design Software (Autodesk, Dassault Systems), Casting Simulation Software (MagmaSoft, SutCast, Flow3D, etc.).	IP considerations as the mould design is often undertaken by a third-party, using the original CAD. There is significant skill and background IP involved in designing an optimised mould.
File Preparation	File is prepared for build using conventional AM software and the software supplied with the printer.	Service Bureaus and Foundries (Voxeljet UK, Grainger & Worrall), AM System Providers (Voxeljet, ExOne), AM software providers (Materialise, Autodesk etc.).	Some IP in the AM software, to ensure parts are suitable for print and files are correctly prepared.
Material	Although materials (sand, resin) used are conventional foundry materials, most AM system providers specify that only OEM-sourced materials can be used in their machines.	AM System Providers (Voxeljet, ExOne).	There may be some IP in the materials to ensure compatibility with the machine.

Process	Moulds are printed by the service bureau or foundry; they can be used directly or stored for future use.	Service Bureaus and Foundries (Voxeljet, Grainger & Worrall, 3DEalise)	IP in the machine hardware and parameters to ensure optimum printing conditions.
Post-Process	AM moulds are treated in the same way as conventional sand moulds.	Service Bureaus and Foundries (Voxeljet, Grainger & Worrall, 3DEalise).	Low IP as conventional foundry techniques are used.
Product	AM mould is used to cast the final products, using conventional casting metals.	Service Bureaus and Foundries (Voxeljet, Grainger & Worrall, 3DEalise).	Background IP may used by the foundry to ensure a successful casting.
End of Life	Mould is destroyed as part of the casting process. Material treated as standard foundry waste.	-	-

10.2 Investment Casting Patterns

An alternative method of manufacturing castings using AM techniques is to print investment casting patterns, which are used in place of traditional casting patterns. Stereolithography was the first AM method to be used widely for investment casting, however, expansion and ash residue were common problems with the early attempts. These issues were largely overcome through the introduction of design methodologies such as QuickCast which was licensed to a major machine manufacturer. In this process, a semi-hollow sacrificial pattern is printed which is then coated in a ceramic slurry to form a shell. The printed pattern can then be burnt out and the shell can be used in the standard investment casting process. The advantage of this process is that relatively large castings with complex geometries can be manufactured and it can be integrated into conventional foundry workflows.

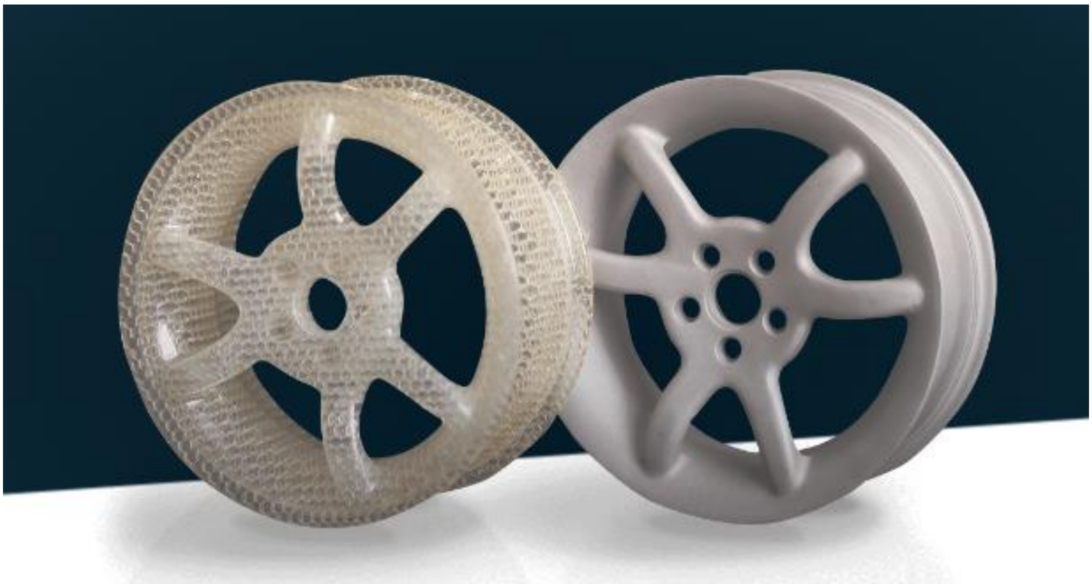

Figure 39: QuickCast casting pattern. Image courtesy of 3D Systems

	Description	Involved Actors	IP Implications
Design	Design for the final part created using conventional design tools, including CAD or 3D scanning. This can then be converted into a design that is optimised for the casting process, such as by creating a "shell" of the model, with a lightweight internal structure such as a honeycomb, to prevent collapse. Gates and risers must also be added to enable pouring of metal and escape of gases. Specialist foundry software may be used to optimise mould design.	Industrial designers, Service Bureaus and Foundries (Materialise, FIT AG, CDG, Malcolm Nicholls Ltd, CRDM, etc) Design Software (Autodesk, Dassault, etc) AM Software (Somos TetraShell, 3D Systems QuickCast, etc), Casting Simulation Software (MagmaSoft, SutCast, Flow3D, etc).	IP considerations in the specialist software tools used to create the optimised pattern. This process is often used for creating replicas of existing castings, leading to IP considerations due to the reproduction of existing parts.
File Preparation	File is prepared for build (addition of support structures, file slicing etc) using conventional AM software and the software supplied with the printer.	Service Bureaus and Foundries (Materialise, FIT AG, CDG, Malcolm Nicholls Ltd, CRDM, etc), AM System Providers (3D Systems, Formlabs, Photocentric etc), AM software providers (Materialise, Autodesk etc).	Some IP in the AM software, to ensure parts are suitable for print and files are correctly prepared.
Material	Materials developed specifically for investment casting are typically used, to minimise shrinkage and ash content.	AM Material providers (DSM Somos, Formlabs, Photocentric etc)	IP in the materials developed specifically for the casting application

Process	Patterns are printed, typically using vat -photopolymerisation techniques such as stereolithography.	Service Bureaus and Foundries (Materialise, FIT AG, CDG, Malcolm Nicholls Ltd, CRDM, etc), AM System Providers (3D Systems, Formlabs, Photocentric etc),	IP in the machine hardware and parameters to ensure optimum printing conditions.
Post-Process	Support structures must be removed, then AM patterns are treated in the same way as conventional investment casting patterns.	Service Bureaus and Foundries (Materialise, FIT AG, CDG, Malcolm Nicholls Ltd, CRDM, etc),	Very low IP involved.
Product	AM pattern is incorporated into the standard investment casting work flow to cast the final products, using conventional casting metals.	Service Bureaus and Foundries (Materialise, FIT AG, CDG, Malcolm Nicholls Ltd, CRDM, etc),	Background IP may used by the foundry to ensure a successful casting.
End of Life	Pattern is destroyed as part of the investment casting process.	-	-

10.3 Jigs and Fixtures

Printing of jigs and fixtures is a popular application for many industrial companies, as it can reduce lead time and cost when compared to traditional solutions and increase productivity by providing production operators with tailored solutions.

Unlike many applications, AM processes can often be directly substituted for existing manufacturing techniques and a cost-benefit analysis can easily be undertaken; as such, it is relatively simple to create a business case for the purchase of a machine. It is therefore a low-risk entry point for many industrial companies looking to introduce AM into their business.

FDM technologies are particularly popular for this application, as they allow manufacturing engineers and designers to print novel designs rapidly and trial them out on the production line. Due to the low aesthetic and mechanical requirements, jigs and fixtures are often used in their as-built condition, without further post-processing.

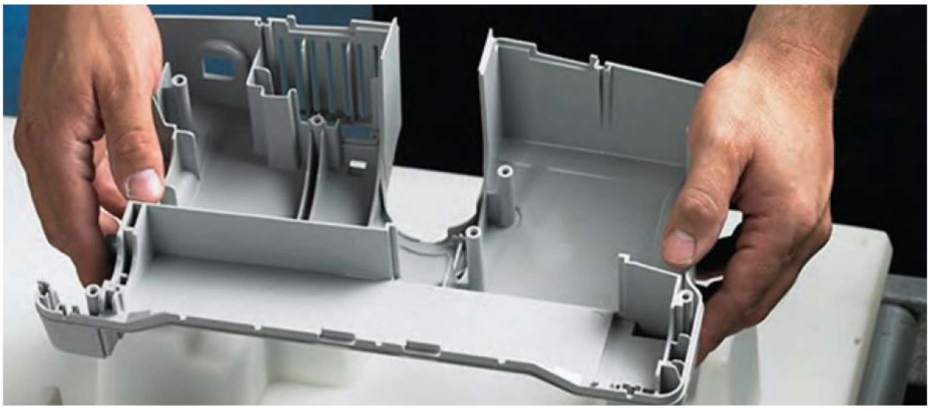

Figure 40: Assembly jig printed using FDM, © Stratasys

	Description	Involved Actors	IP Implications
Design	Production engineers design jigs and fixtures to assist in the manufacture of products. They may use CAD from the original product to assist in the jig / fixture design, or may reverse-engineer the specific requirements.	Manufacturing and Design Engineers within manufacturing companies.	Some IP implications; the design process may involve some reverse engineering or handling of CAD data for the final product.
File Preparation	Parts are prepared and sliced using conventional AM techniques.	Manufacturing and Design Engineers within manufacturing companies, AM Software companies (Materialise, Autodesk, etc.).	Some IP in the AM software, to ensure parts are suitable for print and files are correctly prepared.
Material	Conventional AM materials, including ABS, Ultem®, Polycarbonate, PEEK. Industrial machines typically use OEM-supplied materials, whereas desktop systems are typically open.	AM Material Providers (Stratasys, Ultimaker, ColorFabb, Filamentive, Sabic, DSM Somos etc.).	Some IP in the materials, especially in premium or proprietary materials such as Ultem® or PEEK.
Process	Fused Deposition Modelling is commonly used for jigs and fixtures, due to the relatively low cost and ease of production. Both desktop and industrial machines are used.	Manufacturing and Design Engineers, AM System Providers (Stratasys, Ultimaker, Formlabs, Zortrax, Robox, EOS, Carbon, HP etc.). AM Service Bureaus.	The desktop FDM and SLA market emerged largely due to the expiration of key patents relating to the process; therefore, relatively low IP in the process.
Post-Process	Parts may be post-processed to improve surface finish.	Manufacturing and Design Engineers, AM Service Bureaus.	Conventional post-processing techniques, therefore very low IP.

Product	Jigs and fixtures are used to assist with the manufacture of other products.	Manufacturing organisations in wide range of industries (Automotive, Aerospace, Electronics etc.).	IP is in the final product; very low IP in the manufacturing tools.
End of Life	Products is disposed of via industrial waste streams.	-	

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ET-04-18-600-EN-N

Publications Office
of the European Union

doi: 10.2873/85090