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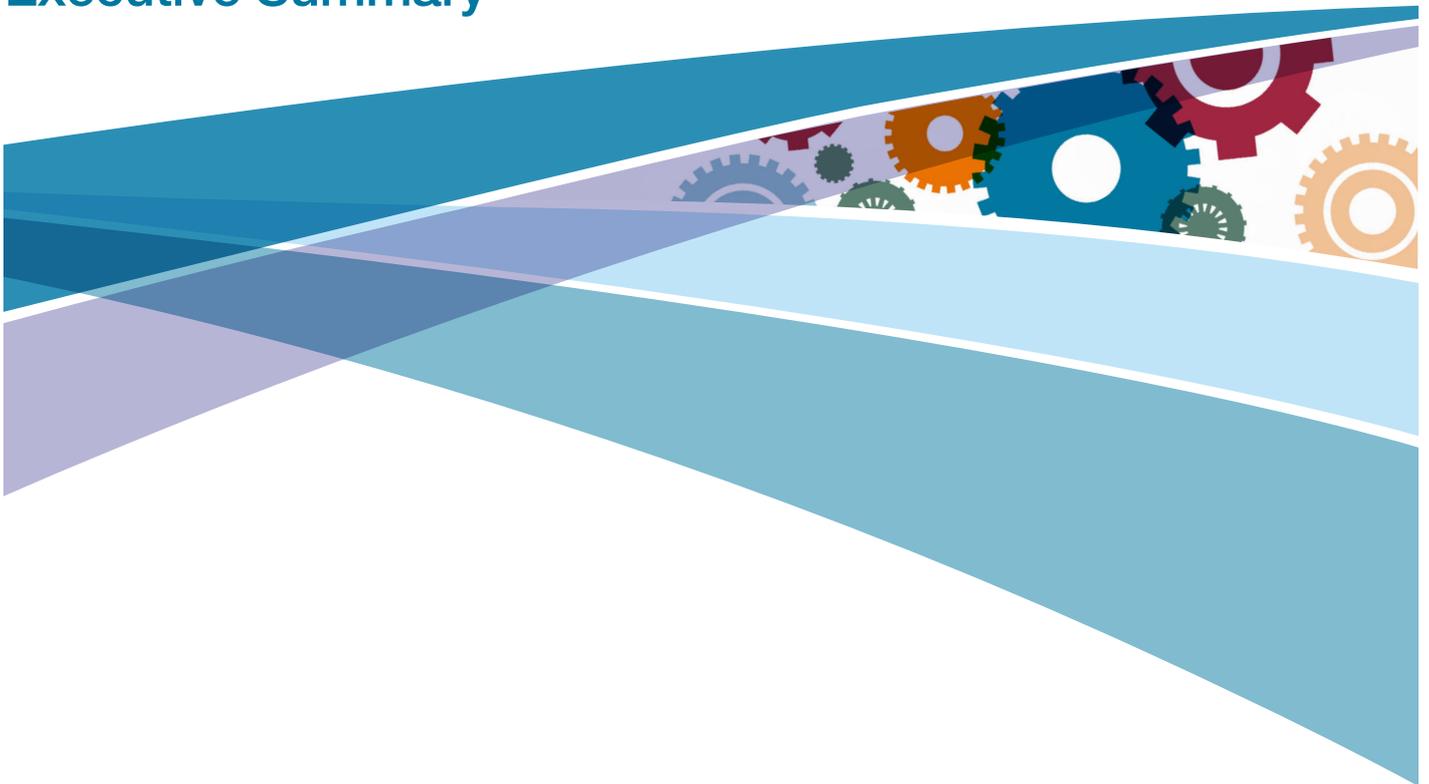
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MANUFACTURING PEOPLE

A Legal and Empirical Study into the Intellectual Property Implications of 3D Printing

Executive Summary



Research commissioned by the Intellectual Property Office, and carried out by:

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March 2015

This is an independent report commissioned by the Intellectual Property Office (IPO). Findings and opinions are those of the researchers, not necessarily the views of the IPO or the Government.

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This is the third of a sequence of three reports on the intellectual property implications of 3D printing commissioned to evaluate policy options in relation to online platforms and selected business sectors.

Study I presents a legal and an empirical analysis of 3D printing online platforms; Study II offers an insight into the current status and impact of 3D printing within selected business sectors by employing a case study approach; the executive summary provides a summary of the findings of Studies I and II and provides conclusions and recommendations for Government, Intermediaries (online platforms) and Industry.

The commissioned project was led by Dr. Dinusha Mendis in collaboration with Dr. Davide Secchi and Dr. Phil Reeves.

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Introduction

In 2012, the Big Innovation Centre, in their Report 'Three Dimensional Policy: Why Britain needs a policy framework for 3D Printing'¹ provided a number of recommendations. A key recommendation was to review the intellectual property implications of 3D printing². Whilst a number of academics^{3,4} have examined the implications for intellectual property (IP) law as a result of the recent proliferation of 3D printing, there is a lack of empirical evidence⁵ to determine whether this emerging technology will have an impact on IP laws.

At the same time, there is limited research on the impact of 3D printing on IP law in the industrial sector. The existing literature does not sufficiently indicate the extent, use and regulation of 3D printing in the replacement parts, customised goods and high-value small status goods sectors. As such, the current research provides an insight into the use, adoption and regulation of 3D printing in the selected industries whilst outlining the IP implications.

This two-part Study (represented in Studies I and II) adopts a quantitative and qualitative approach respectively to fill a gap in the research relating to 3D printing. The two Studies provide for an overarching empirical and legal analysis into the current position of 3D printing. Particularly it offers new data and findings on the exploration of online platforms dedicated to 3D printing as well as its impact in selected industries. This synopsis reports the purpose, scope, methodology and key findings from the two complementary studies carried out by the researchers.

Context: Introduction to 3D Printing

“Like the magic wand of childhood fairy tales, 3D printing offers us the promise of control over the physical world. 3D printing gives regular people powerful new tools of design and production ... In a 3D printed future world, people will make what they need, when and where they need it”⁶.

Whilst it may be some years, before Lipson and Kurman’s prediction is realised, it is true that 3D printing gives people powerful new tools of design and production. However, a 3D printer will only operate on the basis of the instructions provided from a computer in the form of well-designed electronic files. In fact, a “3D printer without an attached computer and a good design file is as useless as an iPod without music”⁷. Furthermore, the selection of materials is equally important to ensure that an object can be 3D printed.

The technology is not new. The first patent was filed in 1971 and was granted in 1977 to American Wyn Kelly Swainson⁸. Before that, an article written by David Jones on the concept of 3D printing was published in the *New Scientist* on 3 October 1974⁹. Ultimately, it was Charles Hull who led the way for the launch of the first commercial 3D printer in 1988, made possible by a patent granted in March 1986 for an ‘Apparatus for Production of Three-Dimensional Objects by Stereolithography’¹⁰.

Since then, the technology has continued to develop significantly¹¹ and around the year 2000, it was suggested that 3D printed parts could also be used directly as end-use products, eliminating the need for traditional production processes such as moulding, casting and machining¹². This direct approach to part production was initially called ‘Rapid Manufacturing’, before being standardised by the American Society for Testing and Materials as ‘Additive Manufacturing’ (AM)¹³.

However, the term AM failed to gain popularity with the media and the general public, who have tended to adopt the term 3D printing. The two terms (3D printing and AM) relate to different activities, although they are quite often used interchangeably¹⁴. Within the context of this research, Study I adopts the term 3D printing whilst Study II uses the two terms as relevant in making reference to businesses or consumers.

Purpose, Scope and Methodology

Purpose and Scope

This two-part Study provides a quantitative and qualitative insight into the IP implications arising from 3D printing, whilst examining the extent of the use of 3D printing within online platforms and selected industrial sectors.

Study I, titled 'A Legal and Empirical Study of 3D Printing Online Platforms and an Analysis of User Behaviour' provides a legal analysis (Section A), an empirical study (Section B) before providing conclusions and recommendations (Section C).

The legal analysis commences with a consideration of the copyright implications arising from the access and use of online platforms. Whilst 3D printing raises a variety of issues relating to Intellectual Property Rights (IPRs), Section A, focuses particularly on the implications for copyright laws. In particular, Section A considers the copyright implications arising from the (1) creation of an object design file; (2) modification of an existing design; and/or (3) scanning of a physical object. In exploring these scenarios, the Report attempts to answer the following questions, amongst others: can a CAD file be protected under copyright law? Does it qualify as a literary work? Can 'modified' files lead to new derivative works under copyright law?

The discussion on copyright law is followed by an overview of three online platforms (Thingiverse, 123D and GrabCad) dedicated to 3D printing – selected on the basis of being the platforms with the highest number of registered users before moving on to a consideration of the governing laws and choice of jurisdiction relating to these online platforms.

Section B provides an overview of how the online platforms operate and to do so, analyses data extracted from 17 online platforms dedicated to the sharing of 3D designs for 3D printing. Section B begins by presenting a description of the variables available in the data collected to specify operations – i.e., how the online platforms dedicated to 3D printing work. The analysis is also used to provide information on the depth of the phenomenon – i.e. qualifying the content and how it is shared. Finally, the analysis is used to define the width – i.e. the range and scope of sharing (of design files) and what seem to be its drivers. As such, the current research attempts to evaluate the extent of this phenomenon amongst users and aims to explore and understand the activities carried out on online platforms. In doing so, the research examines the price, downloads, licences, type of physical objects, which are shared and the implications for IP laws.

The analysis in Section B reflects an exploratory discussion leading to a number of conclusions. It is therefore important to point out that the researchers do not follow a classic hypothesis-testing scheme but perform the analysis aiming at finding whether relationships among variables exist and what their shape is.

Study II titled ‘The Current Status and Impact of 3D Printing within the Industrial Sector: An Analysis of Six Case Studies’ provides an insight into the current status and impact of 3D printing within the business sector by employing a case study approach.

Study II presents six case studies, each looking at a potential consequence of AM and 3D printing in various industrial sectors. The case studies are arranged into three key themes: “Replacement Parts”, “Customised Goods” and “High Value Small Status Goods” and consider the drivers and barriers for the adoption of AM technologies and the effects that technology development could have on these sectors in the future. Furthermore, Study II identifies the various implications for IP laws within the selected business sectors.

The first two case studies address issues relating to Replacement Parts and consider how AM will affect the supply of aftermarket parts to the consumer. For example, what is the likelihood of automotive manufacturers, third-party manufacturers and consumers producing spare parts for vehicles using AM technologies? What are the implications of consumers and independent repair companies being able to manufacture spare parts for domestic appliances on demand, using consumer 3D Printers? The case studies also consider how consumers are using online platforms to share digital designs and models of spare parts and its impact on the domestic appliances aftermarket.

The two case studies within the Customised Goods theme address how AM enables unique products to be manufactured that are tailored to consumers’ needs, and the IP challenges that arise therein. In particular, the case studies consider the IP implications when the consumer has an increased role in the design of products and investigates the extent to which scanning technologies will enable users to replicate and modify existing physical objects using AM and 3D printing. The technical limitations of the technology for both consumer-level and professional-level scanners are also highlighted in this section.

The final two case studies within the High Value Small Status Goods theme examine the impact that AM has on consumer products that have a low functional purpose, such as collectible figurines or sculptures. The IP implications of extracting printable data and content from sources of Computer-Generated Imagery (CGI) such as computer games are considered. Furthermore, this final case study explores how artists and designers protect their digital content from IP infringement that is enabled through commercial AM technology and home 3D printing.

Methodology

A black-letter law methodology is used for the legal analysis followed by a quantitative method for the empirical analysis in Study I. The legal research comprises of a literature-based analysis and utilises a systematic review technique to explore the various issues, which also had the benefit of providing for a high level of flexibility. In particular, the assessment of the implications for copyright law followed by the Governing Laws of online platforms and Choice of Jurisdiction aims to represent the current landscape in relation to 3D printing and IP law.

For the empirical study, data was collected from 17 websites, namely: 123D, 3DLT, CGTrader, Cubehero, Cubify, Cuboyo, GrabCad, i.Materialise, Kraftwurx, Leopoly, Ponoko, Sculpteo, Shapeways, Sketchup, the Pirate Bay, Thingiverse and Youimage. The data extracted from

these 17 online platforms was analysed to understand how these platforms operate. The analysis established that the total number of files shared on the platforms was 385,118 and the total number of users 48,715. Data was retrieved on January 2014 and covers six years, from January 2008 to January 2014. One of the shortcomings of the analysis was the lack of a clear and homogeneous standard for these websites resulting in user-related information varying significantly from website-to-website.

Study II employs a qualitative methodology. The researchers interviewed key stakeholders within selected industrial sectors to identify existing IP implications arising from 3D printing in the UK and EU. The names of individuals and / or companies are identified where possible in the course of examining the findings.

Findings and Conclusions

From the data retrieved in **Study I**, there is nothing to indicate that the activity on 3D printing online platforms is a mass phenomenon yet. As such, there is no urgency to legislate on 3D printing at present.

Whilst there is little to indicate infringement at a noticeable level in the current landscape, interest and activity is growing exponentially every year¹⁵ and conclusions can be drawn from such activities. These in turn highlight the potential for future IP issues.

- Files that carry the label ‘fashion’ attract a higher number of views and downloads while labels such as ‘art’ and ‘robot’ are marketed at higher prices;
- Files bearing the tag ‘miniature’, ‘art’, and ‘jewellery’ are more prevalent on the online communities leading to hypothesise that hobby and leisure is one of the most attractive areas for these platforms;
- The proliferation of by-products such as mobile software applications that interact with 3D printing platforms provide the tools for the modification of CAD files;
- Higher views and downloads are also dependant on (a) the choice of the platform and (b) the type of brand/product. A typical example is the iPhone-labelled files, which attract more downloads and views. This is a paradigmatic example of what can be achieved with the instrumental use of a popular brand/product. The more popular a product the more likely it is that people would look for something to complement it (e.g., a case, a decorative stand);
- It is interesting to note that the number of downloads is unrelated to the price. This could be due to a lack of accessibility to the relevant materials or lack of access to more sophisticated 3D printers; i.e., those that are capable of printing more expensive files.

Online platforms should explain different licence types to users and assign the most appropriate licence as a default with ‘opt-out’ being an option. This is because the vast majority of people

(65%) who use these online platforms do not license their work. The minority 35% that do license their work make their choice in accordance with the product they are uploading.

There should be clarity in relation to CAD files particularly in relation to their copyright status. Any future regulation efforts should therefore be focused on providing guidance on the access and use of CAD files.

Study II suggests that there will be little commercial impact on either the automotive or domestic appliance aftermarket within the next decade as a function of either consumer 3D printing or industrial AM.

The current technology does not lend itself to printing parts that are of a suitable quality to replicate traditionally manufactured automotive or domestic appliance components. Furthermore, the economics of AM production are of a greater magnitude than the accepted price point of current spare parts. However, as the technology continues to grow, steps should be taken in relation to traceability of spare parts, particularly in the car spare parts sector.

If hardware and software reach a point where a product can be printed easily and quickly and it will work in the appliance or automotive industries without having to modify the part through iteration, a wider consumer base may adopt the technology.

There is evidence that consumer orientated software tools will develop significantly in the coming years, through increased awareness by software vendors relating to design and personalisation demands. Consequently, the technical skill level of consumers will develop along with an increase in creativity driven through the resurgence of making 3D printed products within the home and community.

Over time industrial additive manufacturing will reduce in price, which will open the market for more affordable products. On the other hand, the capability of home 3D printing technologies will remain limited for the foreseeable future, as they lack the accuracy, scale and ability to produce truly robust parts to make desirable consumer or automotive products.

The technology relating to consumer-level 3D scanning is currently limited and will remain so for the foreseeable future with little risk to businesses and IP laws. Steps should however be taken to consider developing legitimate channels through which businesses can provide consumers with access to legal downloads of their products for 3D printing.

Key Recommendations

For Government

A premature call for legislative and judicial action in the realm of 3D printing could stifle the public interest of “fostering creativity and innovation and the right of manufacturers and content creators to protect their livelihoods”¹⁶. However, as 3D printing continues to grow, it is important to address the intellectual property issues arising in this area. As such, it will be prudent to take

steps to cultivate a climate better suited to tackle impending IP issues more successfully and in a manner, which takes into account the interests of all stakeholders.

There needs to be clearer guidance on defining whether a CAD file is capable of copyright protection. The territorial nature of copyright law, coupled with the exterritorial nature of online platforms and CAD files shared therein could lead to uncertainty and complex issues in the future.

It is recommended that the UK Intellectual Property Office (UKIPO) establish a Working Group to cover the various IP rights which may need to be tackled in the future. The Working Group should also provide clarity on the status of CAD files and how they can best be used in industry. The Group should also consider how best to tackle the traceability of 3D printed spare parts.

For Intermediaries (Online Platforms)

As mentioned above, 65% of users engaged in the activities of 3D printing on online platforms do not license their work, leaving their creations vulnerable and open to infringement whilst losing the ability to claim authorship.

It is recommended that online platforms provide more awareness and understanding of the different types of licences. This can be achieved by explaining the nuances relating to each licence in clear and simple language, rather than simply 'encouraging' the user to adopt a particular type of licence. Furthermore, online platforms can assign the most appropriate licence as a default with 'opt-out' as an option.

Online platforms increasingly offer tools for the creation, modification, and transformation of object-designed files. For example, these include, 123D Sculpt, Meshmixer, Tinkercad, Workbench and MakerBotDigitizer¹⁷ amongst many others. As online platforms and user-numbers continue to grow it is recommended that spin-offs and by-products offered by the online platforms be monitored.

For Industry

One recommendation for industry would be to adopt secure streaming of 3D CAD files via an Application Programming Interface (API) thereby embracing a 'pay-per-print' business model¹⁸. This is already in operation amongst companies such as Authentise¹⁹, Secure3D²⁰, ToyFabb²¹. This business model removes the need for a CAD file to be sent to the consumer²²; instead the build instructions are sent directly to the printer, which, in turn, prints out the number of objects that have been purchased. This can be particularly effective for the customised goods industry.

Manufacturers could also consider licensing CAD files more widely, thereby opening up doors to a range of outlets selling 3D CAD files. This will avoid locking the manufacturer into an agreement through a system such as a 'one-stop-shop' for (spare) parts. Although a one-stop-shop may take away the costs of manufacture, transportation and storage whilst reducing potential infringement of IP laws, it can lead to a monopoly-situation, which should be avoided.

It is recommended that the automotive industry give consideration to the traceability of 3D printed spare parts, particularly in relation to the safety and usability of the spare part.

Conclusion

The present research and the accompanying data concludes that taking into account accessibility to materials, sophisticated printing machines, costs and economics for the average user, the impact of this technology will not be felt among the general public for a few years to come. Although it is too early to tell when this will happen, the researchers conclude that a technological breakthrough is needed to make 3D printing an everyday reality.

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