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THE INTELLECTUAL PROPERTY IMPLICATIONS OF LOW-COST 3D PRINTING

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Abstract

In the late 1970s 3D printing started to become established as a manufacturing technology. Thirty years on the cost of 3D printing machines is falling to the point where private individuals in the developed world may easily own them. They allow anyone to print complicated engineering parts entirely automatically from design files that it is straightforward to share over the Internet. However, although the widespread use of 3D printers may well have both economic and environmental advantages over conventional methods of manufacturing and distributing goods, there may be concerns that such use could be constrained by the operation of intellectual property (IP) law.

This paper examines existing IP legislation and case law in the contexts of the possible wide take-up of this technology by both small firms and private individuals. It splits this examination into five areas: copyright, design protection, patents, trade marks, and passing off. Reassuringly, and perhaps surprisingly, it is concluded that – within the UK at least – private 3D printer owners making items for personal use and not for gain are exempt from the vast majority of IP constraints, and that commercial users, though more restricted, are less so than might be imagined.

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1. Introduction

Throughout recorded history most people who have wanted a household article have bought or bartered it from someone else – in past times an artisan or trader, more recently a seller of mass-produced products. With few exceptions (such as some clothing) it is rare that any of us make such articles for ourselves these days. That may soon change. Thirty years ago only dedicated enthusiasts would print their own photographs or edit and reproduce their own newsletters. The advent of the home computer, and in particular of low-cost high-quality printers, has now made such things simple and commonplace. Recent developments in producing affordable and hobbyist-friendly printers that can reproduce three-dimensional rather than just flat objects may mean that printing a toast-rack or a comb becomes as easy as printing a birthday card.

Any lawyer familiar with copyright and trade mark law can see, however, that printing one's own birthday cards could, depending on the source and nature of the images used, infringe a number of intellectual property (IP) rights. Tempting as it may be to copy and use a picture of a well-known cartoon character, the resulting cards would very likely be an infringement of the copyright and perhaps trade marks owned by the relevant rights holder. But what if someone uses a printer capable of producing a mobile phone cover bearing such an image? Or reproducing a distinctively-styled piece of kitchenware? What about printing out a spare wing-mirror mount for your car? Do these uses infringe IP rights?

In the first part of this paper, we review the history of 3D printing and describe recent developments, including a project initiated by one of the authors to bring such printers into the home. We then examine the IP implications of personal 3D printing with particular reference to the bundle of rights that would typically be associated with a product that might be copied.

2. Personal 3D Printing: The Technical Aspects of Home Manufacturing

2.1. A Brief History of Manufacturing

People have three ways to make solid objects:

1. Cutting shapes out of a block of material;
2. Adding material piecemeal to build up shapes; and
3. Forming material that is liquid or plastic into the required shapes that then set.

All forming processes are secondary in the sense that the dies and moulds for them must initially be cut or built by one of the other two primary processes. Pre-industrial examples of these three are carving wood, bricklaying, and moulding a jelly.

Since the industrial revolution, an enormous number of variations on these three techniques have been developed and pre-industrial techniques have been much refined. Cutting and forming have, in particular, received a great deal of attention, resulting in sophisticated lathes and milling machines for cutting, and injection-moulding and die-casting machines for forming.

Just after the Second World War, John Parsons invented the idea of numerical control.¹ In this, a manufacturing machine has all its parameters and variables continually controlled by a computer, allowing a previously hand-controlled process to be completely automated. A typical numerically-controlled machine tool is a lathe or a mill that can produce a complicated-shaped part from a simple block entirely without human intervention. This idea has been called the Second Industrial Revolution, and - directly or indirectly - it is the basis of virtually every engineering product that is made and sold today.

Since the creation of the microcomputer in the late 1970s the cost of numerically-controlled machine tools has fallen dramatically and it is now possible for organizations of modest means (such as schools) and also private individuals in the developed world to own lightweight ones. However, the vast majority of all these machines - heavy and light - are still cutting machines, as opposed to additive or moulding machines.

Numerically-controlled cutting machines suffer from an inherent problem: given a computer model of a shape to be made, it is extremely difficult to compute the paths that the cutting tools have to follow in order to make that shape automatically. The more complicated the shape, the more difficult this problem becomes. Further, it is straightforward to design shapes that are perfectly valid three-dimensional objects but that cannot be cut out at all. Almost all these problems stem from the fact that the tool doing the cutting and the device attaching it to the machine must not strike any part of the object being cut except at the point where the actual cutting is happening.

2.2. 3D Printing

Until the late 1970s the alternative primary manufacturing idea - adding material - had received comparatively little attention (except in the electronics industry for chip manufacture, where it was, and still is, ubiquitous, if microscopic). But in 1974 a joke was written and in 1977 a patent was granted that caused that situation to change.

The joke was by David Jones, writing his column under the pen-name “Daedalus” in the *New Scientist*.² He made what he imagined was a tongue-in-cheek proposal that one could shine a laser through a vat of liquid plastic monomer and cause it to solidify along the path of the beam. The photons of light might thereby be made to initiate the covalent cross-linking of the liquid monomer to form a solid polymer. He further proposed that, if the wavelengths were adjusted appropriately, the cross-linking could be made to happen only where two beams intersected, resulting in an intense spot of energy at one point, and that - by computer-controlled mirror deflection - that intense point could be made to trace out the volume of a required solid object.

¹ R Olexa, “The Father of the Second Industrial Revolution” (2001) 127 *Manufacturing Engineering* (article 2).

² D Jones, “Ariadne Column” (3 October 1974) *New Scientist*.

The patent was granted in 1977 to Wyn Kelly Swainson for essentially the same idea, though he had originally filed the patent well before the appearance of Jones's piece.³ In Swainson's system the laser caused covalent cross-linking at the surface of the liquid monomer and the object being manufactured rested on a tray that was gradually lowered into the vat.

This was the start of the 3D printing industry, which engineers sometimes call the rapid prototyping industry. (The latter term has become less current over the last few years – the field is evolving rapidly.) It was called “rapid” because one-offs could be made much more easily and quickly using it than by conventional numerically-controlled machining and it was called “prototyping” because it was too slow and expensive to be used for production (it could not compete with injection moulding for making many copies of a single item, for example).

The primary reason that 3D printing technology was (and is) so easy to use was that it completely eliminated the tool-path calculation problems of numerically-controlled cutting machines. Because parts are built up layer by layer, there is always a flat-topped surface with unrestricted access for the laser (or other solidifying or depositing device) to gain access to build upon. This makes it very simple to write a computer programme to control the machine from a computer model of the shape required. There are other advantages (and disadvantages) to 3D printing, but this is the most significant one.

Although it is typically slightly less accurate than cutting, 3D printing is capable of manufacturing more complicated and intricate shapes than any other primary manufacturing technology. Most 3D printing technologies work using plastics but technologies such as selective sintering of metal granules have allowed the printing of metal shapes⁴ and there are systems that can work with ceramics.⁵

2.3. Home 3D Printing

At the time of writing, the lowest-cost conventionally-made and marketed 3D printing machine (the SD-300 made by Solido Ltd in Israel) was being retailed at about €12,000. Machines range in price from that up to around €300,000 and a typical mid-range machine might cost €40,000. In quick succession after Swainson's patent, all the obviously possible ways of making objects by adding layers under automatic computer control were patented. Those early patents are now expiring but patents for newer 3D printing techniques continue to be issued.⁶

One of the technologies developed was fused-filament fabrication.⁷ This is essentially a computer-controlled glue gun. Molten plastic is extruded from a fine nozzle and laid

³ W K Swainson, “Method, medium and apparatus for producing three-dimensional figure product” (1977) US Patent 4041476.

⁴ S Das and J J Beaman, “Direct selective laser sintering of metals” (2004) US Patent 6,676,892.

⁵ B R Utela et al., “Development Process for Custom Three-Dimensional Printing (3DP) Material Systems” (2010) 132/1 *Journal of Manufacturing Science and Engineering*.

⁶ E. g. US Patent 7,569,273, “Thermoplastic powder material system for appearance models from 3D printing systems”.

⁷ S S Crump, “Apparatus and method for creating three-dimensional objects” (1979) US Patent 5121329.

down on a flat plate by scribbling with the nozzle to form the bottom layer of the object to be made. The plate then drops a small distance, and the next layer is added. Because the plastic is molten when it emerges from the nozzle the second layer welds to the first, and in this way complete three-dimensional solids can be built. This is a comparatively simple technology that requires no hard-to-make parts (such as a laser).

In 2004 Adrian Bowyer realised that 3D printing was such a versatile technology that it ought to be possible to design a fused-filament fabrication 3D printing machine that could manufacture a significant fraction of its own parts.⁸ Conventional industry has little use for this idea: why sell a machine to your customers that means that they never need to come back to you to buy another, never need to buy spares, or even that allows them to go into production themselves in direct competition with you? But owning such a machine would have real advantages for people in general: anyone who had one could use it to make things, and could also make another such machine and give that to a friend. This is an interesting example of a failure of the market: such a self-replicating machine is an object that people would value, but that it is in no one's interest to sell. For these reasons it was decided to make the machine and to give all its designs away free under the GNU General Public Licence on the web.⁹ This was the start of the RepRap project. RepRap is short for Replicating Rapid-prototyper.

RepRap has been a significant success, and is now in its second version (Figure 1).

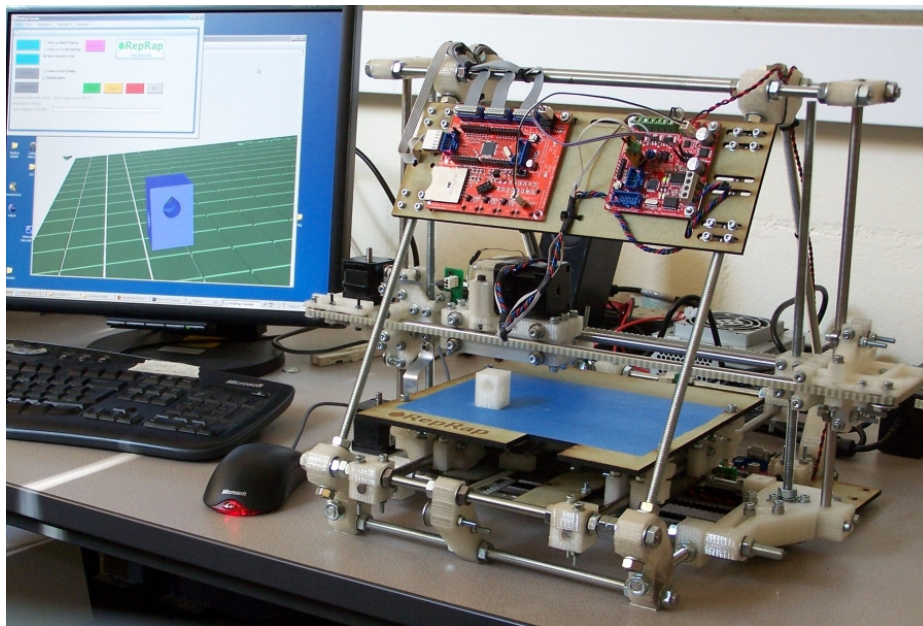


Figure 1. RepRap Version II, “Mendel” The white part on the blue tray is a component of the machine itself. It was printed from the model depicted on the computer’s screen.

⁸ E Sells, Z Smith, S Bailard, and A Bowyer, “RepRap: The Replicating Rapid Prototyper - Maximizing Customizability by Breeding the Means of Production” in F T Piller and M M Tseng, *Handbook of Research in Mass Customization and Personalization* (New Jersey: World Scientific, 2009) 568-580.

⁹ A Bowyer, “The Self-replicating 3D printer — Manufacturing for the Masses” in D M Jacobson, C Bocking and A Rennie (eds), *Eighth National Conference on Rapid Design, Prototyping and Manufacture* (High Wycombe: Buckinghamshire Chilterns University College, 2007).

From the beginning RepRap was conceived as a machine that would be owned and used by people in the home to make things, as well as by industry. The cost of all the materials needed to make a RepRap is low - about €400 - bringing it well within the budget of individuals in the developed world (as well as small communities in the developing world). RepRap makes items at a slightly lower quality than the commercial machines do, but at about 1 per cent of the cost.

Any development or improvement of RepRap design, software or electronics arises out of its users' own initiatives. There is no central institution giving directions: users themselves invest time and thought in the evolutionary process of RepRap design. If they inspire other users they can all team up and combine their efforts. Because of the lack of deadlines for developmental goals, progress is very wide ranging, but it is also admittedly slower than in industrial R&D departments. However, personal ambition to realise their own ideas for the project drives the progress of the users' work. Involving users in product design by providing tool kits has become more important in recent times.¹⁰

The reactions of industry to RepRap have been twofold: the conventional 3D printing manufacturers have (to the best of the authors' knowledge) ignored it, but there has been a flurry of garage start-ups (for example Bits from Bytes Ltd in Bristol and MakerBot Industries LLC in New York) making very low cost machines that are based on RepRap technology. There is also another significant open-source 3D printer: the Fab@Home machine, which was inspired by RepRap.¹¹ Unlike RepRap, these machines do not copy themselves. They are however all able to make RepRap machines, as are almost all the large-scale commercial 3D printing machines. The asymmetry that this introduces into the population dynamics of 3D printing has not escaped us.

Many companies and organisations have bought these low-cost RepRap derivatives or have built RepRap machines, but by far the greatest majority of owners and users are private individuals. MakerBot runs a popular website (www.thingiverse.com) where anyone may upload and download designs of a great range of items to be manufactured by 3D printers for free.

As technology has become more miniaturised, the possible functionality of a single product has massively increased. This is, of course, useful and space-saving. On the other hand these versatile devices can, because of their large functional content, be rather complicated to handle. This is not always in the interests of the customer, as seen in Cooper.¹² Additionally, often not all the functions are used by customers.¹³ Home 3D printing technology provides a way of manufacturing customised objects which have precisely the features an individual user needs.

¹⁰ E von Hippel and R Katz, "Shifting Innovation to Users via Toolkits" (2002) *Management Science* 1–13.

¹¹ E Malone and H Lipson, "The Factory in your Kitchen" in *Proceedings of Mass Customization and Personalization (MCPC) 2007* (Cambridge, MA, 2007).

¹² A Cooper, *The Inmates Are Running the Asylum: Why High Tech Products Drive Us Crazy and How to Restore the Sanity*, 2nd ed (Pearson Higher Education, 2004).

¹³ D V Thompson, D Viana, R Hamilton and R T Rust, "Feature Fatigue: When Product Capabilities Become Too Much of a Good Thing" (2005) 42 *Journal of Marketing Research* 431–442.

All this may be heading towards a world in which people do not buy consumer goods any more but instead download them from the web and print them themselves. They will be able to customise them at will and may avoid some of the environmental and monetary cost currently entrained by the (often global) physical transport of manufactured goods; indeed, work is in train to make RepRap run on home-recycled plastic which would further reduce such costs. In particular, the ability of a 3D printer to, in principle, print a copy of itself, and for both machines to print further copies and so on, suggests that the cost of 3D printing may rapidly fall to the point where it becomes a widely-available technology.

Of course, having many people making few items in the home, instead of few people making many items in factories, is against the idea of economies of scale. But economies of scale are not universal: in the past people took clothes to central laundries to have them washed; now people use their own washing machines. Today electricity is generated in 2 GW power stations tomorrow it may be generated by individual photovoltaics on everyone's roofs. And industrial printing presses offer far greater economies of scale than the home inkjet printers mentioned in the first paragraph that are – for many types of printing – replacing them.

What might this 3D printer be useful for? Working just in plastic would limit it to producing items not requiring great strength or heat resistance, whilst the fabrication volume would preclude production of large objects (other than in parts). However, as mentioned above, there is a great deal of active research going on to extend the range of materials that these low-cost systems can work with. There are many potential applications.

- ***Spare Parts.*** Many appliances require unique and often expensive spare parts. Often these are small, made of plastic and relatively simple design, and would be amenable to domestic fabrication. Examples familiar to the authors include door parts for washing machines,¹⁴ lids for food processors¹⁵ and camera lens accessories.¹⁶ Significantly, provision of third-party spares has led to many IP disputes.¹⁷
- ***Craft and Hobby Items.*** Craft hobbies often require plastic moulds; as with appliance spares, these are often expensive but could be produced with a 3D printer.¹⁸ A 3D printer could equally produce items directly, such as model figures for war-gaming¹⁹ or specialist add-on parts for model-making.²⁰

¹⁴ Door handle for Tricity Bendix washing machine listed at £14.49 (www.espare.co.uk (accessed 25 March 2010)).

¹⁵ Lid plug for Kenwood liquidiser listed at £15.99 (www.espare.co.uk (accessed 25 March 2010)).

¹⁶ Lens hood for Canon 17-55mm f/2.8 lens listed at £49.99 (www.warehouseexpress.com (accessed 25 March 2010)).

¹⁷ A Horton, "European design law and the spare parts dilemma: the proposed regulation and Directive" (1994) 16/2 *European Intellectual Property Review* 51-57.

¹⁸ Icing moulds typically £6 - £10 (http://www.sugarcity.co.uk/acatalog/Online_Catalogue_moulds_4.html (accessed 25 March 2010)).

¹⁹ 32mm model figures from Games Workshop £2 - £10 (uk.games-workshop.com (accessed 25 March 2010)).

²⁰ 1:48 scale aircraft weapons kit £9.90 (www.modelhobbies.co.uk (accessed 25 March 2010)).

- **Educational Uses.** School science teaching frequently requires small specialist components for demonstrating or conducting experiments.²¹
- **Unique Requirements.** A 3D printer, allied with user-friendly design software, would allow the ready creation of bespoke items. The RepRap website cites the fabrication of a unique bracket to allow an MP3 player to be attached to the coin-holder in a car dashboard.²² Individually-tailored body-fitting items such as frames for glasses could be produced, an extension of the use of 3D printing to make tailored medical implants.²³
- **Fashion Accessories.** Existing 3D printing systems have been used to make jewellery.²⁴ Personal 3D printers could add a new dimension (literally) to many forms of fashion art, and allow customisation of personal accessories.

Although discussion so far has assumed home use of low-cost 3D printers, they may appear first in commercial or educational settings such as copy bureaux or schools, just as photocopiers were more common in such venues before combined scanner/printers brought them into the home. These different forms of use are very significant as there are exemptions against infringement of some IP rights for personal or non-commercial use, but not in other circumstances.

3. Introduction to Intellectual Property Implications

Might, however, the promise of low-cost 3D printing be constrained by IP law? Surely, it might be thought, home 3D printing of household items might infringe such rights as copyright, design right, trade marks or patents? The second part of this article will examine such questions. To illustrate the legal issues in question it will consider a hypothetical manufacturer, Acme, which produces a range of goods. Acme's products are protected by various IP rights, such as design right, copyright, patent and trade mark. A consumer, Bridget, owns various Acme products, but finds that additional items, or spares or accessories for the ones she already has, are expensive. Being a 3D printing enthusiast, she creates 3D designs for such items and uses her personal 3D printer to print them out. She also shares her designs over the Internet with Charlie, who downloads them and prints his own ersatz Acme products. What of Acme's rights, if any, have Bridget and Charlie infringed?

Such questions have received surprisingly little attention. A comprehensive literature search for legal references to "3D printing", "rapid prototyping" or related terms found few matches; one referred to the copyright in 3D printing reconstructions of archaeological finds²⁵ whilst another briefly noted 3D printing as facilitating the

²¹ The authors are indebted to Marcus Rowland, a school laboratory technician, for suggesting this use.

²² "Items Made" (<http://reprap.org/bin/view/Main/ItemsMade> (accessed 25 March 2010)).

²³ See D T Pham and S S Dimov, *Rapid Prototyping: The Technologies and Applications of Rapid Prototyping and Rapid Tooling* (London: Springer, 2001) s 5.3; N Peckitt, "Rapid Prototypes and Customised Implants in Maxillofacial Reconstruction", in J A McDonald, C J Ryall and D I Wimpenny, *Rapid Prototyping Casebook* (London: Professional Engineering, 2001), 191-200.

²⁴ See C K Chua and K F Leong, *Rapid Prototyping: Principles and Applications in Manufacturing* (New York: Wiley, 1997) s 7.9.

²⁵ C Carson, "Laser Bones: Copyright Issues Raised by the Use of Information Technology in Archaeology" (1996) 10 *Harvard Journal of Law and Technology* 281-319, at 281.

overseas manufacture of patented products.²⁶ Even searching within 3D printing engineering journals found only one article considering the prospect of widespread Internet-enabled dissemination of design files,²⁷ whilst the sole relevant UK case report concerned ownership of copyright in commissioned models; their production by 3D printing was entirely incidental.²⁸

3.1. Aim and Legal Assumptions

Sections 3 through 7 of this paper are a first attempt to fill this gap. Based on the LLM dissertation of one of the authors (SB) they aim, from the perspective of EC and UK IP law,²⁹ to identify where widespread low-cost 3D printing may impinge on IP rights or where IP law may constrain its development. Perhaps surprisingly, under UK law it transpires that in the scenario presented Bridget and Charlie may not have infringed Acme's IP rights. Purely personal use of 3D printing to make copies of household objects and spare parts does not infringe the IP rights that commonly protect such items, such as design protection, patents or trade marks. However, there are areas, such as the reproduction of artistic works, where IP rights such as copyright may be infringed. The advent of low-cost 3D printing may therefore pose challenges to several communities: manufacturers, who may be unable to enforce design protection against private users of 3D printing; artists, who may see a new forum for infringement of works previously difficult to copy, and users of low-cost 3D printing, who may face confusion as to what is legitimate and illegitimate use of the technology.

3.2. Intellectual Property Rights and 3D Printing

There are four main classes of IP rights that may be infringed by using a 3D printer, which may be divided into those which require registration and those which arise automatically (unregistered rights):

1. Copyright is an unregistered right that protects mainly artistic and creative works.
2. Design Protection exists in both registered and unregistered forms and protects the distinctive shape and appearance of items (in particular those that are mass-produced).
3. Patent is a registered right that protects novel and innovative products such as mechanisms or pharmaceutical compounds.
4. Registered Trade Marks serve to inform consumers of the origin (and by association, reputation) of goods.

²⁶ W Thornewell, "Patent Infringement Prevention and the Advancement of Technology: Application of 35 U.S.C. 271(f) to Software and Virtual Components" (2005) 73 *Fordham Law Review* 2815-2856.

²⁷ M Burns and J Harrison, "Digital manufacturing - Napster Fabbing: Internet Delivery of Physical Products" (2001) 7/4 *3D printing Journal* 194-196.

²⁸ *General Alarms Limited & Another v Time 3D printing Solutions Limited*, [2005] EWHC 3290 (Ch).

²⁹ It is accepted in Scottish law that the decisions of the English Court of Appeal in interpreting the Patents Act 1977 and similar IP legislation apply throughout the UK. See R Black et al (eds) *The Laws of Scotland: Stair Memorial Encyclopedia*, vol 19 (Edinburgh: Butterworths, 1995), para 814.

English common law also provides the action of Passing Off against acts that might confuse customers as to the origin of goods.

This paper will briefly introduce each right and focus on the extent to which it may be infringed by use of a 3D printer and the potential legal defences for such infringement. More detailed discussion may be found in relevant educational and practitioner texts, to which reference will be made as appropriate.³⁰ These rights interact and overlap; in particular the interaction between design protection and copyright has been the subject of much judicial interpretation. It is therefore convenient to consider design protection first.

4. Design Protection

Design protection protects the appearance of items, especially commercial products that might not otherwise be protected by patent or copyright law. Design protection may apply to relatively simple products, to components of more complex ones, or to the overall appearance of such “complex products”. In domestic law there are two main forms of design protection: registered design and unregistered design right (UDR). In the wider European context, registered designs may also be registered with the Community Design Register, whilst there is a short-duration unregistered Community design right (UCD). This discussion will concentrate on registered design (for which the domestic and Community provisions are now virtually identical) and UDR.

4.1. Registered Design

The Registered Designs Act 1949 (as amended) provides that registration of a product protects its “appearance of the whole or a part of a product resulting from the features of, in particular, the lines, contours, colours, shape, texture or materials of the product or its ornamentation”³¹ where a “product” is any industrial or handicraft item.³² The requirements for the registration of designs (such as novelty and individual character) will not be examined in detail;³³ however, some of the constraints on what may be registered are relevant to issues arising from 3D printing of spares or parts for repair of a product.

- **Component Parts.** A component part of a complex product may only be protected as a registered design if it is both visible to the user in ordinary use (which excludes maintenance or repair) and is of novel and individual

³⁰ W Cornish and D Llewelyn, *Intellectual Property: Patents, Copyrights, Trade Marks and Allied Rights*, 6th ed (London: Sweet & Maxwell, 2007); J Davis, *Intellectual Property Law*, 3rd ed (Oxford: OUP, 2008); K Garnett, G Davies and G Harbottle, *Copinger & Skone James on Copyright*, 15th ed (London : Sweet & Maxwell, 2007); D Kitchen et al, *Kerly's Law of Trade Marks and Trade Names*, 14th ed (London : Sweet & Maxwell, 2005); H Laddie et al, *Laddie, Prescott & Vitoria: The Modern Law of Copyright and Designs*, 3rd ed (London: LexisNexisUK, 2000); H MacQueen, C Waelde and G Laurie, *Contemporary Intellectual Property: Law and Policy* (Oxford: OUP, 2007); S Thorley et al, *Terrell on the Law of Patents*, 16th ed (London : Sweet & Maxwell, 2006).

³¹ Registered Designs Act 1949 s 1(2) (hereafter RDA 1949).

³² RDA 1949 s 1(3).

³³ K Garnett, G Davies and G Harbottle, see note 30 above, s 13-44 - s 13-52.

design.³⁴ Many spare parts for cars or domestic appliances will be hidden in everyday use whilst many others, even if normally visible, may be of commonplace design, such as a pipe or washer.³⁵

- **Designs Dictated by Technical Function.** Features of a product dictated solely by technical functionality may not be protected by registered design.³⁶ This constraint was considered by the ECJ in *Philips v Remington*³⁷ where Colomer AG opined that protection would not be available where the design was the only way of achieving the required function. Cornish contrasts this with the decision of the House of Lords in *Amp v Utilux*³⁸ under the previous UK legislation where it was held that whilst an electrical terminal could have been designed in various equally effective ways, all would have been dictated by technical function and so been unregistrable.³⁹ (It would now be unregistrable as an invisible component part.)
- **“Must Fit” Exception.** A design or design element is not registrable if it comprises “features of appearance of a product which must necessarily be reproduced in their exact form and dimensions so as to permit the product in which the design is incorporated or to which it is applied to be mechanically connected to, or placed in, around or against, another product so that either product may perform its function”.⁴⁰ There has been little if any judicial consideration of this point, but by analogy with similar provisions for unregistered design right this provision will exclude many spares and accessories from protection if their shape is determined by the need to connect to or fit into or around another product.

The effect of these exemptions is that many items attractive for 3D printing will not be protected as registered designs. Many spare parts are likely to be components or fall under the “technical function” or “must fit” exemptions. The latter also applies to the shape of accessories and customisation items such as covers for mobile phones (but not, as noted below, to copyright artwork decorating them). Furthermore, even if a spare part escapes these exemptions and is protected as a registered design, such protection is not infringed by its use for “the repair of a complex product so as to restore its original appearance”.⁴¹ This would cover the 3D printing of a part such as a car wing panel that was normally visible and not wholly constrained in design by its function or fit, but which had to be replicated in order to maintain the vehicle’s original appearance.

³⁴ RDA 1949 s 1B(8).

³⁵ D Musker, “Hidden Meaning? UK Perspectives on Invisible in Use Designs” (2003) 25 *European Intellectual Property Review* 450-456.

³⁶ RDA 1949 s 1C(1).

³⁷ *Philips Electronics NV v Remington Consumer Products Ltd*, [2001] RPC 38.

³⁸ *Amp Inc v Utilux Pty Ltd*, [1972] RPC 103.

³⁹ W Cornish and D Llewelyn, see note 30 above, ss 15-19.

⁴⁰ RDA 1949 s 1C(2).

⁴¹ RDA 1949 s 7A(5).

Even where a registered design is copied via a 3D printer this would not be an infringement if it were done “privately and for purposes which are not commercial”.⁴² Both criteria must be met; it is insufficient that copying is not done for profit. Purely personal use of a 3D printer to make items will thus not infringe a registered design, so long as the purpose for which the item was made was genuinely non-commercial. In the introductory scenario therefore, even if Acme’s product is protected as a registered design, neither Bridget nor Charlie infringe that design by making a copy for personal use (although this may not be so if, say, Bridget makes an item for use in paid work from home). However, use in other settings, such as a repair shop, will have to avoid registered designs if it is not to infringe them, unless the “complex product repair” exemption applies. For non-private educational purposes, there is a “fair dealing” exemption,⁴³ but this only applies where the use does not prejudice normal exploitation of the design,⁴⁴ e.g. by substituting for purchase of the item itself. So if Charlie works in a school and uses Acme test-tube stands, if these are registered designs he could not legitimately 3D-print copies to avoid buying new ones from Acme.

4.2. *Unregistered Design Right*

UK UDR was introduced by the Copyright, Designs and Patents Act 1988 to help resolve anomalies in industrial design protection regarding the supply of third-party spare parts (especially for cars) that had culminated in the House of Lords decision in *Leyland v Armstrong*.⁴⁵ UDR provides protection akin to registered design, but rather than requiring registration it arises automatically, as with copyright. Like copyright it is therefore only effective against actual copying.⁴⁶ As an unregistered right its subsistence will be a question of law in each case.

UDR subsists in the shape and configuration of an item, but not its surface decoration or method or principle of construction.⁴⁷ It also excludes features that are required for it to be “connected to, or placed in, around or against, another article so that either article may perform its function” or which “are dependent upon the appearance of another article of which the article is intended by the designer to form an integral part.”⁴⁸ The “must fit” exception is similar to that for registered design, whilst the “must match” exception is analogous to the “repair of complex products” provision.

- **Originality.** To qualify for UDR, a design must be original, defined as not being “commonplace in the design field in question at the time of its creation”.⁴⁹ In *Farmers Build v Carrier*⁵⁰ Mummery LJ noted:

⁴² RDA 1949 s 7A(2)(a), implementing Art 13(1)(a) Directive 98/71/EC of 13 October 1998 on the legal protection of designs.

⁴³ RDA 1949 s 7A(2)(b).

⁴⁴ RDA 1949 s 7A(3).

⁴⁵ *British Leyland Motor Corp v Armstrong Patents Co Ltd*, [1986] AC 577.

⁴⁶ Copyright, Designs and Patents Act 1988 s 226(2) (hereafter CDPA 1988).

⁴⁷ CDPA 1988 s 213(2), 3(a) and 3(c).

⁴⁸ CDPA 1988 s 213(3)(b)(i-ii).

⁴⁹ CDPA 1988 s 213(4).

The designs are “original” in the sense that they are the independent work of the designer of the TARGET machines: they have not been simply copied by him from the GASCOIGNE or SUDSTALL machine....Time, labour and skill, sufficient to attract copyright protection, were expended by Mr Hagan in originating the designs of the individual parts. Similarly, he originated the assembly or combination of those parts in the TARGET machine as a whole.

Laddie J’s remarks illustrate that UDR may subsist in individual parts of a design, the design as a whole, or both. Consequently, an allegedly infringing design may be analysed by being broken down into component parts, some of which may be held to infringe UDR whilst others do not. The meaning of “design field in question” was considered in *Lambretta v Teddy Smith*⁵¹ where Jacob LJ held it to be the range of designs with which the designer of the item in question would be familiar.

- **Method or Principle of Construction.** In *Rolawn v Turfmech*⁵² Mann J summarised prior case law as indicating that this provision prevented UDR subsisting in what he described as abstract, generalised design concepts. Under Mann J’s interpretation aspects of design dictated solely by manufacturing technique or necessitated by sound engineering design will be likely to fall within it. As noted by the Court of Appeal in *Landa & Hawa International v Azure*⁵³ this provision seeks to prevent a designer gaining a monopoly over a particular way of making a type of product.
- **“Must Fit” Exception.** The “must fit” exception for UDR has been the subject of considerable judicial consideration. In *Parker v Tidball*,⁵⁴ the disputed designs were for mobile phone cases, which had both to fit around the phones they were designed for and to allow access to keyboards and displays. Robert Englehart QC adopted the approach of breaking each design down into its components in order to assess whether each element’s design was commonplace and, if not, if it was constrained by the need to fit the phone or if alternatives would have been possible. In *Dyson v Qualtex*⁵⁵ the exception was held to apply to those elements of spare parts that were shaped so as to allow them to conform with the product they were to be fitted to. The “must fit” exception has even been extended to designs that conform to parts of the human body, such as contact lenses in *Ocular Sciences*⁵⁶ – although in *Amoena v Trulife*⁵⁷ it was held that breast implants were not caught by this

⁵⁰ *Farmers Build Ltd v Carier Bulk Materials Handling Ltd*, [1999] RPC 461.

⁵¹ *Lambretta Clothing Co Ltd v Teddy Smith (UK) Ltd*, [2004] EWCA (Civ) 886, [2005] RPC 6.

⁵² *Rolawn Ltd v Turfmech Machinery Ltd*, [2008] ECDR 13.

⁵³ *Landa & Hawa International v Azure*, [2007] FSR 9.

⁵⁴ *Philip Parker and Ors v Stephen Tidball and Ors*, [1997] FSR 680

⁵⁵ *Dyson Ltd v Qualtex (UK) Ltd*, [2006] RPC 31.

⁵⁶ *Ocular Sciences Ltd v Aspect Vision Care Ltd*, [1997] RPC 298.

⁵⁷ *Amoena v Trulife* unreported, 25 May 1995, Chancery Division, Jonathan Sumption QC.

exemption, as they were too flexible to be considered “constrained” in their design.

- **“Must Match” Exception.** The “must match” exception is analogous to the “complex repair” provision for registered design. The example of a car wing panel illustrates it well, and has been cited as epitomising this provision, e.g. by Jacob LJ in *Dyson v Qualtex*. *Dyson* concerned “pattern parts”, spares which replicated the appearance as well as function of the original manufacturer’s parts, in that case for vacuum cleaners. Jacob LJ distinguished between spares for cars, where matching overall appearance was paramount, and those for more mundane items – such as vacuum cleaners – where it was less so. Without clear Parliamentary intent to exclude spares from UDR altogether, he held that the “must match” exception applied only in the former instance.⁵⁸

How, then, does UDR affect the use of 3D printers to make copies of items in which it might subsist? The operative phrase is “might subsist”, as being an unregistered right it will be for the owner of the original item’s design to assert UDR. The factors listed above will determine whether UDR subsists – potentially not if the item is a commonplace design or has a shape and configuration determined by the item it “must fit” onto or around.

For 3D printing of spares, the “must fit”, “principle of construction” and “original design” requirements mean that UDR is unlikely to subsist in items that are of mundane design (c.f. the example of pipes or washers noted earlier) or where shape is dictated by the need to fit against another element of a product or is necessary for proper operation. However, as emphasised in *Dyson*, UDR is by no means excluded for spares, and in particular closely-matching “pattern spares” may fall outside the “must match” exception if they are destined for products where appearance is not critical.

The “must fit” exception would also apply to items such as customised covers for mobile phones although, as was noted with in the discussion of registered designs, this would not cover the use of copyright artwork as surface decoration. But of the other forms of items attractive for copying with a 3D printer many, such as craft and hobby items, would be protected by UDR and so reproducing them may infringe it. Whether they would depends on the statutory exemptions.

For UDR there is no positive provision in CDPA 1988 corresponding to that in RDA 1949 allowing private, non-commercial reproduction of a registered design. Instead, s 226(1) provides that:

- (1) The owner of design right in a design has the exclusive right to reproduce the design for commercial purposes—
 - (a) by making articles to that design, or
 - (b) by making a design document recording the design for the purpose of enabling such articles to be made.

⁵⁸ A Michaels, “The end of the road for ‘pattern spare’ parts? *Dyson Ltd v Qualtex (UK) Ltd*” (2006) 28 *European Intellectual Property Review* 396-398.

On its construction s 226(1) implies that the exclusive right does not apply to non-commercial use. This interpretation is supported by *Copinger and Skone James*, which notes “it seems clear enough that...a person who (for example) makes articles to a design intending to use them domestically does not thereby infringe design right”.⁵⁹ In the Acme scenario, neither Bridget nor Charlie infringes any UDR subsisting in Acme’s products by 3D printing copies for personal use.

The authors of *Copinger* dismiss the impact of this provision, commenting that “as a person is unlikely to make many articles with a view to non-commercial purposes, it should in practice create few problems.” This may be true even with personal 3D printers, but what might change is that many more people will be in the position to make such articles. Furthermore, and in contrast with the situation for registered designs, there is no requirement that non-commercial use also be private. Indeed, by confining infringement to commercial use, defined as making an article or design document with a view to selling or hiring it in the course of business,⁶⁰ the legislation appears to make all non-commercial uses non-infringing. This would include use within educational establishments, or bureau services where a 3D printer is made available for members of the public to use. CPDA 1988 provides that authorising infringement (which, by analogy with copyright, includes permitting infringing activities) is itself primary infringement of design right.⁶¹ But this only extends as far as acts that are themselves infringing, which non-commercial use is not. This is a fine point, and it may be argued that if a charge is made for such a service (e.g. at a commercial copy bureau) then the article is actually being made for the purpose of sale; equally, a private school or commercial training centre may well be “commercial” in this sense. If no charge is made though, for instance in a publically-funded school or training centre, then there is seemingly neither infringement of design right or authorisation of such. Taking the example used earlier, if Acme’s test tube stands were protected only by UDR, Charlie could legitimately copy them for use at his school, but not for sale to others.

Genuine commercial use will still be caught by s 226(1). To avoid infringement, business users will have to confine 3D printing to items not protected by UDR (such as spares within the constraints noted above), or will have to licence the right to produce them. This may well be attractive if it allows dealers to avoid holding large stocks of diverse parts, instead 3D printing them on demand from manufacturer’s authorised patterns. As will be discussed below, sale of self-3D printed unofficial spares, even where not infringing UDR, may fall foul of trade mark and passing off law.

4.3. 3D Printers and Design Protection

In summary, the exemptions for personal and private reproduction of registered designs and the exclusion of non-commercial use from UDR protection mean that the domestic use of a personal 3D printer to reproduce an item will infringe neither registered nor unregistered design protection. Perhaps more surprisingly the exclusive

⁵⁹ K Garnett, G Davies and G Harbottle, see note 30 above, s 13-144.

⁶⁰ CDPA 1988 s 263(3).

⁶¹ CDPA 1988 s 226(3).

right provided by UDR appears not to cover such public but non-commercial users as schools; subject to interpretation, it may not prevent use in a commercial reproduction bureau. Even for commercial use, many items that are attractive for 3D printing, such as spare parts, may be unregistrable as registered designs and excluded from protection by UDR.

Two further issues arise regarding design protection, however: rights in surface decoration of an item to be reproduced by a 3D printer and rights in the design file used by a 3D printer for reproducing an item. Both of these concern copyright, and so will be covered in the next section.

5. Copyright

Copyright is an unregistered right that arises automatically on creation to protect creative works. Different jurisdictions vary as to the works for which copyright can subsist, but they generally follow Art 2(1) of the Berne Convention,⁶² which provides that copyright shall be available for “literary and artistic works”, where this includes musical and dramatic works and 2D and 3D artistic works. In the UK, CDPA 1988 s 1(a) recognises four classes of work in which copyright can subsist: literary, dramatic, musical or artistic. Regarding works that a 3D printer might produce infringing copies of, the artistic category is of most relevance.

Copyright infringement requires actual copying of the original. However, copying need not be exact, with “substantial copying” sufficing to infringe. The meaning of “substantial” was considered in *Designers Guild*⁶³ in which the House of Lords decided that the original and alleged copy had to be considered in their entirety, the test being whether the copier had appropriated a substantial part of the skill and labour of the original author.

In contrast to registered design or UDR there is no threshold for novelty in copyright, with even commonplace works attracting protection if original;⁶⁴ creative merit is not required, merely minimal expenditure of effort.⁶⁵ In UK law, the circumstances under which copying is not infringement are strictly delineated by a number of “fair dealing” provisions, which include the right to reproduce extracts from a work for purposes of study or review.⁶⁶

⁶² “Berne Convention for the Protection of Literary and Artistic Works”, WIPO (http://www.wipo.int/treaties/en/ip/berne/trtdocs_wo001.html) (accessed 25 March 2010)).

⁶³ *Designers Guild Limited v Russell Williams (Textiles) Limited (t/a Washington DC)*, [2001] 1 All ER 700, [2001] FSR 11.

⁶⁴ K Garnett, G Davies and G Harbottle, see note 30 above, s 3-127. In *Infopaq International A/S v Danske Dagblades Forening* (C-5/08), [2009] ECDR 16 the ECJ held that originality required some level of expression of intellectual creation, although the threshold for this was for national courts to determine.

⁶⁵ *Ibid*, s 3-128.

⁶⁶ CDPA 1988 ss 28-50.

5.1. Artistic Copyright under CDPA 1988, s 4

“Artistic works” are defined at CDPA 1988 s 4. The definition is not straightforward and, given the issues it poses, it is reproduced here:

4. Artistic works.

(1) In this Part “artistic work” means —

(a) a graphic work, photograph, sculpture or collage, irrespective of artistic quality,

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

(c) a work of artistic craftsmanship.

(2) In this Part—

“building” includes any fixed structure, and a part of a building or fixed structure;

“graphic work” includes—

(a) any painting, drawing, diagram, map, chart or plan, and

(b) any engraving, etching, lithograph, woodcut or similar work;

“photograph” means a recording of light or other radiation on any medium on which an image is produced or from which an image may by any means be produced, and which is not part of a film;

“sculpture” includes a cast or model made for purposes of sculpture.

The definitions of 2D works such as paintings, drawings and photographs are relatively straightforward, as is that of buildings. However, 3D works are less precisely defined, which is regrettable as these are the category of work where 3D printers offer novel opportunities for copying. The definition of “sculpture” is unhelpfully circular, whilst no definition of the catch-all category of “work of artistic craftsmanship” (WAC) is given at all. Numerous judicial authorities have been advanced regarding the meaning of both sculpture⁶⁷ and WAC⁶⁸ in the context of both current and previous legislation, leaving lawyers and scholars alike with a complex legal thicket to navigate. In 2008 Mann J gave judgment in *Lucasfilm v Ainsworth*⁶⁹ and in doing so comprehensively surveyed these authorities and sought to elucidate clear tests for the meaning of these two terms.

⁶⁷ *Caproni v Alberti* (1891) 65 LT 785; *Britain v Hanks* (1902) 86 LT 765; *Pyram Ltd v Models (Leicester) Ltd*, [1930] 1 Ch 39; *Wham-O Manufacturing Co v Lincoln Industries Ltd*, [1985] RPC 127; *Breville Europe plc v Thorn EMI Domestic Appliances Ltd*, [1995] FSR 77; *J & S Davis (Holdings) Ltd v Wright Health Group Ltd*, [1988] RPC 403; *Metix (UK) Ltd v G H Maugham (Plastics) Ltd*, [1997] FSR 718; *George Hensher Ltd v Restawhile Upholstery (Lancs) Ltd*, [1976] AC 64; *Merlet v Mothercare plc*, [1986] RPC 115; *Guild v Eskandar Ltd*, [2001] FSR 38; *Lucasfilm Ltd v Ainsworth*, [2008] ECDR 17, [2009] FSR 2.

⁶⁸ *George Hensher Ltd v Restawhile Upholstery*, see note 67 above; *Merlet v Mothercare plc*, see note 67 above; *Guild v Eskandar Ltd*, see note 67 above.

⁶⁹ *Lucasfilm Ltd v Ainsworth* [2008] ECDR 17, [2009] FSR 2.

To qualify as a sculpture, he held that an object had to have “...the intrinsic quality of being intended to be enjoyed as a visual thing” even if it had other uses.⁷⁰ On this basis, Mann J excluded such industrial prototypes as the models in *Metix*⁷¹ (deemed by Laddie J not to be sculpture) and those in *Wham-O*⁷² and *Breville*⁷³ (which had previously been held to be such). In the Court of Appeal, Jacob LJ concurred, whilst emphasising that the key point was the intention of the creator.⁷⁴ Turning to WACs, he surveyed the disparate opinions of five Law Lords in *Hensher*⁷⁵ before turning to the interpretation placed on it in the New Zealand case of *Bonz v Cooke*,⁷⁶ where Tipping J held that for a work to be a WAC the author had to combine elements of craftsmanship and art. Whilst this may sound a trivial observation, Mann J explained it in the context of the items under dispute (helmets from the original *Star Wars* film), noting that whilst their creator had undoubtedly employed great craftsmanship, they had not been made for artistic purposes in their own right.⁷⁷ Following *Lucasfilm* it appears therefore that copyright protection as a sculpture or WAC is confined to objects created principally for their artistic merit.

A further important distinction regarding 3D objects is the protection afforded to a graphic design on their surface. Even if not classified as a sculpture or a WAC, such an object may attract design protection. As already discussed, registered design protection includes its outward appearance,⁷⁸ but UDR specifically excludes surface decoration.⁷⁹ Such decoration may be protected by artistic copyright, be it 2D or 3D (in the latter case, presumably as a WAC), although if the object has been exploited industrially⁸⁰ this copyright is limited to twenty five years.⁸¹

5.2. Artistic Works a 3D Printer May Infringe by Copying

A 3D printer, particularly one capable of colour reproduction, can copy a graphic work by laying down a single layer. Of itself, this poses no novel copyright issues beyond those arising from conventional printers. What is novel, however, is that it may apply such a work to the surface of a 3D item. It is not relevant whether such a design is applied to the surface, or if it extends into it in the manner of the lettering in a stick of rock candy (this being readily achievable with a 3D printer). In *Lambretta*⁸²

⁷⁰ *Ibid*, para 118(vii).

⁷¹ *Metix (UK) Ltd v G H Maugham (Plastics) Ltd*, see note 67 above.

⁷² *Wham-O Manufacturing Co v Lincoln Industries Ltd*, see note 67 above.

⁷³ *Breville Europe plc v Thorn EMI Domestic Appliances Ltd*, see note 67 above.

⁷⁴ *Lucasfilm Ltd v Ainsworth* [2010] ECDR 6, [2010] FSR 10, at para 82.

⁷⁵ *George Hensher Ltd v Restawhile Upholstery*, see note 67 above.

⁷⁶ *Bonz Group (Pty) Ltd v Cooke*, [1994] 3 NZLR 216.

⁷⁷ *Lucasfilm Ltd v Ainsworth*, see note 69 above, paras 131-134.

⁷⁸ See note 47 above.

⁷⁹ CDPA 1988 s 213(3).

⁸⁰ Art 2 Copyright (Industrial Process and Excluded Articles) (No 2) Order 1989/1070 defines this as production of more than fifty items.

⁸¹ CDPA 1988 s 52.

⁸² *Lambretta Clothing Co Ltd v Teddy Smith (UK) Ltd*, see note 51 above.

Jacob LJ specifically rejected the suggestion that such a distinction could affect whether the appearance of an object was protected by copyright or by registered design;⁸³ it is excluded from UDR protection in either case.

The significance of this can be illustrated by imagining in our scenario that Bridget owns an Acme mobile phone and decides to make a faceplate illustrated with Heidi Hamster, a cartoon character whose rights are owned by Acme. The faceplate itself is unlikely to attract design protection because of the “must fit” provisions of both registered design and UDR. (Related considerations would apply to, for example, a decorated pencil case, the shape of which would probably be deemed too commonplace for protection.) The decoration would be excluded from UDR though (although not registered design, if recorded as part of the registration), but its reproduction on the 3D-printed item would be an infringement by Bridget of the original copyright in it.

However, this assumes that the phone cover is a novel application of the cartoon. But in these days of extensive merchandising this may well not be the case, and the implications of this are significant. Normally the artwork copyright would last for the full copyright term, but via CDPA 1998 s 52 if it has already been applied industrially, e.g. by licensed production of items bearing it, then after twenty five years it may be copied by making articles of any description.⁸⁴ The original cartoon would still receive full term protection, but its use as a surface design on products would not be infringed once the twenty five-year period had expired.⁸⁵ If Bridget had copied the design from a sufficiently old product – and some well-known intellectual properties are much older than this — then her use as surface decoration would be legitimate.

The practical effects of this are not as dramatic as might be imagined since commercial exploitation of such artwork is also constrained by laws regarding trade mark use and passing off, as discussed later. However, as will be noted, it is unlikely that either sanction prevents private use of such artwork. Well-known cartoon characters might thus be available for legitimate personal use on 3D-printed items if they have a long-enough history of commercial exploitation. (As will be noted in the conclusion, purely private copyright infringement is in any case difficult to police.)

It should also be remembered that it is an infringement of copyright in a 2D item to make a 3D representation of it. In the example given, to take a cartoon character and to 3D print a 3D figurine based on it would infringe the cartoon’s copyright – a point established with regard to the “Popeye” cartoon in the 1941 case of *King Features Syndicate v Kleeman*.⁸⁶ Again though, if there is sufficient prior commercial exploitation of such items, then their copyright might be drastically shortened via s 52 and they may have fallen out of protection, at least for non-commercial use.

⁸³ *Ibid*, at para 30.

⁸⁴ CDPA 1988 s 52(2).

⁸⁵ See H Porter, “U.K. Design Copyright and Cartoon Characters” (2000) 22 *European Intellectual Property Review* 542-546 for a more comprehensive examination of this point, including the complex transitional provisions for pre-1988 creations.

⁸⁶ *King Features Syndicate Inc and Anor v O & M Kleeman Ltd*, [1941] AC 417.

Turning to 3D items, a key question will be whether they fall within the definitions of sculpture or WAC. If not then, like the helmets in *Lucasfilm*, they will not be protected by copyright. They may enjoy UDR protection, but again this does not apply to non-commercial reproduction. Even if they are protected by copyright, s 52 CDPA may limit the term to twenty five years if they have previously been commercially reproduced, as may well be the case with items small enough to be amenable to 3D printer reproduction.⁸⁷ Certain forms of artwork are excluded from this provision, however, such as original sculptures.⁸⁸

5.3. Copyright and 3D Printer Designs

A further complication arises via CDPA 1988 s 51. This provides that the copyright in a *design document* is not infringed by making an article from it. Introduced to avoid the use of copyright to restrict the sale of third-party spares⁸⁹ it means that even if prior graphical artwork exists of a product, if it is deemed to be a design document for that product then its copyright is not infringed by making a copy of that item. This was the case in *Lucasfilm* where the concept artwork for the Stormtroopers was held to be a design document for the helmets, so copying the latter did not infringe copyright in it.⁹⁰

S 51 has additional and potentially more wide-ranging implications for 3D printer use. To produce an item a 3D printer must have a design file specifying its shape and, if appropriate, surface decoration. Questions thus arise of the legal status of such a 3D printer design file (“3DPDF”) and the IP rights relating to it.

- **Copyright of 3DPDFs.** Is a 3DPDF protected by copyright? It is an original work of authorship and may be protected by literary copyright in the same manner as computer software (which, as a series of instructions, it resembles); in *Autospin v Beehive* Laddie J accepted, albeit *obiter dictum*, that such a design file of such type would be so protected.⁹¹ Additionally, that diagrammatic instructions for producing an artwork or design are protected by artistic copyright was established in *Lerose v Hawick*,⁹² although under pre-1988 law, but Whitford J’s reasoning that the instructions need not depict the artwork for artistic copyright to subsist still appears sound.
- **Design Files as Design Documents.** Is a 3DPDF a design document within s 51? S 51(3) defines “design document” as “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 clearly encompasses a 3DPDF and any doubt should be dispelled by *Mackie v Behringer*⁹³ where Pumfrey J held that a document (a circuit diagram) embodying the topology rather than actual

⁸⁷ This factor also applied in *Lucasfilm*. See note 69 above, paras 143-169.

⁸⁸ Art 3(1)(a) Copyright (Industrial Process and Excluded Articles) (No 2) Order 1989/1070.

⁸⁹ *Leyland*, see note 45 above.

⁹⁰ *Lucasfilm*, see note 69 above, paras 136-142.

⁹¹ *Autospin (Oil Seals) Ltd. v Beehive Spinning (A Firm)*, [1995] RPC 683.

⁹² *Lerose Limited and Anor v Hawick Jersey International Limited*, [1973] FSR 15.

⁹³ *Mackie Designs Inc. v Behringer Specialised Studio Equipment (UK) Ltd & Ors*, [1999] RPC 717.

geometric shape of a design was a design document. Since a 3DPDF by definition does embody the shape of a design, it manifestly falls within *Mackie*.

Thus, although a 3DPDF will be protected by copyright, as a design document its copyright is, by virtue of s 51, not infringed by using it to make an item. It is still an infringement of copyright in a 3DPDF to copy it without authorisation, so trafficking in copies of a manufacturers' official 3DPDFs for spare parts would be illegitimate. However, if a new 3DPDF is created for an object protected by design right, by, for example, using a 3D scanner to create a model of it from which a 3DPDF is derived, does the new 3DPDF infringe copyright in the original 3DPDF, or indeed any original design document? This point was considered in *Mackie*, and in the previous case of *BBC v Pally*⁹⁴ which it relied on.

BBC v Pally concerned the production of garments depicting the "Teletubby" characters. The claimants said that these were 2D infringing copies of their 3D creations. Laddie J held admissible an argument that the Teletubbies did not enjoy copyright (the position later adopted in *Lucasfilm*) and the only infringement could have been of original artwork showing them. He then held that as such artwork was a design document (there being no prior artwork as in *Kleeman*) then s 51 applied to it. Crucially, he interpreted s 51(1) as meaning that copyright in a design document was not infringed by any form of copying of the subject article, including making a 2D copy of it. Thus, the garments did not infringe copyright in any original Teletubby design artwork, as they had not been directly copied from them.⁹⁵

Although *BBC v Pally* was a preliminary hearing, Laddie J's reasoning was specifically approved by Pumfrey J in *Mackie*. He held that reverse-engineering a circuit diagram from a device did not infringe copyright in the original manufacturer's circuit diagram, as the latter was a design document. It is nonetheless still true that s 226(1)(b) CDPA 1988 makes it an infringement of design right to make a design document with the aim of allowing the item protected by that right to be reproduced. But as with ss 226(1)(a), this only applies to commercial use.

The significance of these rulings for use of personal 3D printers can be illustrated by considering the use of a 3D printer to make a copy of a vase produced by Acme PLC. Acme owns copyright in the design drawings for the vase, and it is assumed here that the vase is protected either by design registration or UDR. Bridget reverse-engineers a 3DPDF for the vase and uses it to make her own copy of it. She also posts her 3DPDF on the Internet for other 3D printer users to download and use. Charlie downloads it and prints out his own vase. Have Bridget or Charlie infringed any of Acme's rights?

- Acme's copyright in the vase design documents is not infringed by Bridget creating a new 3DPDF, by virtue of s 51(1) as interpreted in *BBC v Pally* and *Mackie*. Nor therefore is it infringed by Bridget posting the 3DPDF to the Internet.

⁹⁴ *BBC Worldwide Ltd and Anor v Pally Screen Printing Ltd and Ors*, [1998] FSR 665.

⁹⁵ H Laddie et al, see note 30 above, ss 37.21-37.22.

- Acme's design right in the vase design documents is not infringed by Bridget creating a new 3DPDF, as s 226(1)(b) only applies where there is commercial intent.
- Acme's copyright of design documents is not infringed either Bridget or Charlie making a copy of the vase, by simple operation of s 51(1).
- Acme's design protection is not infringed by either Bridget or Charlie making a copy of the vase, as neither registered design nor UDR is infringed by private and non-commercial use.

It thus seems that, within the UK at least, the provisions of design and copyright law are such that it is not an infringement to create 3D printer designs for items protected by design right, to disseminate such designs or to use a 3D printer to make copies of said item for personal, private use. As noted earlier, it will likely be an infringement to 3D-print designs based on or embodying pre-existing artwork, although in some cases the copyright for such artwork will have been greatly shortened if it has previously been industrially applied. Even so, many household items and spares will not be covered by artistic copyright and so may be legitimately reproduced by personal 3D printing.

6. Patent

Will use of a personal 3D printer infringe patent rights? As a registered right, there will be no question of law as to whether a patent exists, and the question is therefore whether 3D printer use to make a copy of a patented item falls into any statutory exemptions from infringement.

A patent grants an exclusive right to the owner for a defined period (normally 20 years) to make the subject invention, which is infringed by another making or disposing of the item without permission or offering to do so.⁹⁶ "Making" includes manufacturing the invention from new and also, as explained in *United Wire v Screen Repair Services (Scotland)*,⁹⁷ undertaking such comprehensive refurbishment of a patented item as to effectively remanufacture it. "Dispose" is interpreted by *Terrell* as commercial sale or loan or proposals to do so.⁹⁸

If Bridget buys a patented product from Acme, creates a 3DPDF for it and 3D-prints a copy, she has on the face of it infringed Acme's patent. It might be thought that the 3D printer described earlier would be unable to reproduce any invention likely to meet the requirements for novelty and inventive step needed for grant of a patent.⁹⁹ However, simple but genuinely innovative ideas still gain patent protection, such as the Haberman "Anyway" baby feeder¹⁰⁰ that could in principle be copied in flexible plastic by a 3D printer. Furthermore, as 3D-printer technology improves, the range of patentable inventions the machines can 3D-print will widen, so the question is worth considering.

⁹⁶ Patents Act 1977 s 60(1)(a) (hereafter PA 1977).

⁹⁷ *United Wire Ltd v Screen Repair Services (Scotland) Ltd*, [2001] FSR 24.

⁹⁸ S Thorley et al, see note 30 above, ss 8-22.

⁹⁹ W Cornish and D Llewelyn, see note 30 above, s 5-01 to s 5-52 for the criteria for patentability.

¹⁰⁰ *Haberman and Anor v Jackel International Ltd*, [1999] FSR 683.

If Bridget makes the invention privately and for non-commercial purposes she does not infringe Acme's patent.¹⁰¹ This exception matches that for registered designs, and Cornish notes that, as there, this does not apply to non-commercial uses that are not private, such as educational or charitable ones.¹⁰² Equally, "experimental" use is non-infringing;¹⁰³ this might for example cover testing the capability of a 3D printer to reproduce a complex, patented invention.

However, should Bridget then upload her 3DPDF to allow others to make the design, she may encounter problems. Unlike registered design law, the Patent Act includes a specific provision against providing others with the means to infringe a patent. S 60(2) provides that Bridget so infringes if she "...supplies or offers to supply in the United Kingdom...any of the means, relating to an essential element of the invention, for putting the invention into effect...". Is a 3DPDF such a means? Supplying a kit of parts may constitute "means",¹⁰⁴ but it is not obvious that a 3DPDF counts as such. One interpretation would be that a 3D printer, raw materials and a 3DPDF for a patented item together count as a kit for making that item, on which basis the 3DPDF is the essential "means" that the 3D printer user would require to infringe the patent, thus bringing supply of it within s 60(2). The opposite view would present the 3DPDF as a document describing the patent, which of course the patent itself does – albeit not necessarily with the level of detail necessary to directly make the item. Judicial or legislative clarification may be required to settle the question of whether a patent is infringed by providing instructions allowing a 3D printer to make it. What is clear, despite the convoluted wording of the legislation,¹⁰⁵ is that Bridget cannot escape s 60(2) even if the use she intends others to make of the 3DPDF is, like her own, private and non-commercial.¹⁰⁶

Where a patented invention is capable of being made by a 3D printer, it therefore appears that personal and private use is permissible, but disseminating 3DPDFs (even freely and with the intent that they be for personal and private use) may be an infringing act. Furthermore, the use of a 3D printer to repair a patented item for commercial purposes would only be legitimate if it stayed within the "remanufacture" boundary set by *United Wire*.

7. Trade Marks and Passing Off

7.1. Trade Marks

Trade marks are a registered right serving to indicate the trade origin of goods.¹⁰⁷ Once registered, they last for as long as the mark is kept in use. Trade marks are

¹⁰¹ PA 1977 s 60(5); *Smith Kline France Laboratories Ltd v Evans Medical Ltd*, [1989] FSR 513.

¹⁰² W Cornish and D Llewelyn, see note 30 above, s 6-11.

¹⁰³ PA 1977 s 60(5)(b); see also *Smith Kline France v Evans*, note 101 above.

¹⁰⁴ *Rotocrop v Genbourne*, [1982] FSR 241.

¹⁰⁵ PA 1977 s 60(6).

¹⁰⁶ S Thorley et al, see note 30 above, s 8-36; W Cornish and D Llewelyn, see note 30 above, s 6-18 fn 11.

¹⁰⁷ D Kitchen et al, see note 30 above, s 2-003.

infringed by use in the course of trade of the same mark on identical goods;¹⁰⁸ infringement also arises through use of a similar mark on the same goods, or the same mark on similar goods.¹⁰⁹ Sufficiently famous marks may be protected against competing use on any form of goods.¹¹⁰ Trade marks traditionally took the form of distinctive words or graphical devices, but more recently their definition has broadened to include shapes and combinations of colours. This widens the scope for infringement of a trade mark via 3D printing; the distinctive narrow-waisted Coca-Cola bottle is a trade mark of the Coca-Cola Company,¹¹¹ and making a bottle of that shape might infringe it. It is not necessarily the case that it would, though, as there may be an exemption for private use, or the mark may not be being used in what is deemed “the trade mark sense”.

The exemptions from design protection and patent for purely personal use have already been noted. Is there a similar exemption for trade mark use? It appears uncontroversial that purely personal use cannot be “in the course of trade” and so cannot infringe. Giving the Advocate-General’s Opinion in the ECJ hearing of *Arsenal v Reed*, Colomer AG noted that it would not infringe BMW’s trade mark for an individual to put it on a key ring. Indeed, he went further and cited both use in artistic work (e.g. Warhol’s use of Campbell soup tins) even for reward, and educational use, as being non-commercial use against which the mark owner had no rights.¹¹²

Commercial use of a trade mark is likely to infringe it, though. If Bridget owns an Acme car she might create 3DPDFs for some of its spare parts, to allow herself to 3D print copies should she need them. One of these is a cap for the windscreen wash reservoir. It is of commonplace design and has to have a diameter and screw pitch to fit the reservoir opening, so it is assumed that no design protection subsists. It does however have Acme’s name moulded into it, a trade mark registered in numerous categories including vehicle parts, and Bridget’s 3DPDF includes this. Bridget makes the 3DPDF available online, and it is downloaded by Dave, who owns a small garage. One of Dave’s customers needs an Acme reservoir cap, so Dave uses his workshop 3D printer to make one from Bridget’s 3DPDF and sells it. He infringes no design right or design document copyright by doing so, but he has sold goods bearing Acme’s trade mark, which he has therefore infringed. If, though, Bridget had removed or omitted the trade mark, Dave could have legitimately labelled the cap as being for an Acme™ car as there is specific provision for a mark to be used to indicate the intended purpose of a product, such as a spare part.¹¹³

There are other circumstances where commercial use of a trade mark may not infringe it, depending on whether the mark is being used in “the trade mark sense”, i.e. as an indication to customers that there is a link between the owners of the mark and the

¹⁰⁸ Trade Marks Act 1994 s 10(1) (hereafter TMA 1994).

¹⁰⁹ TMA 1994 s 10(2).

¹¹⁰ TMA 1994 s 10(3).

¹¹¹ UK Registered Trade Mark 2000546.

¹¹² *Arsenal Football Club Plc v Reed* (Case C-206/01), [2003] 1 CMLR 12, paras A63-A64.

¹¹³ TMA 1994 s 11(2)(c).

person using it.¹¹⁴ The law here is complex and subject to conflicting ECJ decisions,¹¹⁵ but as an example it was held in *Opel v Autec* that sale of a model car bearing Opel's trade mark logo was not infringing use as the mark's use was for verisimilitude rather than as a badge of origin. Similar issues may arise from the use of personal 3D printers due to the ease of including trade marks as surface decoration.

7.2. Passing Off

A form of IP protection related to trade marks is the common-law tort of passing off. Passing off arises where the goodwill of a trader is appropriated in a way that causes confusion as to the origin of goods, as when a competitor packages or presents products in a way misleadingly similar to that of a more established and reputable trader. Passing off requires three elements, per Lord Oliver in the "Jif Lemon" case:¹¹⁶ that the offended party has goodwill (i.e. an established positive reputation in trade) amongst the public; that there has been misrepresentation as to the origin of goods; and that actual damage to the offended party has resulted.¹¹⁷

Passing off only applies to non-private use, as one cannot mislead oneself. In the car parts scenario, Dave might misrepresent the origin of the reservoir cap, either explicitly (if it bears Acme's logo) or implicitly (if he supplies it when asked for an Acme spare).¹¹⁸ Presuming Acme's goodwill, Dave has cost it trade (so damage) and is liable for passing off. Although this is in no way different in principle to existing cases of the supply of counterfeit or misleadingly-described spares, the advent of low-cost 3D printers may increase the scope for such deception – particularly, as in *Jif Lemon*, where goodwill exists in the distinctive shape of goods. As noted earlier, passing off may arise even where other rights, such as copyright of industrially-reproduced artwork, have expired, if the resulting goods are sold so as to appropriate the goodwill of the original rights holder.

8. Conclusion

Hitherto a technology limited to the production within industry of models or prototypes, 3D printing is, like the computer in the 1970s, becoming available to the domestic enthusiast. Like the home computer, personal 3D printing has the potential to radically change aspects of the way in which we live; we can even envisage a society where home manufacturing of many items is the norm. However, as with home computers, such developments may have wider effects. The convergence of the Internet, digitised music and media players has had dramatic consequences for music copyright. 3D printing technology may have similar implications for artistic copyright, design right, trade marks and patents, but in a rather more diverse legal framework.

¹¹⁴ D Kitchen et al, see note 30 above, s 14-018.

¹¹⁵ I Simon, "Embellishment: Trade Mark Use Triumph or Decorative Disaster?" (2006) 28 *European Intellectual Property Review*, at 321.

¹¹⁶ *Reckitt & Colman Products Ltd v Borden Inc*, [1990] 1 All ER 873.

¹¹⁷ D Kitchen et al, see note 30 above, s 15-005.

¹¹⁸ *Ibid*, s 15-126.

Indeed, it is clear that – within the UK at least – personal use of 3D printing technology does not infringe the majority of IP rights. Registered design and patent explicitly exempt personal use, trade mark law has been interpreted as doing so, and UDR is only applicable to commercial use. There is no such exemption for copyright, but the CDPA 1988 has been interpreted so as to provide numerous instances where copyright does not subsist for certain 3D items or is substantially shortened. Furthermore, the experience of music copyright is that purely local and personal infringements (e.g. format shifting from CD to MP3) are in practice impractical to pursue. Many attractive uses of a 3D printer, such as to make spare parts, are in any case likely to be permitted by specific legal exceptions. It thus appears that the legal environment, in the UK at least, is surprisingly favourable towards the use of low-cost 3D printers for personal, and even in many cases commercial, purposes.

Equally clearly, rights holders are likely to be concerned if personal 3D printers become widespread and effective enough to impinge on commercial exploitation of their IP rights. Indications as to how they might react can be seen from the recent history of music copyright infringement via the Internet. Both technical and legal responses have been tried, including the use of Digital Rights Management (DRM) technology and proposals to strengthen legislative measures.¹¹⁹ Will these be applied to restrict low-cost 3D printing?

Technical measures would quickly founder on the problem that, unlike music file-sharing, personal 3D printing does not produce an exact copy that can be digitally signed or protected with DRM. It is the sharing of (as seen, legitimately) reverse-engineered designs that is the issue, not original design documents. Although scanners and printers have incorporated anti-forgery measures to detect attempts to duplicate banknotes, such techniques are very specifically targeted at one well-defined item.¹²⁰ Whist commercially-produced low-cost 3D printers might be configured to only use authorised DRM-protected 3DPDFs digitally signed by the rights holder, such measures would seriously constrain their usefulness and make them unattractive compared to open-source 3D printers.

It is worth noting, however, that this same point indicates that it may be some time before the level of detail and accuracy attainable by personal 3D printers becomes sufficient to seriously impinge upon the market for quality products, as distinct from utilitarian goods or spare parts (the reproduction of which, as has been noted, is in any case less likely to infringe IP rights.) Unlike digital audio and video copying, which produces perfect copies, copying of articles via 3D printing will be readily distinguishable from the original.

Legal measures might entail removing the personal use exemptions for registered designs, or making UDR enforceable against any copying. However, doing so would require amending the underlying EC Directive and would seriously prejudice the right of individuals to repair products they own. Furthermore, as Part 1 of this paper has explained, there may be policy grounds for seeking to encourage domestic manufacture of household products to reduce the environmental impact of the large-

¹¹⁹ Such as, *inter alia*, the Digital Economy Bill before Parliament at the time this article was in final preparation.

¹²⁰ T Thompson, “Security Clampdown on the Home PC Banknote Forgers” (6 June 2004) *The Guardian*.

scale transport of them. It to be hoped that such factors might mitigate legislative attempts to extend the scope of IP rights, or reduce the personal and non-commercial use exceptions to them, in such a way as to constrain the development of 3D printing.

The most optimistic evangelist of low-cost 3D printing would probably admit that the household domestic 3D printer is years, if not decades, from widespread use. Its impact will be gradual, as unlike file-shared MP3s it will not immediately provide for the reproduction of faithful copies. Rather, as its ease-of-use, fidelity and range of materials increases, so will its attractiveness and range of applications. This should, at least, allow for a more measured consideration of the legal issues that will arise from such use. In the longer term, personal 3D printers may conceivably lead to radical changes in the nature of the manufacturing economy; the IP implications of such further developments have so far been imagined only in science fiction.¹²¹

¹²¹ N Stephenson, *The Diamond Age, or, A Young Lady's Illustrated Primer* (London: Viking, 1995); C Doctorow, *Makers* (available online: <http://craphound.com/makers/download/> (accessed 25 March 2010)).