THE IMPACT OF THREE-DIMENSIONAL SCANNING AND PRINTING TECHNOLOGIES ON THE RIGHTS OF INTELLECTUAL PROPERTY OWNERS WITH A SPECIFIC FOCUS ON COPYRIGHT

by

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Declaration of originality

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CHAPTER 1: RESEARCH QUESTION

Technologies are emerging and affecting our lives in ways that indicate we are entering what has been dubbed the Fourth Industrial Revolution ("Industry 4.0").[1] Professor Klaus Schwab in his book, *The Fourth Industrial Revolution* stated of this era that:[2]

> *"the changes are so profound that, from the perspective of human history, there has never been a time of greater promise or potential peril. My concern, however, is that decision-makers are too often caught in traditional, linear (and non-disruptive) thinking or too absorbed by immediate concerns to think strategically about the forces of disruption and innovation shaping our future"*

Industry 4.0 is expected to impact all disciplines, industries and economies and to have the ability to deliver on promises of raised income levels and improved quality of life.[3] 3D printing technologies have been recognised as one of the pillars of Industry 4.0. It is projected to be present, relevant and determinative in shaping the way of the future.

The nature of 3D printing technologies is such that it inevitably involves reproducing and adapting pre-existing drawings, objects or articles. This must mean that owners of copyright that protect such existing works stand to be impacted significantly through the acts of 3D printing if it is indeed destined for the predicted widespread and decisive application.

This dissertation takes a closer look at the relevance of the technology, where or how it is or could be applied and by whom. The extent of the current application of the technology coupled with the role it is expected to play in the level of innovation that will be required to stimulate economic growth in the Industry 4.0 environment, is indicative of a real risk of a noticeable impact on copyright owners. Considering the advantages of 3D printing

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[1] https://www.weforum.org/agenda/2016/01/what-is-the-fourth-industrial-revolution/ *World Economic Forum: What is the fourth industrial revolution?* Nicholas Davis, 19 January 2016, accessed 19 October 2018

[2] https://www.forbes.com/sites/bernardmarr/2018/08/13/the-4th-industrial-revolution-is-here-are-you-ready/#4e233c0e628b *The 4th Industrial Revolution Is Here - Are You Ready?* Bernard Marr, 13 August 2018, accessed 19 October 2018

[3] 1 supra

technologies, however, it is clear that unprecedented socio-economic benefits stand to be achieved from the use and development of the technology and lack of participation is likely to have a severe negative impact on economic growth. The key appears to be finding ways to enable engagement with these technologies in a manner that reduces unnecessary exposure to liability for copyright infringement but also protects copyright owners against uncontrolled pillaging of their property.

An application of the South African copyright law to 3D printing technologies is undertaken and attention is also given to commentary on and reaction to the interplay between the technologies and copyright or related laws, in the United States of America, the United Kingdom and Australia.

Informed by all of the above, consideration is given to the South African legal landscape and its ability to balance the impact of 3D printing technologies on copyright, with the need to create an environment in which engagement with these technologies is not only allowed but encouraged.

CHAPTER 2: GLOBAL OVERVIEW OF 3D PRINTING TECHNOLOGIES

2.1 INTRODUCTION

Though founded in the 1960s, it was not until the 1990s that the internet developed from being a network used exclusively by the United States Defence Department to a network of networks enabling instant connection, communication and access to content on a global scale. In 1995, less than 1% of the world's population was online. In 2017, nearly half of all humans on the planet had internet connections, and the rate was growing at an estimated 10 people per second.[4] Over the course of three decades, the internet has completely transformed the way in which we go about our daily lives illustrating the effect, over time, of disruptive technologies.

[4] http://www.bbc.com/future/story/20170207-what-if-the-internet-stopped-for-a-day *What if the internet stopped for a day* Rachel Nuwer, 7 February 2017, accessed 12 July 2018

Of course, the speed at which technologies develop is not in slow and steady inclines but rather model the "second half of the chessboard"[5] principle, increasing exponentially with each enhancement. This means that, whilst it may take some time for technology to develop to the point of complete disruption, the most and most disruptive developments occur in the later stages and at an elevated pace.

3D printing technologies is one such disruptive technology and, having regard to the current state of these technologies, we may expect to see unimaginable progress in the near future.

3D printing technologies include both scanning and printing processes as detailed further below. Research conducted for this dissertation has revealed an alarmingly extensive application of these technologies across all of the major manufacturing industries. It has also revealed a global and sophisticated do-it-yourself consumer-following within which creation, manufacture and, more importantly, reproduction, of just about any article is not only possible but has become everyday practice.

2.2 THE HISTORY OF 3D PRINTING TECHNOLOGIES

The first 3D printing technologies were invented in the 1980s during which time they were referred to as rapid prototyping technologies. According to reports, the first patent was granted in the United States of America in 1986 to one Charles Hull for a rapid prototyping machine he invented in 1983. Hull went on to co-found 3D Systems, Inc. ("3D Systems") which has grown into one of the largest and most successful businesses relevant to the 3D printing environment today.[6]

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[5] The wheat and chessboard problem is a mathematical problem which states that if a chessboard were to have wheat placed upon each square such that one grain was placed on the first square, two on the second, four on the third, and so on (doubling the number of grains on each subsequent square), the total number of grains at the end of the first half of the chess board is 4 million. Over the course of the second half of the chess board the increases are so great that by the end of the board, the total has increased to 18 quintillion. https://en.wikipedia.org/wiki/Wheat_and_chessboard_problem

[6] https://www.3dsystems.com/our-story; https://3dprintingindustry.com/3d-printing-basics-free-beginners-guide#02-history , accessed 9 July 2018

It was not until January 2009 that the first commercially available 3D printer was offered for sale.[7] Interestingly, this system was based on the so-called RepRap concept, an open-source project aimed at producing self-replicating systems and making them freely available for the benefit of everyone.[8] As an open source project, anybody could contribute to the development of the RepRap printer and this continues to be the case today. Designers, engineers and software developers are free to make modifications to the machine, but they are obliged by the GNU General Public Licence[9] to re-share their improvements.[10] It was reported in 2017 that the RepRap machines were the most widely used printers amongst the global Maker Community.[11]

In the near-decade since the technology became commercially available, it has advanced in leaps and bounds and research undertaken for this thesis has indicated that, since about 2014, it has attracted major interest and attention as constituting a critical part of the fourth industrial revolution. This is a mere four years ago.

2.3 THE CURRENT STATE OF THE 3D PRINTING TECHNOLOGY INDUSTRY

Wohlers Associates Inc. ("Wohlers") is an independent consultancy firm that provides information and advice on new developments and trends in the 3D printing sector.[12] Wohlers releases a detailed annual report on the state of the 3D printing industry including how many 3D printers are sold each year.

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[7] 6 supra

[8] https://reprap.org/wiki/RepRap; https://all3dp.com/history-of-the-reprap-project/ accessed 11 July 2018

[9] The GNU is an operating system that is made available as "free software" meaning that it is distributed under a licence that allows it to be run, studied, shared, modified, reproduced, adapted, distributed etc without limitation. The GNU Licence is the licence under which GNU is made available. The GNU licence, in turn, has been made publicly available to be used by any copyright owner who wants to distribute software on the same terms. https://en.wikipedia.org/wiki/GNU_General_Public_License; https://www.gnu.org/licenses/gpl-3.0.en.html, accessed 22 September 2018

[10] 8 supra

[11] 8 supra. The Maker Movement will be explained further below but in summary is a social movement that emphasises informal, networked, peer-led, and shared learning.

[12] https://3dprint.com/208122/wohlers-report-2018/ *Wohlers Report 2018 Details Overall 3D Printing Industry Growth, Major Gains in Metals* Clare Scott, 27 March 2018, accessed 12 July 2018

The Wohlers Report 2018[13] revealed that the worth of the 3D printing industry exceeded US$ 7.3 billion.[14]

More than 278,000 desktop 3D printers (each having a retail price of under $5,000) were sold worldwide in 2015 and the 2018 report has the estimated number of desktop systems sold at nearly double that. In just over two years, an astonishing 528,952 desktop 3D printers are believed to have been sold. [15]

The growth is not in machines alone, but more companies are making the machines as well. The 2018 report records 135 companies around the world producing and selling industrial 3D printing systems in 2017. That figure was 97 in 2016. An estimated 1,768 metal 3D printing systems were sold in 2017, compared to 983 systems in 2016, an increase of nearly 80 percent.[16]

The current state of the 3D printing industry indicates a widely available technology which is developing and growing at a rapid pace.

2.4 HOW THE TECHNOLOGY WORKS

3D printing is the process of making three-dimensional objects from a digital file. The machine used to do the printing needs a digital 3D model (blueprint) from which it can work. The creation of a 3D printed object is then achieved using additive processes. In an additive process an object is created by laying down successive layers of material until the 3D object has been created.[17]

The digital model exists in the form of a computer aided design (CAD). The CAD can be created either through a design process or through the use of 3D scanning technology.

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[13] Available from https://wohlersassociates.com/

[14] https://www.forbes.com/sites/tjmccue/2018/06/04/wohlers-report-2018-3d-printer-industry-rises-21-percent-to-over-7-billion/#fb2b0cb2d1a4 *Wohlers Report 2018: 3D Printer Industry Tops $7 Billion* TJ McCue, 4 June 2018, accessed 12 July 2018

[15] 14 supra

[16] 14 supra

[17] https://3dprinting.com/what-is-3d-printing/ , accessed 9 July 2018

After the creation of the digital model, it needs to be converted into a file format that can be read by 3D printers (referred to here as a "3D printing file format"). The majority of printers currently use a file format called STL.[18]

Thereafter, instructions for the printer to follow must be added to the 3D printing file format. This process is called "slicing" and is done by using specialist software. Slicing refers to the division of the digital model contained in the STL (or other) file into thousands of horizontal layers that become the step by step instructions carried out by the printer. A lot of information is added to these instructions at the time of carrying out the slicing process, such as the temperature requirements, amount of material to be used, the speed at which the printer is required to move, and so on. All of this information is taken up into another file, typically referred to as the GCode file.[19] Following slicing, the object can be printed.

As mentioned above, it is possible for the digital design to come into existence following a scanning process. 3D scanning technologies analyse physical objects and capture their shape and construction in a number of images.[20]

There are several devices available that can carry out a 3D scanning process, from big machines to handheld devices. There are also software applications available that can use a series of photographs taken by any camera (even the one on a smartphone) to create digital models.[21] The 3D scanning process renders a digital model of the physical object. The digital model is then turned into either a CAD or directly into a file format that can be read by 3D printers, the same file formats discussed above following the CAD design.

Whichever process is followed in reverse following scanning, once the final 3D printing file format has been created, the slicing process follows and the object can be printed.

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[18] https://all3dp.com/what-is-stl-file-format-extension-3d-printing/ *STL File Format (3D Printing) – Simply Explained* Dibya Charavorty, 5 August 2018, accessed 9 July 2018

[19] https://www.goprint3d.co.uk/blog/what-is-slicing-software-and-what-does-it-do/ *What is slicing software, and what does it do?* Jakk, 6 July 2016, accessed 9 July 2018; 18 supra

[20] https://en.wikipedia.org/wiki/3D_scanning , accessed 9 July 2018

[21] One such application is 123D Catch, available for free download to any Android or Apple device.

The simple fact is that either scanning or printing a three dimensional object constitutes copying of a pre-existing work. It necessarily amounts to reproduction.

2.5 WHERE ARE 3D TECHNOLOGIES FOUND, USED OR APPLIED

As could be expected, large industrial manufacturers are using the technologies extensively for the production of engineering and other functional parts. However, as will be revealed below, the technology is also extensively used in the manufacturing of other articles across a very diverse range of industries, spanning technological and creative fields, from medical implants to toys, from buildings to clothing, and from education to foodstuffs.

The automotive, aviation and aerospace industries are examples of manufacturers in which technologies have found application for quite some time. Car manufacturers, restorers and repairers have been employing 3D printing for a number of years. Vehicle manufacturers are using the technology to produce not just parts, but also tools and interior elements. For example, BMW AG ("BMW") has been researching and producing 3D printed parts since 1990 and is currently manufacturing the top cover of the i8 Roadster vehicle by printing it.[22] BMW operates an Additive Manufacturing Centre in Munich and has recently invested €10million in a 6,000 square foot Additive Manufacturing Campus just North of the city.[23] On its website,[24] BMW makes available, for free download, a file containing a digital model of the famous BMW logo for home printing.

Automobile enthusiasts all over the world are using printed parts to restore old cars. One such example is when Australian engineers printed parts to bring a Delage Type-C vehicle back to life.[25] In doing so, they had to print parts that were out of production for decades and they succeeded.

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[22] https://www.bmw.com/en/innovation/3d-print.html 25 August 2018, accessed 13 July 2018

[23] https://www.bmwblog.com/2018/04/16/bmw-announces-plans-to-build-specialized-3d-printing-facility/ *BMW Announces Plans to Build Specialized 3D Printing Facility* Gabriela Nica, 16 April 2018, accessed 13 July 2018

[24] www.bmw.com

[25] http://www.abc.net.au/news/2017-03-27/saving-the-last-delage-type-s-grand-prix-car/8310958 Fiona Pepper, 29 March 2017, accessed 9 July 2018

The Boeing Company was reported to be the first company to use 3D printed structural parts in its 787 Dreamliner, whilst Airbus SE was the first to install 3D printed cabin components.[26]

In the education sector, the technologies find extensive application both in enabling students for research projects and prototyping, but also teaching learners, even from a young age, how to use and apply the technologies. In the United States, programs such as the Create Education Project[27] and Kiddeville[28] facilitate the integration of 3D printing technologies into school curricula by supplying printers and lesson plans that guide students through the research, development and printing processes. Locally, 3D Printing Systems South Africa supplies educational STEM[29] kits that consist of curriculum supported learning tools and the company foresees having these technologies on school desks in the near future.[30]

Many universities are using 3D printing processes for prototyping. The processes are, of course, very relevant to the fields of engineering, computer science, architecture, arts and medicine. Most tertiary institutions offering qualifications in these fields have their own dedicated 3D scanning and printing facilities on offer to staff and students. The Nelson Mandela University claimed in 2017 to have built the largest 3D printer in Africa[31] whilst at the University of Stellenbosch, the Idea2Product Lab[32] offers 3D printing, 3D design and 3D scanning services and even 3D-printing training courses. The Idea2Product Lab in Stellenbosch is open to staff, students and the general public.

Architects use 3D printed models of projects to illustrate and visualise their designs.[33] In the construction industry, the first houses and even an office building have already been

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[26] https://www.reuters.com/article/us-norsk-boeing-idUSKBN17C264 *Printed titanium parts expected to save millions in Boeing Dreamliner costs* Alwyn Scott, 10 April 2017; https://www.airbus.com/newsroom/news/en/2018/04/bridging-the-gap-with-3d-printing.html, accessed 13 July 2018

[27] https://www.createeducation.com/, accessed 12 July 2018

[28] https://kidesign.org/kideville/, accessed 12 July 2018

[29] Science, Technology, Engineering and Mathematics

[30] https://3dprintingsystems.co.za/education/, accessed 12 July 2018

[31] http://news.mandela.ac.za/News/Largest-3D-printer-in-Africa-built-at-NMMU, accessed 13 July 2018

[32] http://blogs.sun.ac.za/idea2product/, accessed 13 July 2018

[33] https://www.archdaily.com/881662/this-3d-printer-designed-specifically-for-architects-is-surprisingly-easy-to-use 16 October 2017, accessed 9 July 2018

printed.[34] A printer that can print a 400 square foot structure in under 24 hours already exists[35] and in China, recyclable materials are used to print houses for under US$5,000 (approximately R60,000) per unit.[36]

Home interior items[37], lighting fixtures[38] and various furniture pieces are being printed.[39]

The toy industry has benefited greatly from the technology, with toys by their very nature consisting largely out of small plastic parts. One of the world's largest toy manufacturers, Mattel Inc., uses 3D printed parts in the manufacturing of most of its toys, including the famous Barbie doll and Hot Wheels toy cars.[40] Mattel even supplies a printer for children, the ThingMaker 3D, to print their own toys. The printer uses a simple software application and can be managed from a smartphone or tablet.[41] Another multinational toy manufacturer, Hasbro, Inc. not only uses 3D printing in the manufacturing process but has collaborated with the manufacturer, 3D Systems, to create a site for its My Little Pony toy range called SuperFanArt[42] where users can download designs of the toys to print themselves.

As for unmanned aerial vehicles, commonly referred to as drones, most of their parts such as frames, landing gear and propellers can be and are extensively manufactured through 3D

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[34] https://www.engineering.com/Education/EducationArticles/ArticleID/12225/Dubai-Unveils-First-3D-Printed-Office-Building.aspx *Dubai Unveils First 3D Printed Office Building* Michael Molitch-Hou, 26 May 2016; http://www.engineeringnews.co.za/article/concrete-3d-printed-house-showcased-in-milan-2018-04-26 *Concrete 3D Printed House Showcased in Milan* Marleny Arnoldi, 26 April 2018; https://futureofconstruction.org/case/winsun/ 6 December 2016, accessed 10 July 2018

[35] https://www.livescience.com/58156-3d-printed-house-built-in-less-than-a-day.html *This House Was 3D Printed in Less Than 24 Hours* Kacey Deamer, 7 March 2017, accessed 10 July 2018

[36] https://www.ibtimes.co.uk/china-recycled-concrete-houses-3d-printed-24-hours-1445981 *China: Recycled Concrete Houses 3D-Printed in 24 Hours* Mary-Ann Russon, 24 April 2014; https://www.bbc.com/news/blogs-news-from-elsewhere-27156775 *China: Firm 3D prints 10 full-sized houses in a day* 25 April 2014, accessed 10 July 2018

[37] https://www.laurelandwolf.com/blog/3d-printing-is-taking-custom-interior-design-to-a-whole-new-level/, accessed 12 July 2018

[38] http://www.3dprinting.lighting/, accessed 12 July 2018

[39] https://www.sculpteo.com/blog/2018/02/21/3d-printed-furniture-appliances-of-the-future/, accessed 9 July 2018

[40] https://www.wsj.com/articles/SB10001424127887323372504578469560282127852 *Printing Out Barbies and Ford Cylinders* Clint Boulton, 5 June 2013, accessed 12 July 2018

[41] http://fortune.com/2016/02/12/mattel-3d-printing-toys/, accessed 12 July 2018

[42] https://www.shapeways.com/superfanart/mylittlepony, accessed 12 July 2018

printing processes.[43] Whilst drones find application in many industries, including agriculture, military, cinema and security, there is also a large recreational community. Here, the users will often suffer broken parts of the vehicle from crashes and simply print a replacement as needed.[44]

The technology has greatly benefited the sports industry, too. Sporting goods manufactured through 3D printing processes include golf clubs[45] baseball bats,[46] gloves,[47] helmets,[48] bicycle handle bars,[49] surfboards and skateboard decks,[50] mouthguards,[51] shin guards[52], and even sports sunglasses.[53] A company called Skelmet[54] has created a software application that allows users to scan their own heads and faces which data it then uses to manufacture custom sports sunglasses. Well-known sports goods manufacturer, Nike Inc., has been at the forefront of 3D printed sports equipment and apparel including shoes, and in particular, soles, inners, uppers and cleats.[55] Many other sports manufacturers have followed suit, including

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[43] https://www.sculpteo.com/blog/2017/11/15/top-11-of-the-best-3d-printed-drone-projects/ accessed 9 July 2018

[44] https://all3dp.com/3d-print-drone-parts/, accessed 9 July 2018

[45] https://3dprint.com/46036/golf-equipment-manufacturer-ping-introduces-golfs-first-3d-printed-putter/ *Golf Equipment Manufacturer Ping Introduces Golf's First 3D-Printed Putter* Debra Thimmesch, 22 February 2015; http://grismont.paris/, accessed 12 July 2018

[46] https://www.techtimes.com/articles/107791/20151117/smart-baseball-softball-training-bat-provides-real-time-data-analytics.htm *Smart Baseball And Softball Training Bat Provides Real-Time Data, Analytics With Each Swing* Mark Lelinwalla, 17 November 2015, accessed 12 July 2018

[47] https://all3dp.com/hockey-made-safer-3d-antibacterial-gloves/ , accessed 12 July 2018

[48] https://3dprint.com/176374/riddell-new-nfl-football-helmets/ *Riddell Uses 3D Scanning for New, Safer NFL Football Helmets* Bridget Butler O'Neal, 1 June 2017, accessed 12 July 2018

[49] https://www.3dnatives.com/en/3d-printing-sport-201220174/ , accessed 12 July 2018

[50] https://www.disruptsports.com/3d-printing/ , accessed 12 July 2018

[51] https://3dprint.com/210316/dsm-3dmouthguard-partnership/ *DSM Helping Dutch Sports Initiative 3D Print Custom Sports Mouthguards On the Spot* Sarah Saunders, 16 April 2018, accessed 12 July 2018

[52] https://www.sculpteo.com/blog/2014/06/05/3d-printed-football-equipments/ *The world's first 3D printed football equipments* Nike Arthur Cassaignau 5 June 2014, accessed 12 July 2018

[53] https://3dprint.com/164449/skelmet-3d-printed-sunglasses/ *3D Scanning & 3D Printing for a Perfect Fit: Meet Skelmet's 3D Printed Sports Sunglasses* Clare Scott, 13 February 2017, accessed 12 July 2018

[54] https://skelmet.com/ , accessed 12 July 2018

[55] https://inside3dprinting.com/news/tag/nike/; https://inside3dprinting.com/news/nikes-3d-printed-shoe-uppers-first-in-london-marathon/45412/ *Nike's 3D-Printed Shoe Uppers First in London Marathon* Sandra Helsel, 24 April 2018; https://inside3dprinting.com/news/nikes-3d-printed-football-equipment-for-summer-2014/18094/ *Nike To Release 3D Printed Football Equipment for Summer 2014* Sandra Helsel, 2 June 2014; https://inside3dprinting.com/news/nike-debuts-second-football-cleat-using-3d-printing-technology/14775/ *Nike Debuts Second Football Cleat Using 3D Printing Technology* Sandra Helsel, 28 February 2014; https://inside3dprinting.com/news/nike-continues-just-do-it-with-3d-printed-carbon-vapor-shoe-for-super-bowl/13370/ *Nike Continues 'Just Do It' with 3D Printed Carbon Vapor Shoe for Super Bowl* Sandra Helsel, 16 January 2014, accessed 10 July 2018

Reebok[56], Under Armour, Inc.[57] and Adidas AG.[58] 3D printed sports apparel was credited for increased performance, and even a gold medal, at the 2018 Olympics.[59]

Another significant application of the technology on the sports field is enabling and supporting persons with disabilities and impairments. Besides the manufacture of prosthetics, 3D printing has been used in the production of racing wheelchairs, running blades, gloves, bicycle braces and hand braces.[60]

The clothing industry is not being left behind either.[61] In 2015, Israeli student Danit Peleg launched a collection of clothing that was entirely created using desktop 3D printers at home and one of her jackets went on to become the first commercially available 3D printed garment.[62] Some of the larger fashion houses have been experimenting with the technology too, such as Levi Strauss & Co.[63] and Balenciaga.[64]

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[56] https://www.sporttechie.com/reebok-unveils-3d-printed-floatride-running-shoe-liquid-factory/ *Reebok Unveils 3D-Printed Shoe And Commits To More 3D Production* Jen Booton, 26 March 2018, accessed 10 July 2018

[57] https://3dprint.com/168953/under-armour-architech-futurist/ *Under Armour Presents Latest Athletic Shoe with 3D Printed Midsole* Sarah Saunders, 24 March 2017, accessed 10 July 2018

[58] https://techcrunch.com/2018/01/18/adidas-joins-carbons-board-as-its-3d-printed-shoes-finally-drop/ *Adidas Joins Carbons Board As Its 3D Printed Shoes Finally Drop* Brian Heater, 18 January 2018, accessed 10 July 2018; https://www.forbes.com/sites/andriacheng/2018/05/22/with-adidas-3d-printing-may-finally-see-its-mass-retail-potential/#57a4daa14a60 *How Adidas Plans To Bring 3D Printing To The Masses* Andrea Cheng, 22 May 2018, accessed 10 July 2018

[59] https://3dprint.com/206664/3d-printing-olympics-gold/ *3D Printing Helped Chinese Team Win Gold at 2018 Winter Olympics* Clare Scott, 13 March 2018; https://3dprint.com/204760/3d-printing-olympic-biathlon/ *3D Printing Prototypes Supports Reach for 2018 Olympic Gold in Men's Biathlon* Hannah Rose Mendoza, 22 February 2018; https://3dprint.com/203737/us-luge-team-3d-printing/ *US Olympic Luge Team Hopes for a 3D Printed Advantage with Help from Stratasys* Clare Scott, 14 February 2018, accessed 10 July 2018

[60] http://www.3ders.org/articles/20160909-how-3d-printing-will-power-the-paralympic-games.html 9 September 2016, accessed 10 July 2018

[61] https://www.sculpteo.com/blog/2018/05/23/3d-printed-clothes-top-7-of-the-best-projects/ *3D printed clothes: Top 7 of the best projects* Lucy Gaget, 23 May 2018, accessed 19 August 2018

[62] https://3dprint.com/182312/danit-peleg-3d-printed-jacket/
3D Printing Goes Ready to Wear as Danit Peleg's Bomber Jacket Becomes the First Commercially Available 3D Printed Garment Sarah Anderson Goehrke, 28 Juy 2017; https://danitpeleg.com/about/ accessed 19 August 2018

[63] https://www.levistrauss.com/unzipped-blog/2017/07/31/levis-tests-3d-printing-technology/ ; https://www.designnews.com/materials-assembly/levi-strauss-experiments-3d-printed-denim/127098683857307 *Levi Strauss Experiments with 3D-Printed Denim* Elizabeth Montalbano, 14 August 2017, accessed 19 August 2018

[64] https://3dprintingindustry.com/news/balenciaga-3d-printing-fashion-130162/ *Balenciaga 3d Scanning And 3d Printing For Luxury Fashion In Aw 2018 Collection* 9 March 2018, accessed 19 August 2018

In the medical field, the application of 3D printing technologies has been vast. It ranges from the printing of surgical tools, prosthetics, bone structures, synthetic skin,[65] medical implants, drugs and biomaterials for organ structures to the establishment of 3D printing laboratory facilities in hospitals.[66] In Haiti, a 3D printing lab was established that identified 16 printable tools to meet the real-time requirements of medical professionals in disaster relief areas.[67]

The culinary industry has embraced the technology with the first restaurant using only 3D printed produce opening its doors in London in 2016. In fact, not only the food but everything in the restaurant, including the furniture and utensils were made through 3D printing processes.[68] In the confectionary world, candy printers are used to make sugar art, chocolate crafts, cake toppers and cookie toppings.[69]

3D printing technologies is furthermore extensively used in what has become known as the Maker Movement. The Maker Movement is a social movement which emphasises "learning through doing" in social environments.[70] The Maker Movement encourages do-it-yourself (DIY) approaches to innovation and urges consumers to be creators.[71] People come together to share information, knowledge and ideas for the purposes of innovation and creation.[72] Whilst many different cutting-edge technologies are applied in the design and creation processes that take place within these Maker Spaces, there is a strong focus on not only the use of 3D printing technologies but also their development, as has been borne out by the RepRap project.

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[65] https://www.allthat3d.com/3d-printing-medicine/; https://3dprintingindustry.com/news/12-things-we-can-3d-print-in-medicine-right-now-42867/ accessed 10 July 2018

[66] https://www.asme.org/engineering-topics/articles/manufacturing-design/top-5-ways-3d-printing-changing-medical-field *Top 5 Ways 3D Printing Is Changing the Medical Field* Nancy S Giges, May 2017 accessed 10 July 2018

[67] https://3dprint.com/68527/medical-3d-printing-in-haiti/ *Disaster Relief in Three Dimensions* Kayla Matthews, 29 May 2015, accessed 19 August 2018

[68] http://foodink.io/press-kit/ *Official World Premiere*; https://www.youtube.com/watch?v=xk9hNin_sag; https://3dprinting.com/food/3d-printing-as-a-solution-to-global-food-crises/ *3D Printing As A Solution To Global Food Crises* 4 November 2016, accessed 12 July 2018

[69] https://3dprinting.com/food/new-candy-printer-enter-market/ *A New Candy Printer to Enter the Market* 20 August 2014, accessed 12 July 2018

[70] https://en.wikipedia.org/wiki/Maker_culture

[71] http://www.openair.org.za/wp-content/uploads/2018/02/WP-9-A-Scan-of-South-Africas-Maker-Movement.pdf *A Scan of South Africa's Maker Movement* de Beer, Armstrong, Ellis and Kraemer-Mbula 21 December 2017, accessed 15 September 2018

[72] https://www.popsci.com/rise-makerspace-by-numbers *By The Numbers: The Rise Of The Makerspace* Nicole Lou and Katie Peek, 22 February 2016, accessed 15 September 2018

It is evident that 3D printing technologies are extensively and widely applied across many different industries and have, in fact, become an integral part of manufacturing today. It is also evident that consumers have not allowed themselves to be left behind and they are actively involved in both the development and the application of the technologies. Furthermore, the age at which consumers, and future developers, architects, engineers, artists, educators and the like are starting to engage with the technology is likely only to decrease. What is interesting, especially in light of the latter observation, is that industry leaders are engaging with the technologies in a way that accepts the consumer's access to and experience with the technologies.

2.6 ONLINE DESIGN REPOSITORIES AND PRINTING SERVICES

As mentioned above, any 3D printed object requires a blueprint in the form of a computer aided design ("CAD"). It is possible to create an original CAD or to create one not by designing it but through a reversed process that starts with scanning an object. However, should a consumer not have the required expertise, software or time to create a CAD, he or she can simply go online and download one.

A large number of online design repositories have been created alongside the development of the technologies. These repositories are websites that host 3D printable files which are uploaded by users and made available for downloading and printing. CAD creators therefore simply upload designs to these repositories, and they become available to anyone with internet access.

One of the largest and most popular online design repositories is called Thingiverse. Thingiverse is owned by the 3D printer manufacturer, Makerbot, and, to date, more than one million 3D model designs have been uploaded to the Thingiverse platform.[73] All designs uploaded are required to be made available under the Creative Commons Licence,[74] meaning

[73] https://www.thingiverse.com/about/, accessed 2 September 2018

[74] https://creativecommons.org/ The Creative Commons Licence is a standard licensing scheme that allows a copyright owner to choose a licence type which determines the terms upon which the work is made available

that anybody is free in turn to download, alter and re-upload the design. This is the only requirement for designs to be uploaded, that it is made available on an open-source basis. Designs available on Thingiverse include designs for 3D printers or their parts.

A search[75] for the phrase "STAR WARS" on Thingiverse returned results for printable designs for the STAR WARS movie logo, masks, characters and vehicles. A search for "BMW" returned designs for cup holders, phone holders, a kidney grill clip replacement, cam lock blocks, glove box latch, replacement sunroof clip, amongst many other articles.

Other online repositories include 3D Warehouse by Sketchup[76] operated by Trimble Inc. and Pinshape[77] which is operated by the 3D printing technology manufacturer, Formlabs Inc.

In addition to the online repositories, there are online platforms that provide 3D printing services. They enable a user to upload or submit a digital model and then order the printed object. Examples include US based Shapeways,[78] i.Materialise from Belgium,[79] and France based Sculpteo.[80]

In the circumstances, not only is it possible to obtain an already existing CAD design from the internet with extreme ease, one also does not need physical access to a 3D printer to be able to use the technology. Once the desired CAD design has been obtained, it can be sent or uploaded to one of many online 3D printing service providers who will then carry out the printing and return the finished product.

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for free download and reproduction. The main purpose of the Creative Commons Licence is to allow the copying and distribution of a work based on the premise that it benefits the greater community.

[75] Searches done on 2 September 2018

[76] https://3dwarehouse.sketchup.com/?hl=en, accessed 2 September 2018

[77] https://pinshape.com/3d-marketplace , accessed 2 September 2018

[78] https://www.shapeways.com/ Shapeways is operated by Shapeways B.V. , accessed 2 September 2018

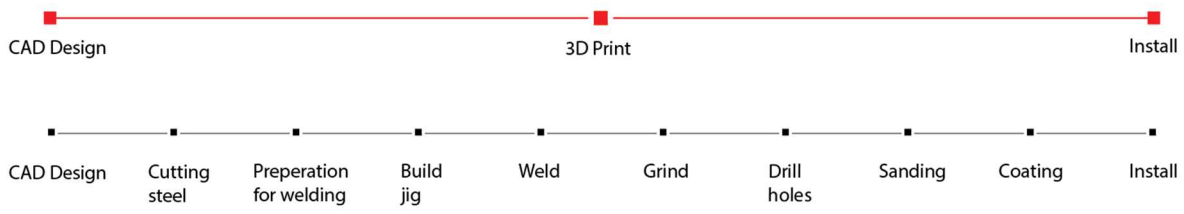
[79] https://i.materialise.com/en by Materialise nv, accessed 2 September 2018

[80] https://www.sculpteo.com/en/ , accessed 2 September 2018

2.7 ADVANTAGES OF 3D PRINTING TECHNOLOGIES

Research for this thesis revealed many benefits of 3D scanning and printing technologies. One of the most important advantages is borne out by the alternative name, rapid prototyping. Complex designs can be printed in a matter of hours. This faster design and prototype production allow more time to analyse and test the prototype, which in turn leads to better quality products and earlier entry to market.

The process eliminates many of the steps involved in traditional manufacturing processes. Once a CAD file has been created, printing can start. Furthermore, should alterations be required, it can be as simple as amending the CAD file or tweaking the information during the slicing process. By contrast, depending on the article being produced, traditional manufacturing requires many intervening steps. In illustration, the manufacturing process of a custom steel bracket is shown below, with the 3D printing process being the red line and traditional manufacturing shown in black:[81]



Additional benefits include precision production and elimination of waste. Given the way in which the products are manufactured, building layer upon layer and adding material only there where it is needed, very little if any material goes to waste. By contrast, subtractive manufacturing, which requires the removal of material until the desired shape has been achieved, by its very nature produces high volumes of left-over material.

The technology offers complexity and design freedom as it is not inhibited by the characteristics of traditional manufacturing methods and offers a level of customisation that

[81] https://www.3dhubs.com/knowledge-base/advantages-3d-printing *The Advantages of 3D printing* Ben Redwood, accessed 11 July 2018

no other manufacturing process has ever been capable of. Just one of many examples, the ability to scan a football player's head and print a player-specific helmet is enabling the National Football League in the United States of America to reduce the occurrence of brain injuries in players.[82] Other practical implications vary from made-to-fit medical implants or prosthetics and personalised sports equipment to enhance an athlete's performance, to personalised designer golf clubs, furniture or jewellery.

3D printing processes are faster and more cost-efficient than traditional manufacturing processes. It enables on-site development, prototyping and manufacturing. The cost savings on operations, material and labour are self-evident.

The technology also creates employment opportunities in the value chain, such as design services, software development and material innovation. The technology is extremely accessible and could unlock opportunities that would otherwise be unattainable due to high input costs.

3D printing technologies enable the manufacture of new things in new ways. The competitive advantage to economies that are able to exploit participation in these technologies at various levels of the supply and value chains seems to be self-evident. The socio-economic advantages brought on by the ability to deliver large-scale affordable housing, medical supplies, furniture and equipment to schools and even supplementation of food supplies further weigh heavily in favour of the adoption and development of, as well as support for, these technologies.

2.8 DISADVANTAGES

The costs of investment, research and development of these technologies are still high. Though continuously evolving in a manner that will keep driving the costs of engagement down, some 3D printers and especially those required to deliver high quality or high volume products are still expensive. Some of the print materials also remain expensive. Materials

[82] https://3dprint.com/176374/riddell-new-nfl-football-helmets/ *Riddell Uses 3D Scanning for New, Safer NFL Football Helmets* Bridgett Buttler O'Neal, 1 June 2017, accessed 2 September 2018

are largely plastic and metal based and therefore somewhat limited, but this is changing quickly, too.

A significant negative socio-economic impact brought on by 3D printing technologies especially in the industrial sector is the potential loss of employment opportunities in the actual manufacturing process.

However, it is the technology's greatest advantage that is also potentially its greatest disadvantage, at least to copyright owners, and that is its ease of access.

What once was an exclusive, high-cost technology is now in the hands of the public at large including the do-it-yourself consumer, and becoming increasingly affordable. 3D scanning technology is available on your smartphone. 3D printers are available from retailers and designs can be downloaded from the internet in seconds. This necessarily equates to reproduction on a large scale and the ability to copy brings with it the ability to infringe copyright.

CHAPTER 3: SOUTH AFRICA

3.1 WHAT IS HAPPENING IN SOUTH AFRICA

Implementation of 3D printing technologies in South Africa started in the early 1990's with the acquisition of a 3D printing system by a company 3D Systems (Pty) Ltd. That was followed by the implementation of two systems at the Council for Scientific and Industrial Research (CSIR) four years later. Reports indicate that the uptake in the technology was slow initially, but since 2011 there has been a rapid escalation in the number of 3D printing systems in South Africa.[83]

[83] https://www.dst.gov.za/images/2018/Additive%20Manufacturing%20Strategy.pdf April 2016; https://site.rapdasa.org/what-is-rapdasa/ , accessed 14 July 2018

An important driver of local acceptance of this technology appears to be the efforts of the Rapid Product Development Association of South Africa (RAPDASA).[84] RAPDASA is a non-profit organisation that represents all facets of what it refers to as the Additive Manufacturing (3D printing) sector, from idea or concept to design, prototype development, manufacturing and even commercialisation. RAPDASA aims to create awareness of the potential of 3D printing technologies in South Africa and stimulate its use in the manufacturing industry.

Another important role player locally is the Centre for Rapid Prototyping and Manufacturing (CRPM) which is located at the Central University of Technology of the Free State in Bloemfontein. It was established as part of a research initiative and was the first establishment in South Africa to receive ISO accreditation for the 3D printing of medical devices.[85] It is extensively involved in research in the 3D printing technologies field and offers 3D printing services with a focus on articles intended for medical application. It also has as its aim to expand the application of the technology in the South African manufacturing industry.

Indeed, there has been significant development in the 3D printing technology field in South Africa. South Africa has a large, sophisticated metals industry which represents roughly a third of its manufacturing industries.[86] It is within this industry, that South Africa has become a leader in the development and utilization of 3D printing technologies through what has become known as the Aeroswift project.

The CSIR and Aerosud Innovation Centre (Pty) Ltd, a South African aeronautical engineering and manufacturing company, [87] have developed an advanced 3D printer for producing metal components as part of project Aeroswift. The Aeroswift printer was designed with the specific aim of printing titanium aircraft parts from titanium powder. The CSIR developed a novel process whereby titanium metal powder can be produced from the mineral, and which

[84] 83 supra
[85] http://www.crpm.co.za/#portfolio , accessed 14 July 2018
[86] https://www.brandsouthafrica.com/investments-immigration/business/economy/sectors/manufacturing-in-south-africa *Manufacturing in South Africa* 20 June 2017, accessed 16 July 2018
[87] https://www.aerosud.co.za/ ; Aerosud is an established supplier to major aircraft manufacturers including Airbus and Boeing. Accessed 14 July 2018

powder is then used by the printer. The Aeroswift printer is now reported to be the biggest, state-of-the-art 3D printer in the world.[88] The Aeroswift project, funded by the Department of Science and Technology, has since produced three titanium parts for the South African developed AHRLAC aircraft as well as one for a commercial aircraft.[89]

According to reports, apart from being the largest of its kind in the world, the Aeroswift printer is ten times faster than any other laser melting machine currently available globally and will start printing parts for both The Boeing Company and Airbus SE in 2019.[90]

Through the success of this project, South Africa has achieved the ability to add value to one of its metal resources prior to export, bolstering the value chain of a single resource and increasing both its competitive advantage and financial gain from this resource.

In addition to use in and application on an industrial scale, desktop 3D printers are also available for sale in South Africa. So, too, 3D scanners, software for creating 3D designs and all materials required are available locally through companies such as Rapid 3D,[91] 3D Printing Factory's 3D Printing Store,[92] and 3D Printing Systems South Africa[93] amongst others.

In fact, the first 3D printed mechanical hand, the so-called "robohand" was created by a South African, Rich van As, who lost fingers on his right hand in a woodworking accident. van As could not afford a prosthetic hand and this led him to design and co-create the robohand which is still in distribution today.[94] In his searches to improve the quality of the robohand, van As also went on to establish a South African company that manufactures 3D printers locally, Robobeast (Pty) Ltd.[95] Robobeast printers come in various sizes and the company can even make custom-built printers to a client's specifications.

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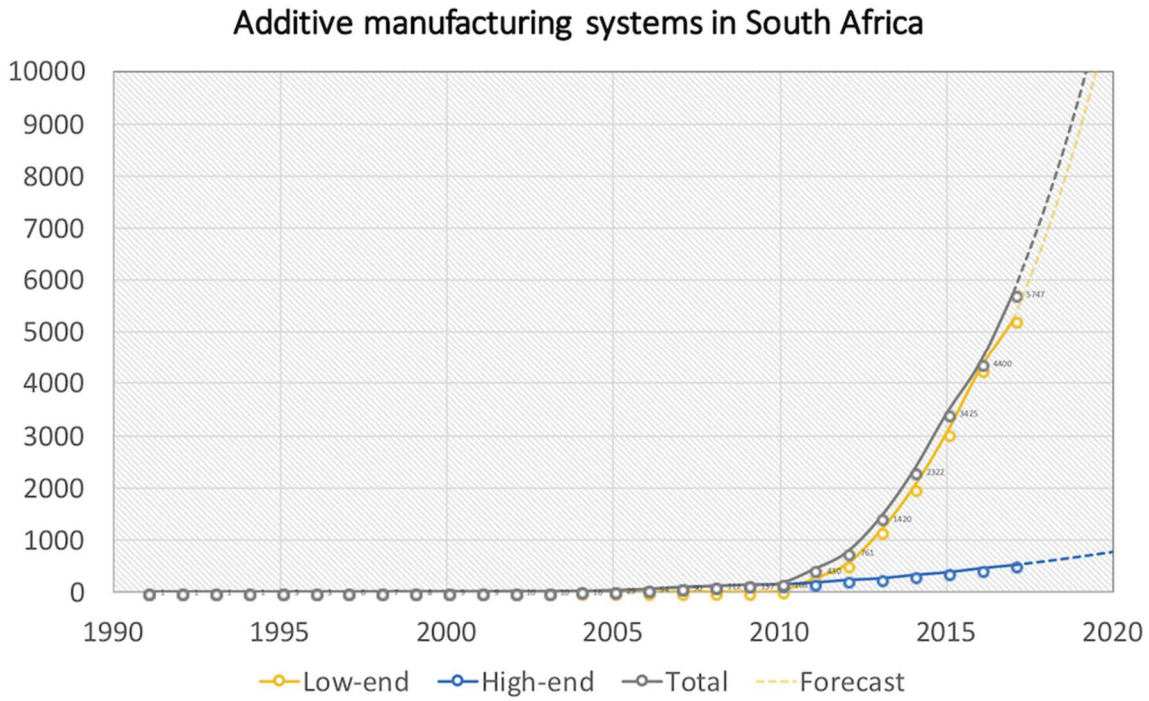
[88] https://www.thesouthafrican.com/aeroswift-biggest-3d-printer/ *Aeroswift: The biggest, state-of-the-art 3D Printer in SA* Erene Oberholzer, 1 Augustus 2018, , accessed 15 September 2018
[89] https://www.csir.co.za/project-aeroswift , accessed 14 July 2018
[90] 88 supra
[91] https://www.rapid3d.co.za/ , accessed 15 July 2018
[92] http://www.3dprintingstore.co.za/ , accessed 15 July 2018
[93] https://3dprintingsystems.co.za/ , accessed 15 July 2018
[94] http://robobeast.co.za/rich-van-as/; https://www.fin24.com/Finweek/Entrepreneurs/how-3d-printing-gave-a-craftsman-his-hand-back-20151116 *How 3D printing gave a craftsman his hand back* Shandukani Mulaudzi, 16 November 2015, accessed 14 July 2018
[95] http://robobeast.co.za/ , accessed 14 July 2018

RAPDASA's records indicate that there were approximately 5,700 3D printing machines in South Africa in 2018[96] and that system sales surged between 2015 and 2018. Below is a graph taken from a presentation on the global trends and South African opportunities in the 3D printing sector by RAPDASA:[97]



Interestingly, approximately 94% of all machines sold in South Africa fall within what is considered to be the low cost category (under US$5,000).[98]

In addition, there are many local 3D printing service providers such as Rapid 3D Parts,[99] which offers 3D printing and scanning services and has centres in Johannesburg, Cape Town and Pietermaritzburg, offering country-wide service. 3D Forms[100] and 3D Print Tech,[101] are further

[96] https://site.rapdasa.org/additive-manufacturing-in-south-africa/, accessed 14 July 2018
[97] https://site.rapdasa.org/wp-content/uploads/2017/02/Additive-Manufacturing-Global-Trends-and-SA-Opportunities.pdf Additive Manufacturing: Global trends and South African opportunities, May 2017, accessed 14 July 2018
[98] https://site.rapdasa.org/additive-manufacturing-in-south-africa/ , accessed 14 July 2018
[99] https://www.rapid3dparts.co.za/ , accessed 15 July 2018
[100] http://www.3dforms.co.za/ , accessed 15 July 2018
[101] https://www.3dprinttech.co.za , accessed 15 July 2018

examples, the latter also being a local online design repository. These services are available to anyone with internet access and the materials that are available for printing through these service providers include various plastics, resins, metal, rubber, sand casting, wax, nylon and paper.

The earlier referenced Maker Movement is also present in South Africa. A study[102] by the Open African Innovation Research network (OpenAIR[103]) looking at over twenty Maker Spaces across all the provinces in South Africa confirmed the use of 3D printers in all but three of these facilities. It further confirmed that many of these communities are embedded in formal institutions, such as Universities, Industry Technology Hubs and even Government Organisations.[104]

A few examples of local Maker Spaces include The Maker Space[105] headquartered in Durban which also offers an online 3D printing service, MakerLabs[106] in Johannesburg and Maker Station[107] in Cape Town. The latter, for example, collaborates with the University of Stellenbosch's Idea2Product Lab.

South Africa is therefore already extensively actively engaged in 3D printing technologies. Not only is the technology being used and applied at both industrial, educational and consumer level, it is also being developed and enhanced here and innovation appears to be evolving at about the same pace as those in advanced economies.

3.2 THE NATIONAL POSITION

Given the relevance of 3D printing technologies and, in particular, the role it is destined to play in the Fourth Industrial Revolution, it follows that the technology cannot be ignored and,

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[102] http://www.openair.org.za/wp-content/uploads/2018/02/WP-9-A-Scan-of-South-Africas-Maker-Movement.pdf *A Scan of South Africa's Maker Movement* de Beer, Armstrong, Ellis and Kraemer-Mbula 21 December 2017 pp 22-24, accessed 15 September 2018
[103] http://www.openair.org.za/ , accessed 15 September 2018
[104] 102 supra p.29
[105] http://themakerspace.co.za/ , accessed 15 September 2018
[106] http://makerlabs.co.za/ , accessed 15 September 2018
[107] http://makerstation.co.za/ , accessed 15 September 2018

in my view, requires strategic engagement at governmental level to ensure that potential benefits are garnered timeously and with maximum effect. In this regard, RAPDASA expressed the need for South Africa to have what it called a Rapid Manufacturing Roadmap.[108] This led to the Department of Science and Technology commissioning a South African Additive Manufacturing Strategy that was formulated and released in 2016 ("the AM Strategy").[109]

The AM Strategy recognises the role 3D printing technologies can play in supporting the South African government's plans to grow and diversify the economy. It is stated that the AM strategy is intended to support the implementation of national policy such as the National Development Plan.[110] The need for South Africa to invest strategically not only in the technology but also in local skills development and scientific and technological infrastructure as well as to encourage the adoption of such technologies, is also acknowledged in the AM Strategy.

A number of promising market applications have been identified for 3D printing in South Africa in the AM Strategy.[111] It specifically refers to South Africa's abundant mineral reserves and highlights the titanium mineral reserves and the benefication of these resources through the manufacturing of aerospace and medical parts.[112]

Alongside the AM Strategy, the Department of Trade and Industry has released Phase I of the Intellectual Property Policy of the Republic of South Africa ("the IP Policy").[113] According to the IP Policy, although South Africa has made substantial progress in the protection, administration, management, and deployment of intellectual property, comprehensive policy is needed to promote and contribute to the country's socio-economic development. The IP Policy proposes key reforms that are aimed at advancing South Africa's socio-economic

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[108] South African Journal of Industrial Engineering August 2015 Vol 26(2) pp 85-92 *Implementing The South African Additive Manufacturing Technology Roadmap – The Role Of An Additive Manufacturing Centre Of Competence* W Du Preez and D De Beer available at http://www.nstf.org.za/wp-content/uploads/2016/03/Additive-Manufacturing-Roadmap.pdf , accessed 14 July 2018

[109] https://www.dst.gov.za/images/2018/Additive%20Manufacturing%20Strategy.pdf , accessed 14 July 2018

[110] See 116 below

[111] 109 supra, examples on p.34 onward

[112] 109 supra pp.26 - 30

[113] https://www.thedti.gov.za/news2018/IP_Policy2018-Phase_I.pdf Intellectual Property Policy of the Republic of South Africa Phase I 2018 , accessed 16 September 2018

development objectives as outlined in key policy documents of the national government such as the National Development Plan. [114]

The overarching objective of the IP Policy is expressed as ensuring that the policy becomes a just, balanced, and integral part of the broader development strategy for South Africa by assisting in transforming the South African economy through the promotion of local manufacture, generating more employment, utilising and preserving the country's resources, encouraging innovation and empowering domestic stakeholders to take advantage of the intellectual property system.[115] Phase 1 of the policy focuses on two issues, namely, intellectual property and public health on the one hand, and international cooperation on the other. It does not address technological advances or the handling of current disruptive technologies.

The National Development Plan[116] calls for a greater emphasis on innovation, improved productivity, an intensive pursuit of a knowledge economy as well as the better exploitation of comparative and competitive advantages.[117] It is recognised that, as a small open economy, South Africa can develop niche products for example, through the development and manufacture of goods for use in the mining industry, where South Africa has substantial expertise and know-how. Capturing a small share of global demand in areas where local firms can compete can have a big impact and would make an important contribution to industrialisation in a global niche market.[118]

In the National Development Plan, intellectual property is stated to be an important policy instrument in promoting innovation, technology transfer, research and development,

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[114] 113 Supra p.4
[115] 113 Supra
[116] The National Development Plan of South Africa is a national policy document that aims to eliminate poverty and reduce inequality by 2030. It was drafted by the National Planning Commission appointed by President Jacob Zuma. https://www.gov.za/sites/default/files/Executive%20Summary-NDP%202030%20-%20Our%20future%20-%20make%20it%20work.pdf *National Development Plan 2030 Our Future Make It Work* Executive Summary released by the National Planning Commission, Department of The Presidency of South Africa, accessed 16 September 2018
[117] 116 supra p.3
[118] 116 supra

creative expression, consumer protection, industrial development and more broadly, economic growth.[119]

Thus, the AM Strategy, encouraging the adoption of 3D printing technologies in South Africa and its wide exploitation with reference to the potential benefits, has been drafted to support the National Development Plan and in particular the aim of growing and diversifying the economy. So, too, has the IP Policy been drafted to support the National Development Plan, which support it is intended to provide through reforms of South Africa's Intellectual Property Laws to enable a knowledge based economy. It becomes apparent that it is critical for these policy documents to coincide if they are to achieve the same goal. It also appears as though the IP Policy, and in particular the Phases still to come, will play an important role in finding that delicate balance of fulfilling the Policy's role in driving the economy forward. The IP Policy will have to pave the way for the socio-economic benefits of these technologies to be garnered but at the same time counter act the potentially severe socio-legal impact that is bound to flow from a technology that enables uncontrolled proliferation of infringement of copyright in this country.

CHAPTER 4: COPYRIGHT IN SOUTH AFRICA

4.1 INTRODUCTION TO SOUTH AFRICAN COPYRIGHT LAW

Copyright is a form of intellectual property. As property, it is protected by the most supreme law of South Africa, being the Constitution.[120] Section 25[121] of the Bill of Rights in the Constitution provides that:

> *"No one may be deprived of property except in terms of law of general application, and no law may permit arbitrary deprivation of property"*

[119] 116 Supra
[120] The Constitution of South Africa 1996
[121] Section 25(1)

Currently, copyright law in South Africa is governed by the Copyright Act no. 98 of 1978 ("the Copyright Act").

Copyright is a statutory right which vests automatically provided certain conditions are met. There are no formality requirements and there is no copyright registration process in South Africa.[122] This means that, once a work has been created and exists in material form, questions regarding copyright subsistence and ownership inevitably arise.

In summary, copyright grants to its owner the exclusive right to exploit the copyright work in certain specific manners. Reserving those acts of exploitation for the copyright owner allows the copyright owner to benefit commercially from the copyright work.

The grant of copyright protection is based on the *quid pro quo* principle, namely that the State will grant an exclusive right to the creator or innovator which will allow a commercial advantage to be gained in return for some benefit to accrue to the public. In the case of copyright, the benefit to the public is giving the public access to the copyright work, so as to enable the public to derive enjoyment and benefit from such access.[123]

4.2 SUBSISTENCE OF COPYRIGHT

The Copyright Act confers copyright on works[124] that are eligible for copyright protection and defines works to be so eligible if they are original,[125] and have been reduced to material form.[126]

The first requirement, namely that of originality, is a basic copyright law principle. In South Africa, to determine whether a work is original, reference is had to what is typically referred to as the "sweat of the brow" test. What is required, is for the author to have expended his

[122] With the exception of cinematograph films that can be registered for evidentiary purposes in terms of the Registration of Cinematograph Films Act 62 of 1977
[123] The Law of South Africa Third Edition Volume 10 par. 98
[124] By virtue of Sections 3, 4 or 5
[125] Section 2(1)
[126] Section 2(2)

or her own intellectual or creative labour, skill and effort.[127] The work need not be new or inventive nor is it necessary that the work is expressed in a form which is novel or without precedent.[128] The work should emanate from the author himself and should not be blatantly copied from an earlier work.[129]

Furthermore, a work shall not be ineligible for copyright protection by reason only that the making of the work involved an infringement of copyright in some other work.[130] Therefore, even if the making of a work infringes the copyright of others, it may still be protected by copyright itself if sufficient skill and effort went into its creation.

If a work is eligible for copyright protection, copyright is conferred if the work was made under the direction and control of the State,[131] the author is a qualified person[132] or with reference to the country of origin of the work.[133]

The Copyright Act[134] states that the Minister of Trade and Industry may, by notice in the *Government Gazette*, provide that any provision of the Copyright Act may apply to works first published in specified countries, or to works where the authors are citizens of specified countries, in the same manner as it applies to South Africa. Therefore, when considering the eligibility of works to enjoy copyright protection, it must be borne in mind that copyright in South Africa can also be conferred on foreign works and their authors.[135]

4.3 CATEGORIES OF WORKS PROTECTED

The Copyright Act specifies the types of works that are eligible for copyright protection namely literary, musical and artistic works, cinematograph films, sound recordings, broadcasts,

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[127] *Appleton v Harnischfeger Corporation* [1995] 2 All SA 693 (A); *Moneyweb (Pty) Limited v Media 24 Limited and Another* 2016 (4) SA 591 (GJ)
[128] The Law of South Africa Third Edition Volume 10 par. 125
[129] *Appleton v Harnischfeger Corporation* [1995] 2 All SA 693 (A); *Haupt t/a Softcopy v Brewers Marketing Intelligence (Pty) Ltd* 2006 (4) SA 458 (SCA)
[130] Section 2(3)
[131] Section 5(2)
[132] Section 3(1)
[133] Section 4(1)
[134] Section 37(1)
[135] The Law of South Africa Third Edition Volume 10 Par. 132

programme-carrying signals, published editions and computer programs.[136] Only three are highlighted here for their relevance, being literary works, artistic works and computer programs.

Literary works are defined to include,[137] amongst other works, tables and compilations, including those of data stored or embodied in a computer or in a medium used in conjunction with a computer, irrespective if their literary quality and in whatever mode or form expressed.

Artistic works include, irrespective of the artistic quality thereof:[138]

(a) paintings, sculptures, drawings, engravings and photographs;
(b) works of architecture, being either buildings or models of buildings; or
(c) works of craftsmanship, not falling within either paragraph (a) or (b).

The Copyright Act defines a computer program[139] as a set of instructions fixed or stored in any manner and which, when used directly or indirectly in a computer, directs its operation to bring about a result.

4.4 AUTHORSHIP AND OWNERSHIP

The Copyright Act comprehensively defines the term "author" according to the category of work concerned.[140]

In relation to a literary or artistic works, the word "author" bears its ordinary meaning, which is the maker or creator of the work. In relation to a computer program, the author is the person who exercised control over the making of the computer program.

[136] Section 2(1)
[137] Section 1
[138] Section 1
[139] Section 1
[140] Section 1

The Copyright Act also recognises that a literary or artistic work or a computer program may be computer-generated. In that case, the author is the person who undertakes the necessary arrangements for the creation of the work.

Ownership of any copyright vests in the author or co-authors of a work[141] except if one of the four specified exceptions apply.[142] The exceptions relate to employment relationships, a limited number of commissioned works or a contractual arrangement which excludes the application of any exception.

4.5 INFRINGEMENT AND EXCEPTIONS TO INFRINGEMENT

4.5.1 Infringement

The Copyright Act provides for two forms of infringement, namely direct infringement and indirect infringement. Simply put, direct infringement occurs when someone does or causes one of the acts that have been reserved for the copyright owner to be done without the authorisation of the copyright owner.[143] Indirect infringement is when the infringer, although not actually committing any of those acts, is involved in certain specified acts in relation to works which he knows infringe copyright or would infringe copyright if the article concerned had been made in the Republic.[144] So-called "guilty knowledge" is required.

Each category of copyright work has its own set of exclusive acts that only the copyright owner may perform in relation to that work.

In respect of a literary[145] or artistic works, [146] the exclusive acts include the right to reproduce the work, to make an adaptation thereof and to make the first publication thereof. The same exclusive rights are provided for in respect of a computer program.[147]

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[141] Section 21(1)(a)
[142] Section 21(1)(b) to 21(1)(e)
[143] Section 23(1)
[144] Section 23(2); The Law of South Africa Third Edition Volume 10 Par. 141
[145] Section 6
[146] Section 7
[147] Section 11B

It follows that any person who does or causes any other person to do any of the exclusive acts without the authority or licence of the copyright owner will infringe the copyright in the work. In respect of each category of work, the right to reproduce (copy) or adapt the work, has been reserved for the copyright owner.

Adaptation is defined in the Act.[148] In respect of an artistic work, adaptation includes a transformation of the work in such a manner that the original or substantial features thereof remain recognisable.

The Copyright Act provides that the doing of any act in relation to a copyright work shall be construed as a reference to the doing of any such act in relation to a substantial part of the work.[149] This means that infringement also occurs where there has been copying of a substantial portion of the work. As to what, in fact, constitutes a "substantial part" of a work, the South African Courts have held that it depends more on the quality of the portions taken than how much of the work was taken.[150]

Furthermore, it does not matter whether copying is direct, where the original work itself is copied, or is indirect, where an intervening copy of the original work is copied. This results from the definition of "reproduction"[151] which states that the act of reproduction includes a reproduction made from a reproduction of the original work.

Insofar as the meaning of reproduction otherwise is concerned, in the case of artistic works, the Copyright Act provides that reproduction occurs when a version of a work is produced by converting the work into a three-dimensional form if it is in two dimensions or, if it is in three dimensions, by converting it into a two-dimensional form.[152]

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[148] Section 1
[149] Section 1(2A)
[150] *Galago Publishers (Pty) Limited and Another v Erasmus* 1989 (1) SA 276 (A); *Moneyweb (Pty) Limited v Media 24 Limited and Another* 2016 (4) SA 591 (GJ)
[151] Section 1
[152] Section 1

Indirect infringement essentially amounts to the dealing in infringing copies or articles and includes in relation to such infringing matter, their importation, sale, distribution for purposes of trade or for any other purpose prejudicially affecting the copyright owner; or acquiring an article relating to a computer program, whilst having the required guilty knowledge.[153]

4.5.2 Exceptions

A finite list of exceptions to copyright infringement are provided in the Copyright Act[154] and they constitute so-called "fair dealing" exceptions. The exceptions include the fair dealing with works for purposes of research or private study, personal or private use, criticism or review, reporting on current events, judicial proceedings, quotation and illustration for teaching. The Copyright Act does not provide a definition for fair dealing.

Due to the *numerus clauses* of exceptions and the relative scarcity of copyright infringement cases in South Africa, the principle of fair dealing has not enjoyed much attention in local jurisprudence. The two cases that have sought to provide guidance on the interpretation of the concept of fair dealing[155] dealt with exceptions relating to the reporting of news events. In the case of *South African Broadcasting Corporation SOC Ltd v Via Vollenhoven,* the work in question was a documentary (cinematograph) film and the issue of fairness was briefly addressed[156] with the Court stating that it is premised on *bona fide use* of the work and requires a genuine purpose as opposed to a pretext for a purpose. The case of *Moneyweb (Pty) Limited v Media 24 Limited*[157] consulted the criteria as laid down in the case of *Ashdown v Telegraph Group Ltd*[158] but that test was not adopted as such into South African law by the Court. Instead, particular facts relevant to the question of fair dealing were considered that centred around the exception relating to news reporting.

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[153] Section 23(2)
[154] Sections 12 to 19B
[155] *Moneyweb (Pty) Limited v Media 24 Limited and Another* 2016 (4) SA 591 (GJ) and *South African Broadcasting Corporation SOC Ltd v Via Vollenhoven and Appollis Independent CC and Others* [2016] 4 All SA 623
[156] Par. 36
[157] 155 supra
[158] EWHC Ch 28, [2001] 2 WLR 967

If an exception to copyright infringement is raised, the circumstances relied upon have to fall within the specific exceptions provided for and there is no general discretion which a Court can exercise to excuse copyright infringement otherwise. South Africa does not have a general "fair use" exception such as found in the United States. In the case of *South African Broadcasting Corporation SOC Ltd v Via Vollenhoven and others*[159] the Court was asked to acknowledge an implicit exploitation exception and a single copy exception, neither of which it was willing to do, stating that these exceptions do not exist and the Copyright Act does not provide for the inference of exceptions beyond the closed list of permitted use defences.

There is one additional and very relevant defence to copyright infringement in respect of artistic works found in Section 15(3A) of the Copyright Act. This defence, often referred to as the "reverse engineering" defence, provides that copyright in an artistic work of which three-dimensional reproductions were made available to the public by or with the consent of the copyright owner (authorised reproductions) shall not be infringed if any person, without the consent of the owner, makes or makes available to the public three-dimensional reproductions or adaptations of the authorised reproductions, provided the authorised reproductions primarily have a utilitarian purpose and are made by an industrial process.

It must be noted that the revere engineering defence is not subject to the requirement of fairness. A key requirement of the reverse engineering defence, on the other hand, is the fact that the article in question must have a primarily utilitarian purpose. The requirement is not that it must be exclusively utilitarian, but primarily so. Naturally, complex questions can arise in the case of articles that possess both functional and aesthetic features. In the case of *Bress Designs (Pty) Ltd v GY Lounge Suite Manufacturers (Pty) Ltd and Another*[160] the Court held that an "M" shaped sofa, whilst having extraordinary aesthetic features, was primarily utilitarian. In so finding, the Court stated that the test is an objective one and the maker's intentions are irrelevant to the question.

[159] [2016] 4 All SA 623
[160] 1991 (2) SA 455 (W)

Provided all of the criteria of the reverse engineering defence are met, it does not amount to copyright infringement to reproduce three-dimensional functional articles the unauthorised reproduction of which would otherwise have amounted to infringement.

4.6 ENFORCEMENT

Copyright is enforceable by the copyright owner, the exclusive licensee, or exclusive sub-licensee.[161]

The available remedies in civil proceedings include an interdict, delivery of infringing copies or plates used or intended to be used for infringing copies, and damages.[162] *In lieu* of damages, it is possible to claim a reasonable royalty which would have been payable by a licensee in respect of the work or type of work concerned.[163]

An order for delivery-up can be requested in respect of infringing copies, as well as plates used or intended to be used for infringing copies.

"Plates" are defined in Section 1 as including any stereotype, stone, block, mould, matrix, transfer, negative, record, disc, storage medium or any version of a work of whatsoever nature used to make copies.

In *Nu Metro Filmed Entertainment (Pty) Ltd And Others V Mr Video (Pty) Ltd And Others*[164] the Court, in applying the deeming provision in the definition of infringing copy, held certain DVD's to infringe the copyright of the applicants and ordered that all infringing copies in the possession or under the control of the respondents be delivered up to the applicants. The Court held that the relief was necessary in the circumstances of the case to safeguard the rights and interests of the applicants as holders of the copyright in the relevant films. In granting the delivery up relief, the Court took into account the difficulty the applicants faced

[161] S 25(1)
[162] S 24(1)
[163] S 24(1A)
[164] 2008 BIP 317 (C); The Law of South Africa Third Edition Volume 10 par. 173

in monitoring and enforcing the interdict as well as the respondents' opposition to the order for delivery up, which the Court found indicated an intention to continue dealing in the infringing copies. On appeal, the Supreme Court of Appeal[165] upheld the order for delivery up.

4.7 SA COPYRIGHT LAW APPLIED TO 3D PRINTING TECHNOLOGIES – WHAT IS OR COULD BE PROTECTED

4.7.1 Authorship

In the 3D printing process, the printing itself is done by a machine. Rendering a digital model from an existing article by using a scanning process, leads to the creation of a digital artistic work by a machine. A natural consequence of the process of 3D printing is therefore that human authors are excluded in certain circumstances.

The question of who, or what, created a work is relevant both to the issue of authorship as well asto infringement. It is submitted that the definition of "computer generated" work in the Act[166] is sufficient to identify the person responsible for making the relevant work concerned. A factual enquiry to determine who was responsible for making the arrangements for the creation of the work will therefore identify the author of a computer generated work.

4.7.2 Prior to printing

As explained in paragraph 2.4 above, 3D printing can only take place once a digital three-dimensional model of the object exists. Referred to as the digital model or digital blue print, this work will necessarily be in electronic format.

The digital blue print can be obtained either through original creation or following a process in which an existing article is scanned. Where a pre-existing article is used to create the digital

[165] *Mr Video (Pty) Ltd and Others v Nu Metro Filmed Entertainment (Pty) Ltd and Others* [2010] 2 All SA 34 (SCA)
[166] Section 1

model, it is possible that the pre-existing article (for instance, in the case of a work of craftsmanship or sculpture) or the underlying drawings of the article, could be protected by copyright.

Creating the blue print itself will give rise to another work that may be eligible for protection. It is possible that the digital blue print could qualify for protection as either a literary work or, and perhaps more likely, as an artistic work, even if it infringes an earlier work. If a scanning process is used, it is also possible that the work created can be categorised as computer-generated.

4.7.3 The printing process

The first step in the printing process, is what is referred to as "slicing". This is where computer instructions are added to the digital blue print. These instructions can in certain circumstances be very complex and detailed and require significant intellectual skill and effort to compile. The printer, or rather the printer's computer, requires these instructions to be able to print the object.

The question arises as to whether the slicing process creates a work that may qualify for protection as a computer program. The latter is defined as a set of instructions fixed or stored in any manner and which, when used directly or indirectly in a computer, directs its operation to bring about a result.[167] My view is that, in the absence of a *sui generis* definition of any such copyright work, the work (instructions) created during the slicing process should qualify as a computer program provided it is sufficiently original. An alternative could be to classify the work as a literary work.

4.7.4 After printing has been completed

The 3D article would have been made from the digital drawing, or the 3D printed article would constitute a reproduction of a scanned article. Therefore, once the article has been printed,

[167] Definition of computer programme in Section 1

a reproduction of a prior work will necessarily exist. That reproduction could be indirectly protected by virtue of the definition of reproduction in the Copyright Act.[168] In this regard, the unauthorised reproduction of an authorised reproduction of the original work constitutes infringement, as does the making of a two-dimensional work from a three-dimensional article.

4.7.5 Authorship and Ownership of copyright

Given the role played by machines, particularly scanners and printers, during the creation processes, a question can arise as to who was responsible for making the relevant drawings or article involved. This is because, according to the general principles discussed in paragraph 4.4 above, ownership of copyright is determined with reference to authorship but it may be so that no human author was involved. The question is relevant in two contexts, the first being who may lay claim to the copyright that may vest in the work(s) and the second, to determine who carried out the act of reproduction or adaptation, for purposes of infringement.

In my opinion, the question should be relatively easy to answer with reference to the definition of authorship of a computer generated work.[169] In this regard, the person who made the arrangements for the work to be created, would qualify as the author.

4.8 WHICH PARTS OF THE 3D PRINTING PROCESSES COULD CONSTITUTE INFRINGEMENT UNDER SA LAW

4.8.1 Prior to printing

Since digital designs are eligible for copyright protection, mainly as artistic works, any unauthorised reproduction or adaptation of such designs could amount to copyright infringement. Therefore, downloading an existing CAD file from the internet onto a computer, which design has not been made available for reproduction with the authority of

[168] Section 1
[169] Section 1

the copyright owner, may constitute an act of direct infringement. In fact, every time that file is downloaded or stored an act of reproduction and potential infringement occurs (for instance, transferring it from the computer onto which it has been downloaded onto a mobile storage device creates another copy, transferring it from the memory device onto the printer's computer creates another copy).

Modifying that digital design in a manner that the original or substantial features remain recognisable (adapting[170] it), would constitute another act of infringement.

The potential acts of infringement insofar as the digital design is concerned could be broken down even further. If the digital model was made available for reproduction by the copyright owner and with its consent, but the right of adaptation has not also been granted, downloading the file would be lawful but modifying it could amount to infringement.

In the event that the creation of the digital blue print amounts to digitisation of a work that exists in another format, for instance, on paper, if done without the authorisation of the owner of the copyright in the original drawing (artistic work), that would amount to infringement. So, too, rendering the three-dimensional digital model from two-dimensional digital drawings could amount to infringement. The example of architectural drawings would illustrate these scenarios.

Where the digital blue print is created with reference to an existing article, the making of that blue print could amount to copyright infringement if it is unauthorised. As pointed out above, such copyright could exist in the article itself or its underlying drawings. Thus, if drawings, digital or otherwise, or even a direct 3D model, are made with reference to an existing article, the making of the drawings and/or digital model could amount to copyright infringement. Similarly, using a scanning process to create the digital blue print of a pre-existing article, could amount to infringement.

[170] See definition of adaptation of an artistic work in Section 1 of the Copyright Act

4.8.2 The printing process

One of the most significant steps during the printing process is that of slicing. Should the slicing instructions used merely be an unauthorised reproduction or adaptation of a pre-existing set of slicing instructions that is protected by copyright, such unauthorised reproduction or adaptation could amount to infringement.

4.8.3 After printing has been completed

Every printed article is a potential copyright infringement. It would constitute an infringement of the digital blue print in the absence of authorisation for such reproduction. It would also infringe the copyright which can subsists in a number of ways in any pre-existing article or drawings that was used to create the blue print and for which consent has not been obtained.

4.9 LIABILITY FOR INFRINGEMENT

4.9.1 Direct infringement

For purposes of direct infringement, the liability would fall on the person who did, or caused the restricted act to be carried out. In the case of 3D printing, those acts would necessarily be the acts of reproduction and/or adaptation.

4.9.2 Indirect infringement

As already indicated, any person dealing in an infringing article in one of the manners provided for in the Copyright Act is exposed to a claim for indirect infringement, provided that the required guilty knowledge exists.[171]

[171] Par. 4.5 supra

The Copyright Act does not provide for a situation where the alleged indirect infringer ought to have known that the making of the article constituted an infringement and actual knowledge is required.[172]

4.9.3 Contributory infringement

Liability for contributory infringement in the form of inciting, aiding or abetting the commission of a civil wrong is recognised under South African common law.[173] The Supreme Court of Appeal has upheld claims for contributory infringement in respect of trade marks[174] and patents[175] and is therefore likely to accept that such liability also exists in the case of copyright infringement.

4.9.4 Defences

The fair dealing defences, most notably, those of research, private study, personal or private use and illustration for teaching could provide some relief in reducing potential liability for copyright infringement. However, these defences are unlikely to find application in circumstances where the goods manufactured are intended for trade.

In addition, these defences are not likely to be available to the person who makes a 3D printed article from a digital blue print the making of which infringed a pre-existing work. In this regard, it is expected that the criteria of fairness would be difficult to satisfy in circumstances where the infringement is enabled because of an earlier infringement of the original protected by copyright.

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[172] Section 23(2)
[173] *McKenzie v Van der Merwe* 1917 AD 41
[174] *Esquire Electronics Ltd v Executive Video* 1986 (2) SA 576 (A)
[175] *Cipla Medpro (Pty) Ltd v Aventis Pharma SA, Aventis Pharma SA and Others v Cipla Life Sciences (Pty) Ltd and Others 2013* (4) SA 579 (SCA)

The defence likely to be of greatest relevance will be that of reverse engineering in Section 15(3A) of the Act and the liability for infringement claims involving primarily functional articles, in particular, spare parts, is likely very much reduced in light of this defence.

4.10 CONCLUSION

The assessment of the South African copyright law and its application thereof to 3D printing technologies reveals potential shortcomings in the ability of the legislation to provide adequate protection for creations flowing from such new technologies.

The process of slicing, for instance, could lead to the creation of a *sui generis* type of work not yet recognised in the Copyright Act. Given the technical expertise required to ensure successful slicing at least in complicated production, it is envisaged that such slicing instructions could become very valuable and worthy of protection. Such instructions could very well become a type of work from which commercial gain is to be had in exchange for allowing the public to benefit from having access to them.

It is possible that the absence of human authors at certain stages in the process of 3D printing could lead to a *lacuna* for purposes of identifying a person responsible for the making of the work, in particular, for purposes of infringement. However, the existing recognition of computer generated works in the Copyright Act should alleviate any such concern.

The greatest concerns, however, arise from the significant exposure to liability for copyright infringement on the one hand and the proliferation of infringements of copyright owners' rights on the other.

The Copyright Act provides relatively few defences to copyright infringement and no general "fair use" defence, thereby increasing the copyright owner's ability to succeed in an infringement action, but that also increases the exposure to liability for infringement by persons carrying out or enabling 3D printing practices in South Africa. It is submitted that the limited fair dealing exceptions will not encourage participation in 3D printing processes.

On the other hand, the South African Copyright Act does provide a very significant defence for purposes of 3D printing processes in the form of reverse engineering in Section 15(3A) that will be relevant to many industries, but in particular in relation to articles finding industrial application, such as spare parts. One danger of this defence is the fact that it is not subject to the criterion of fairness. It is also not available to articles that are not primarily utilitarian in nature and questions will arise in respect of articles containing both functional and aesthetic features where neither is clearly primarily utilitarian. Designer watches could be one such example. Entities manufacturing functional articles on a large scale and wanting to do so using 3D scanning and printing technologies could view this defence as creating somewhat of a safe haven which could prove attractive and in turn stimulate local investment. However, concerns could be raised over the potential perceived lack of protection for owners of copyright that should protect such articles given that the process of reverse engineering is simplified by these technologies thereby likely to escalate its occurrence.

CHAPTER 5: OVERVIEW OF FOREIGN JURISDICTIONS

5.1 INTRODUCTION

This section seeks to consider commentary by academics in other jurisdictions, relative to the copyright laws of each territory, proposed recommendations and reactions by legislative authorities. Relevant provisions are briefly mentioned at a high level but no in-depth analysis of the copyright laws of these territories has been undertaken.

5.2 UNITED STATES OF AMERICA

This territory has been chosen for its relevance to the technology under discussion, it being the country hosting many of the world's industry leaders in the field, and also because it provides practical examples of infringements and responses thereto.

5.2.1 Brief synopsis of the law

Copyright law in the United States of America ("USA") is governed by the Copyright Act of 1976.[176]

The right of reproduction is reserved for the copyright owner[177] and copyright is infringed,[178] *inter alia*, by anyone who violates any of the exclusive rights of the copyright owner. The right to make an adaptation of a work is also reserved for the copyright owner in Section 106 of the Act which stipulates that only the copyright owner may prepare a derivative work[179] based on the copyright work.

Works of artistic craftsmanship are protected insofar as their form but not their mechanical or utilitarian aspects are concerned. The design of a useful article is considered a qualifying work of artistic craftsmanship only if, and only to the extent that, such design incorporates pictorial, graphic, or sculptural features that can be identified separately from, and are capable of existing independently of, the utilitarian aspects of the article.[180] Purely functional articles are therefore not protected by copyright law in the USA.

The case of *Star Athletica v Varsity Brands*,[181] however, illustrates that the hurdle for overcoming the requirement of independence so that a design of a utilitarian article may be eligible for protection is not necessarily very high. This case involved cheerleader uniforms designed by Varsity Brands and copied by Star Athletica, and a number of 3D printing companies filed a brief in the case supporting the notion that industrial articles (the clothing in this case) should not enjoy protection at all. The Court held that the ultimate question is whether a particular design would have been eligible for copyright protection had it originally been fixed in some tangible medium other than a useful article before being applied to a

[176] United States Copyright Act of 1976, Title 17 of United States Code
[177] Section 106
[178] Section 501
[179] Definition of derivative work in Section 101
[180] Section 101
[181] 580 U.S. ___ (2017)

useful article.[182] If so, it indeed qualifies for protection as was held to be the case with the uniforms.

Insofar as exceptions to copyright infringement are concerned, the USA has a liberal and flexible fair use exception.[183] The fair use exception requires exactly what the name states, that use of a copyright protected work, be fair. Such fairness is determined on the basis of established criteria.

The USA also has fairly old but, by comparison, sophisticated so-called "safe harbour" legislation in the form of the Digital Millennium Copyright Act of 1998 ("DMCA"). The ideology behind safe harbour legislation is that it is intended to provide some relief to copyright owners who will otherwise be hesitant to make their works readily available on the internet given the ease with which digital works can be copied and distributed virtually instantaneously. It is also stated that safe harbour legislation ensures continued growth of the existing off-line global marketplace for copyright works in digital format by setting strong international copyright standards. Simultaneously, by limiting the service providers' exposure to copyright infringement, the efficiency of the internet will continue to improve and the variety and quality of services on the internet will continue to expand.[184]

The DMCA provisions cover every website that allows users to post their own content on it and provides for a process that ensures the swift removal of alleged infringing content, known as the "takedown" process. The takedown process requests of an Internet Service Provider ("ISP") or search engine operator to remove or disable access to illegal or outdated information and is predominantly used in circumstances of alleged copyright infringement.[185] Under the provisions of the DMCA, if a rights holder sees something on a website it believes to be infringing, a takedown notice is sent to the website operator, usually the ISP, in which the works must be identified and a good-faith belief of infringement must be sworn under oath. The operator then removes the content and sends an email to the user. The user can

[182] par. B2
[183] Section 107
[184] http://digital-law-online.info/lpdi1.0/treatise33.html, accessed 22 September 2018
[185] https://searchcontentmanagement.techtarget.com/definition/take-down-request

either agree with the allegation, or simply choose not to challenge it in which case the content will not be restored. Alternatively, if the validity of the claim is challenged, a counter-notice is issued which the website relays to the complainant and the works can then be restored. The only option then is for litigation to follow and, if it does, it will be between the rightsholder and the user. In other words, the website operator does not have to become involved in disputes over infringements at all and is also absolved from any liability.

Despite the occurrence of infringing acts through 3D printing processes, research for this thesis did not reveal any 3D printing specific case law to date in the USA. It would seem as though the takedown procedure may have played some role in this. Thingiverse received its first takedown request in 2011 in respect of a 3D model for an optical illusion called a "Penrose triangle".[186] The design was removed but the situation led to widespread public outcry, turning on questions over the originality of the work in the first place, and the monopolisation of an optical illusion. The original design was subsequently made public as a result of public pressure, but by the complainant author himself.

Thingiverse also found itself amidst a dispute between a designer who had published her works on Thingiverse and an eBay store which she discovered was selling 3D printed copies of one of her 3D models despite that model carrying a Creative Common Attribution Non-Commercial licence, meaning it could be copied but not sold.[187] Again, there was ferocious reaction from the maker community, supported by Thingiverse itself which released a statement that the conduct was "*unequivocally a violation of the principles of what Thingiverse as a 3D model sharing platform stands for, not to mention the spirit of the CC licenses*". The conduct of the alleged infringer was also in violation of the Thingiverse Terms of Use.[188] The dispute reached a boiling point which resulted in the store being suspended by eBay Inc. and the owners of the store chose to pursue defamation lawsuits against, *inter alia*, Stratasys (the owner of Thingiverse), which it ultimately lost.

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[186] https://www.publicknowledge.org/files/What's%20the%20Deal%20with%20Copyright_%20Final%20version2.pdf *What's the Deal with Copyright and 3D Printing?* Michael Weinberg, January 2013 p.6, accessed 22 September 2018

[187] https://3dprint.com/121262/makerbot-responds-to-jpi/ *MakerBot Responds to Shady eBay Store Selling Thingiverse Users' 3D Models* Scott J Grunewald, 24 February 2016, accessed 23 September 2018

[188] 187 Supra

In 2017, Disney Inc. filed a takedown notice with Thingiverse to effect the removal of a few Star Wars models. The user responsible for the publication of the relevant model designs did not dispute the actions taken by Disney and instead stated "*I took someone else's trademarks and used them without authorization. I took that risk, and the maker community spent 18 months printing my models*".[189]

The DMCA also provides for the preservation of technological protection measures.[190] This is in accordance with the WIPO Copyright Treaty of 1996 which obliges contracting parties to provide legal protection against the circumvention of technological protection measures.[191] Technological protection measures are means by which copyright owners seek to prevent the unauthorised exploitation of their works, such as encryption technologies or password systems. An example relevant to 3D printing processes, would be Disney Inc.'s technology for creating merchandise with a material that resists scanning through light distortion.[192]

5.2.2 Commentary

The USA is undoubtedly a front-runner in the 3D printing technologies field having most of the industry leaders that have embraced this technology and are extending its frontiers. Then President, Barak Obama, acknowledged the role of 3D printing technologies in the 2013 State of the Union address:[193]

"*Our first priority is making America a magnet for new jobs and manufacturing.*

After shedding jobs for more than 10 years, our manufacturers have added about 500,000 jobs over the past three. Caterpillar is bringing jobs back from Japan. Ford is bringing jobs back

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[189] https://all3dp.com/disney-pulls-star-wars-models-from-thingiverse/ *Disney Pulls Star Wars Models From Thingiverse: An Inside Look at Copyright Issues in the 3D Space* Tyler Koslow, 12 November 2017, accessed 23 September 2018
[190] Section 1201
[191] Article 11
[192] https://www.theregister.co.uk/2017/06/15/disney_fights_counterfeiting/ *Disney mulls Mickey Mouse magic material to thwart pirates' 3D scans* Thomas Claburn, 15 June 2017, accessed 23 September 2018
[193] https://obamawhitehouse.archives.gov/blog/2013/02/13/president-obamas-2013-state-union , accessed 22 September 2018

from Mexico. After locating plants in other countries like China, Intel is opening its most advanced plant right here at home. And this year, Apple will start making Macs in America again.

There are things we can do, right now, to accelerate this trend. Last year, we created our first manufacturing innovation institute in Youngstown, Ohio. A once-shuttered warehouse is now a state-of-the art lab where new workers are mastering the 3D printing that has the potential to revolutionize the way we make almost everything."

Michael Weinberg,[194] author of a number of whitepapers on 3D printing warns against crippling the technology through restrictive intellectual property laws.[195] He holds a strong view that the benefits of widespread access to the technology outweighs any call for increased protection in the USA.[196] He comments that contract law can provide robust, flexible, and enforceable protection as needed.[197]

The US Copyright Office has been conducting a study on the efficacy of the safe harbor laws provided for in the DMCA. The system has come under criticism for facilitating large-scale unsubstantiated takedown requests and the effect that the system has on online freedom of speech and expression.[198] Makerbot and Shapeways have expressed concerns that the system is not functioning optimally due to the submission of service providers to overly broad and aggressive takedown requests.[199] The Copyright Office has recognized that adjustments

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[194] General Counsel at Shapeways

[195] https://www.publicknowledge.org/files/docs/3DPrintingPaperPublicKnowledge.pdf *It Will Be Awesome If They Don't Screw It Up: 3D Printing, Intellectual Property, and the Fight Over the Next Great Disruptive Technology* Michael Weinberg, November 2010 p.2, accessed 22 September 2018

[196] https://www.publicknowledge.org/files/docs/3DPrintingPaperPublicKnowledge.pdf *It Will Be Awesome If They Don't Screw It Up: 3D Printing, Intellectual Property, and the Fight Over the Next Great Disruptive Technology* Michael Weinberg, November 2010 p.15, accessed 22 September 2018

[197] https://www.shapeways.com/blog/wp-content/uploads/2016/05/white-paper-3d-scanning-world-without-copyright.pdf *3d Scanning: A World Without Copyright* Michael Weinberg, May 2016 p.15, accessed 22 September 2018

[198] http://boingboing.net/2016/03/30/landmark-study-on-the-effects.html *Landmark Study on the Effects of Copyright Takedown Abuse on Online Free Expression* Cory Doctorow, 30 March 2016, accessed 22 September 2018

[199] https://www.shapeways.com/wordpress/wp-content/uploads/2017/02/Kickstarter-et-al-512-second-comment-as-filed.pdf *'In the Matter of Section 512 Study: Notice and Request for Public Comment Docket No. 2015-7'* Kickstarter, Makerbot, Meetup, and Shapeways, 22 February 2017, accessed 22 September 2018

will likely need to be made to the safe harbour provisions but the nature of the adjustments are not clear. [200]

There have also been calls from some within the 3D printing industry, for the circumvention of technological protection measures to be once again legalised. This has, however, been resisted by the likes of Stratasys and intellectual property owners.[201]

5.3 UNITED KINGDOM

The United Kingdom ("UK") has been chosen for the similarity of its copyright provisions to those in South Africa and the guidance South African Courts often take from UK decisions.

5.3.1 Brief synopsis of the law

Copyright in the UK is governed by the Copyright, Designs and Patents Act, 1988. The Act reserves for the copyright owner,[202] *inter alia*, the acts of copying and making adaptations of a copyright protected work. However, the right to make an adaptation of a work is only granted in respect of literary, dramatic or musical works.[203] Artistic works are therefore not protected against adaptation.

In relation to an artistic work, copying is defined[204] as including the making of a copy in three dimensions of a two-dimensional work and the making of a copy in two dimensions of a three-dimensional work.

Copyright in a work is infringed by a person who, without the licence of the copyright owner does, or authorises another to do, any of the acts restricted by the copyright, in relation to the work as a whole or any substantial part of it, either directly or indirectly, and it is

[200] https://copyright.gov/policy/section512/ Section 512 Study, accessed 24 September 2018
[201] https://eprints.qut.edu.au/96839/1/96839.pdf *Makers Empire: Australian Copyright Law, 3d Printing, And The 'Ideas Boom'* Prof. Matthew Rimmer p.40, accessed 24 September 2018
[202] Section 16
[203] Section 21
[204] Section 17

immaterial whether any intervening acts themselves infringe copyright.[205] Secondary infringement is also provided for.[206]

Several exceptions[207] are provided for including fair dealing provisions and purpose-specific exceptions. In particular, it is not an infringement of any copyright in a design document or model recording or embodying a design for anything other than an artistic work or a typeface to make an article to the design or to copy an article made to the design.[208]

There appears to have been no 3D printing specific case law in the UK to date but many academic publications in the field exist and some debate has taken place,[209] in particular, over the nature of CAD files and whether they should enjoy protection under copyright as literary works, artistic works, computer programs, or, in fact, at all. The question is relevant, given the exception referred to above.

The case of *Lucasfilm Limited and others v Ainsworth and another*[210] has been cited[211] as support for the deduction from the current legal position in the UK, that a three-dimensional object which comes into being from a CAD file or other design document does not infringe copyright if the CAD file or model embodying the design is used to create an object for anything other than an artistic work.

The *Lucasfilm* case concerned copyright in various artefacts made for use in the first Star Wars film. The most important of these was the Imperial Stormtrooper helmet, the purpose of which was to be worn as an item of costume in a film, to identify a character but also to portray, in an artistic manner, something about that character.[212] The Respondent, Mr

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[205] Section 16
[206] Sections 23 and 24
[207] Chapter III
[208] Section 51
[209] https://core.ac.uk/download/pdf/42142009.pdf *"Clone Wars": Episode II - The Next Generation The Copyright Implications relating to 3D Printing and Computer-Aided Design (CAD) Files* Dinusha Mendis December 2014 pp.7-8 , accessed 24 September 2018
[210] [2011] 3 WLR 487
[211] https://core.ac.uk/download/pdf/42142009.pdf *"Clone Wars": Episode II - The Next Generation The Copyright Implications relating to 3D Printing and Computer-Aided Design (CAD) Files* Dinusha Mendis December 2014 p.20 , accessed 24 September 2018
[212] 210 Supra par. 1

Ainsworth, was responsible for the manufacture of the helmets for the Appellant and produced several prototype helmets. Mr Ainsworth then used his original tools to make versions of the helmet for sale to the public. The claim for copyright infringement was of the helmet as a work of artistic craftsmanship, or sculptures.[213] The Court held that it was the Star Wars film that was the work of art that the Appellant had created and that the helmet was utilitarian in the sense that it was an element in the process of production of the film.[214] The claim for infringement was dismissed.

There is no express "site-blocking" legislation in the United Kingdom but, following the decision of the English High Court in *Twentieth Century Fox Film Corporation and Others vs British Telecommunications Plc*,[215] it became possible to obtain "site-blocking" interdicts against service providers. "Site-blocking" is when a service provider blocks the end-user from accessing a particular website. It follows that this kind of regulation is relevant to infringements taking place on the internet as it circumvents the need for the rights holder to take action in each and every instance of infringement, the extent of which can make it practically impossible to do so.

In the case of *Dramatico Entertainment Ltd and Others v British Sky Broadcasting Ltd and Others*[216] the ability to obtain "site-blocking" interdicts was taken further when the Court held that the operators and users of the infamous Pirate Bay peer-to-peer file sharing website had infringed the copyright of the claimants, even in the absence of the operators and users as participants in the litigation. The court held that the operator had done so by "authorising" the infringements, with "authorising" held to mean granting or purporting to grant the rights to do the acts complained of, and that such authorisation could be implied from the circumstances of the case.[217]

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[213] It is important to note that, at the time of the judgment, Section 52 of the 1988 Copyright Act was still in force. It was subsequently removed by virtue of the Enterprise and Regulatory Reform Act 2013.
[214] 210 Supra par. 45
[215] [2011] EWHC 1981 (Ch)
[216] ChD 20 February 2012
[217] See also par. 6.2 below

The UK does not have specific safe harbour legislation aimed at assisting service providers in circumstances where users of content commit acts of copyright infringement. In fact, as the above cases illustrate, the UK appears to favour a stricter approach to liability for such infringements. However, it appears possible to file requests for the removal of infringing content from a website with the service provider in terms of the European e-Commerce Directive.[218] The provisions of the Directive[219] state that a service provider must act expeditiously to remove or to disable access to information, upon obtaining knowledge or awareness of illegal activity.

The UK Copyright Act does provide for technological protection measures.[220]

5.3.2 Commentary

The advantages to the industrial and manufacturing sectors, and to overall economic growth, to be gained through early adoption of, and support for, 3D printing technologies are recognised in the United Kingdom, as can be seen from its National Additive Manufacturing strategy.[221]

Insofar as the interaction with copyright is concerned, an observation was made in a 2015 Report that was commissioned by the UK Intellectual Property Office that infringement of copyright through 3D printing technologies was not yet at a noticeable level, but that interest and activity had been growing exponentially year on year. A general hesitance to legislate too quickly in response to this technology is noted from the Report and recommendations for the adoption of different business models to alleviate potential infringement concerns are raised.[222]

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[218] Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000 available at https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32000L0031 , accessed 24 September 2018

[219] Article 14

[220] Section 296

[221] Available at http://am-uk.org/wp-content/uploads/2017/11/AM-UK_Strategy_Publication_Amends_Novermber_Digital.pdf , accessed 24 September 2018

[222] http://ipaware.org/wp-content/uploads/2018/05/3D-Printing-Feb-18.pdf *Legal and Empirical Study into the Intellectual Property Implications of 3D Printing* Executive Summary Dinusha Mendis, Davide Secchi and Phil Reeves, March 2015; see also *3D Printing the Future* Dinusha Mendis, February 2018, accessed 24 September 2018

Prof. Dinusha Mendis,[223] who has published many articles, reports and papers on the subject of 3D printing and copyright, is of the view that UK copyright law does not lend very much support to rights holders who may find it difficult to construct a case against those who scan and reverse engineer their products. Referencing the protection of derivative works and little support for rights holders, she makes out a case for the re-consideration of copyright law, but cautions that it would be prudent not to stifle this emerging technology by applying stringent intellectual property laws in haste.[224]

Prof. Mendis suggests that the creation of a 3D parts store, similar to the iTunes model of Apple Inc. for buying digital object design files for 3D printing could be a possible solution, alternatively, manufacturers could consider licensing 3D designs more widely.[225] A further alternative supported by Prof. Mendis is secure streaming of 3D CAD files on a 'pay-per-print' business model. This model removes the need for a CAD file to be sent to the consumer as the printing instructions are sent directly to the printer, which, in turn, prints out the number of objects that have been purchased. There are examples of businesses operating this way already.[226]

Prof. Mendis has also warned that an impulsive or a reactive 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". She is of the view that it will be sensible to adopt a symbiotic approach between developing the existing copyright law and embracing new business models.[227]

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[223] Professor Dinusha Mendis, Professor of Intellectual Property and Innovation Law and Co-Director of the Centre for Intellectual Property Policy and Management at Bournemouth University in the United Kingdom.
[224] https://core.ac.uk/download/pdf/42142009.pdf *"Clone Wars": Episode II - The Next Generation The Copyright Implications relating to 3D Printing and Computer-Aided Design (CAD) Files* Dinusha Mendis December 2014 pp.20-21, accessed 24 September 2018
[225] 224 Supra p.21
[226] 224 Supra p.22
[227] 224 supra p.22

5.4 AUSTRALIA

Australia has been chosen for the similarities between its copyright infringement exceptions and those in South Africa and, in particular, the debate around fair dealing versus fair use defences which has enjoyed attention specifically with reference to the subject of 3D printing.

5.4.1 Brief synopsis of the law

Copyright Law in Australia is governed by the Australian Copyright Act of 1968. It reserves the act of reproduction for the copyright owner[228] and reproduction[229] is defined to include, in the case of a work in a two-dimensional form the production of the work in a three-dimensional form and vice versa.

The right to make an adaptation is provided but does not extend to artistic works.[230]

Infringement[231] of copyright occurs if a person who, not being the owner of the copyright, and without the licence of the owner of the copyright, does in Australia, or authorises the doing in Australia of, any act comprised in the copyright.[232]

Defences[233] to infringement are purpose-specific fair dealing defences but extend far beyond the list of defences provided for in the South African Copyright Act. The fair dealing defences include for purposes of research or study, criticism or review, parody or satire, reporting news, judicial proceedings, technical processes and various others. Interestingly, there is no general provision for the fair dealing in a work for private and instances where private use may constitute a defence are very limited.

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[228] Section 31(1)
[229] Section 21
[230] Section 31
[231] Sections 36 to 39
[232] Section 36(1A) provides factors for determining whether or not a person has authorised the doing of any act
[233] Sections 40 to 53

Australia has so-called "site-blocking" legislation in the form of the Copyright Amendment (Online Infringement) Act 2015 (Cth). This legislation has led to copyright actions against a number of websites in the Federal Court of Australia, which in 2016 ordered internet service providers to block access to peer-to-peer file sharing sites such as Pirate Bay, finding that they were in flagrant disregard of copyright owners' rights.[234]

Australia also has a safe harbour regime in the form of the Copyright Amendment (Digital Agenda) Act 2000 (Cth). This Act has, however, limited the safe harbour provisions to traditional service providers, such as telecommunications networks and internet service providers.[235] Subsequently, there has been call for the expansion of the safe harbour provisions[236] to include a broader range of entities. However, after opposition from copyright owners, the safe harbour reforms were excised in the final version of the bill and the Copyright Amendment (Disability and Other Measures) Bill 2017 (Cth) focused only on copyright law and disability rights; copyright term for unpublished works; and statutory licensing.[237]

Circumvention of technological protection measures is provided for in Australia's Copyright Amendment (Digital Agenda) Act.[238] Australia's technological protection measures regime is also tied to the Digital Millenium Copyright Act[239] as a result of the Australia-United States Free Trade Agreement 2004.[240]

No 3D printing specific case law appears to be available in Australia just yet.

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[234] https://eprints.qut.edu.au/96839/1/96839.pdf *Makers Empire: Australian Copyright Law, 3d Printing, And The 'Ideas Boom'* Matthew Rimmer p.30, accessed 25 September 2018
[235] 234 Supra p.32
[236] Which led to the Copyright Amendment (Disability Access and Other Measures) Bill 2016 (Cth)
[237] 234 Supra p.32
[238] 2000 (Cth)
[239] 1998 (US)
[240] 234 Supra p.8

5.4.2 Commentary

According to Professor Matthew Rimmer[241] who has published extensive work on the subject, there has been a high adoption of 3D printing in respect of art, craft, design, and science in Australia. [242]

There has been an interest in integrating the role of 3D printing into government policies in respect of education, innovation, and manufacturing and references are made to increasing concerns about the need to boost Australia's national and science technology policy and performance as well as concern over the decline in Australia's manufacturing industries.[243] It seems that there is some hope that 3D printing technologies will revive Australia's advanced manufacturing capacities. In this regard, the Coalition Government has published a National Innovation and Science Agenda called the "Ideas Boom".[244]

Against this backdrop, Prof. Rimmer notes that Australian copyright law is not necessarily well-adapted to 3D printing technologies.[245] He refers to an idiosyncratic copyright regime that has been shaped by English influence. Whilst Australia has repeatedly updated its copyright laws in order to address local cultural conditions and new technologies, Prof. Rimmer notes that, in the absence of more radical copyright law reform, there has been a need to rely on open licensing such as the Creative Commons licence scheme[246] to share 3D printing works and files.[247]

Prof. Rimmer recommends that 3D printing platforms would benefit, firstly, from a wider safe harbour regime. [248] The current Copyright Amendment Series Providers Bill 2017 will extend

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[241] Faculty of Law at the Queensland University of Technology in Brisbane
[242] https://eprints.qut.edu.au/96839/1/96839.pdf *Makers Empire: Australian Copyright Law, 3d Printing, And The 'Ideas Boom'* Matthew Rimmer p.1, accessed 25 September 2018
[243] 242 Supra
[244] 242 Supra p.3
[245] 242 Supra p.8
[246] See 74 Supra
[247] 242 Supra p.45
[248] 242 Supra p.33

the copyright safe harbour to include educational institutions as well as libraries and archives but does not extend to other kinds of service providers such as search engines and social media platforms.[249]

Moreover, the case for the adoption of a fair use defence, modelled upon the United States defence of fair use, is made.[250] Prof. Rimmer warns that 3D printing poses complications for a number of jurisdictions, which only have a purpose specific defence of fair dealing since the developers of 3D printing technologies would struggle to obtain protection under these defences. In the circumstances, he argues that such developers would be loath to establish their operations in Australia because of the vulnerability, risks and uncertainties in respect of litigation under Australian copyright law. A technology-neutral open standard such as fair use, he argues, has the dynamism or agility to respond to future technologies, economies and circumstances that don't yet exist, or haven't been foreseen, such as the emergence of 3D printing.[251]

The Australian Law Reform Commission (ALRC)[252] also recommended the introduction of a fair use exception into Australian copyright law.[253] The report released by the ALRC observed that there had been evidence presented that Australia's current exceptions may unnecessarily prohibit and stifle a range of activities, including 3D printing. The Australian Law Reform Commission contended that the adoption of a defence of fair use would be flexible and technology-neutral; promote the public interest and transformative uses, assist

[249] http://www.copyright.org.au/ACC_Prod/ACC/News_items/2017/Safe_Harbour_Bill_Introduced.aspx *Breaking: Safe Harbour Bill Introduced Into Parliament And 2017 In Review* 5 December 2017, accessed 25 September 2018

[250] http://www.alrc.gov.au/sites/default/files/subs/122.matthewrimmer_3d.pdf *Copyright And The Digital Economy: 3D Printing A Submission To The Australian Law Reform Commission* Dr Matthew Rimmer, accessed 25 September 2018

[251] 250 supra p.45 and p.46

[252] The Australian Law Reform Commission (ALRC) undertakes research, and provides recommendations to reform the law, on topics selected by the Attorney-General of Australia

[253] Australian Government Australian Law Reform Commission Copyright and the Digital Economy Summary Report p.21 and p.22 available at https://www.alrc.gov.au/sites/default/files/pdfs/publications/summary_report_alrc_122.pdf see also https://www.alrc.gov.au/publications/4-case-fair-use-australia/alrc's-proposals-reform, accessed 25 September 2018

innovation, and align with reasonable consumer expectations. Moreover, the regime would be sufficiently certain and predictable, and be compatible with international law.[254]

The ALRC's report recommends, in the alternative, fair dealing exceptions for non-commercial private use, technical use and education.[255]

CHAPTER 6: CONCLUSION – THE BALANCING ACT

6.1 INTRODUCTION

In undertaking the research for this dissertation, I had hoped to find clear guidance on how to deal with 3D printing technologies from a legal point of view and, in particular, with reference to copyright legislation. At the very least, I had envisaged finding some case law that would be indicative of what the ideal legal landscape might look like for these technologies.

However, the material uncovered in the territories discussed above has been of limited assistance. Locally, the question of copyright infringement within the 3D printing environment has not enjoyed the attention of the courts. In fact, even within the digital copyright environment, there has been very limited consideration of copyright principles in local case law. As a result of the dearth of case law, many questions around enforcement of copyright and liability for copyright infringement in the online and technological environments remain open.

What is apparent to me, is that the support and development of 3D printing technologies will be crucial in future manufacturing and industrial environments and the technologies will play a pivotal role in stimulating economic growth. The Aeroswift printer[256] is but one example of

[254] 250 Supra p.49
[255] 250 supra p.22
[256] See par. 3.1 supra

how the local economy can benefit at different levels of the value chain where such benefits were not enjoyed previously.

One great danger of these technologies is the potential job losses due to reduced steps in manufacturing processes. A country like South Africa, with nearly a third of its workforce unemployed,[257] can naturally not afford taking any step that reduces the already limited employment opportunities. However, sight cannot be lost of the opportunities that arise around 3D technologies in other ways, again, as the Aeroswift printer has shown, by creating the prospect of participation at other levels of production and enabling diversification of skills. The area of design services or the creation and development of new printable materials come to mind. So, too, the development of niche products informed by local expertise as referred to in the National Development Plan[258] could be an area of various opportunities given the flexibility of 3D printing technologies and the advantage of rapid prototyping.

For all of the above reasons, it is sensible in my view, to caution against an over-reaction to the potential negative impact on copyright owners and, in particular, against attempts to legislate too quickly or too stringently. In my opinion, the South African Copyright Act is somewhat ahead of the legislation in the countries discussed in Chapter 5 above for having a clear reverse engineering provision in Section 15(3A) of the Copyright Act and making express provision for computer-generated works.

South Africa also finds itself in an interesting time period insofar as copyright legislation amendments are concerned, with a controversial Amendment Bill[259] currently before National Parliament. The Amendment Bill falls outside of the scope of this dissertation but it would have to be seen what amendments are ultimately effected as some of them could also address the recommendations that will be discussed below.

There are two areas of consideration for purposes of making recommendations. The first is the exposure to liability for copyright infringement, and whether that requires management

[257] https://tradingeconomics.com/south-africa/unemployment-rate, accessed 3 November 2018
[258] See par. 3.2 supra
[259] Copyright Amendment Bill [B13-2017]

in an effort not to stifle the development and application of 3D printing technologies. The second is enabling effective enforcement of copyright where uncontrolled infringements and unfair dealings would stifle the presence of and investment by copyright owners in the local economy.

6.2 EXPOSURE TO LIABILITY FOR COPYRIGHT INFRINGEMENT

Exposure to liability for copyright infringement in South Africa exists insofar as direct infringement is concerned, both when an act of reproduction or adaptation is carried out, and when it is caused to be carried out.

Questions arise in respect of online design repositories and third party service providers who facilitate digital design creation, scanning and printing processes. Can they be said to be causing the acts of reproduction or adaptation?

Businesses or Maker Spaces offering 3D printing services could be equated to the provision of photocopying services to the public, or the sale of blank compact discs for purposes of copying and storing digital content. These scenarios in particular have not enjoyed sufficient attention in South African jurisprudence for me to state the position with any certainty. Design repositories, where digital blue prints are widely shared and made available for downloading, are akin to peer-to-peer file sharing websites, and this is another issue that has not been addressed by South African courts yet.

In an unreported case[260] of the then Transvaal Provincial Division of the High Court, the respondent sold a device which had as its primary function the making of reproductions of computer games which were the subject of copyright. The claim was that the respondent was instigating or facilitating the making of unauthorised copies of the computer games by third parties by means of selling the device and by promoting such sales by drawing attention to the capabilities of the device. The respondent was held to have infringed copyright even in the absence of evidence of any actual reproduction of the games and the court granted the

[260] *Atari, Inc. and Another v JB Radio Parts (Pty) Ltd* Case no. 17419/83 TPD

interim interdict. The outcome of this case is questionable seeing as the Court appears to have accepted that, simply because it is possible to use the device for unlawful activity, that it was also, in fact, being used that way in the absence of any proof.

South African courts often find case law from the United Kingdom ("UK") persuasive and it worth considering how the issue of causing infringement has been dealt with in the UK. The UK Act provides for such infringement where the act is done or *authorised* by the alleged infringer. This element of authorisation has resulted in the courts[261] focussing their attention on the issue of the alleged infringer's control over the infringing acts in finding against copyright infringement in the case of the sale of empty cassettes on the one hand, and machines used to make unauthorised copies of records, on the other.

In a 2012 decision of the UK Chancery Division[262] dealing with peer-to-peer file sharing websites, the Court found that the operator of such a website had infringed copyright by authorising infringement by the users of the websites. "Authorise" was held to mean granting or purporting to grant the rights to do the acts complained of. It was also held that such authorisation could be implied from the circumstances of the case. The Court found that the operator of the website went to "great lengths" to make it easy for the users to search and locate content for downloading, it knew that the downloads infringed copyright and it refused to remove infringing content despite having the technical ability to do so.

Though modelled on the UK Act, the South African Act refers to an infringement being *caused* by an unauthorised person. The question as to whether the use of different wording in the South African Act could result in a different outcome is open to debate but it is submitted that the word "cause" implies something more than just facilitating a service where the user is in control over what is being reproduced. Dean in The Handbook of South African Copyright Law use the words "instigate" or "instruct" as alternatives to "cause".[263]

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[261] *CBS Inc v Ames Records and Tapes Ltd:* 1982; *CBS Songs Ltd v Amstrad Consumer Electronics Plc: HL* 12 May 1988

[262] *Dramatico Entertainment Ltd and Others v British Sky Broadcasting Ltd and Others: ChD* 20 Feb 2012

[263] Dean: *Handbook of South African Copyright Law* Revision Service 15 OH Dean Par. 1-8.23

In a 2004 judgment[264] by the Supreme Court of Appeal in Canada involving a service whereby freestanding, self-service photocopying machines were made available to library patrons, the court held that the defendants did not authorise copyright infringement simply by maintaining self-service photocopiers. Although authorisation could be inferred from acts that were less than direct and positive, it was held that a person did not authorise infringement by authorising the mere use of equipment that could be used to infringe copyright. Furthermore, a presumption should be made that a person who authorises an activity does so only insofar as it is in accordance with the law. It was stated, though, that the presumption could be rebutted if it was shown that a certain relationship or degree of control existed between the alleged authoriser and the persons who committed the copyright infringement. The court also rejected the plaintiff's argument that the posting of a notice warning that it would not be responsible for any copies made in infringement of copyright, constituted an express acknowledgement by the defendant that the photocopiers would be used in an illegal manner.

It is submitted that South African courts should, ultimately, follow the UK and Canadian line of reasoning by finding that the provision of a service intended for legitimate actions and in respect of which the user is ultimately in control, should not *per se* be equated to causing copyright infringement. This would constitute a deviation from the judgment in the *Atari*[265] case where the court arguably erred in finding infringement in the absence of evidence of any form of causation, authorisation or control or even a single instance of unauthorised reproduction.

However, hosting and facilitating the upload and download of the designs for purposes of printing arguably is closer in facts to the peer-to-peer file sharing scenario where the operator of the design repository is in a clearer position of control, being able to manage both the content and to some extent user engagement with the content. Here, the potential liability for copyright infringement by the operator of the design repository appears to be greater.

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[264] *CCH Canadian Ltd v Law Society Upper Canada 2004 SCC 13, 2004 CSC 13*
[265] 260 supra

It is submitted that the exposure to liability for copyright infringement in the case of 3D printing technologies is managed to some degree by the existing wording of Section 23(1) of the Act and, specifically, the requirement that a finding of infringement, unless directly carried out, should only be made where there is an element of control, authorisation or other direct involvement encouraging such infringement. Such circumstances, of authorisation or control over the infringing acts, also warrant the existence of a liability.

Exposure to liability is further addressed in the defences provided for in the Act and, in particular, the fairly general defence of fair dealing for purposes of private use. One can envisage that a business printing a single replacement part for one of its machines may well be able to raise this defence. The criteria of fairness should ensure protection against circumstances where such production of replacement parts, even for private use, is on a large scale or in a manner otherwise unfairly detrimental to the copyright owner. However, it is the defence of reverse engineering in Section 15(3A) that could provide the most comfort to potential infringers as it is likely find widespread application to most functional articles. Indeed, in my view, if this defence is left unchecked, it could open the floodgates to acts that would otherwise have constituted copyright infringement. It is worth mentioning that, in practice, proving all of the allegations required to succeed with a defence based on Section 15(3A) can be difficult. In this regard, evidence must be led of the creation process of the alleged infringing work, and necessitates testimonies by the persons involved in reverse engineering the article, which persons are often located overseas.

6.3 ENABLING EFFECTIVE ENFORCEMENT

3D printing technologies enable widespread and extensive copyright infringement. Every printed article carries the risk of constituting an act of copyright infringement and it can be carried out by anyone with access to a printer, anywhere, at any time. It would be an extremely difficult task for copyright owners to be aware of and to litigate in each and every instance of potential infringement. A need therefore exists for alternative ways in which to counter act the threats of infringement.

I reiterate that, in my view, the reverse engineering defence in Section 15(3A) is likely to become increasingly important in the application of 3D printing technologies. It could enable legions of reproductions that would otherwise have constituted infringements. At the time when Section 15(3A) was introduced, reverse engineering and manufacturing an article would still have necessitated a fair amount of time, effort and costs that could easily have outweighed the benefit of doing so. With the introduction of advanced technologies and, in particular, 3D scanning an printing, it will become increasingly easier and more cost-effective to undertake processes of reverse engineering. The defence is applicable to all articles that are made by industrial process and have a primarily utilitarian purpose. It is not limited to a particular industry or product type. Depending on the interpretation of the requirement "primarily utilitarian", it could apply to a very wide range of everyday articles of consumption, including designer items as the case law illustrates. [266] The potential extensive application of this defence may very well act as a deterrent for investment by certain copyright based industries.

It is submitted that the legislature should consider introducing a fairness element into the reverse engineering defence, alternatively, investigate a suitable limitation to its application.

It is noted that the Copyright Amendment Bill [267] seeks to introduce a general fair use defence, modelled on that of the United States. The introduction of such a defence has been met with criticism and is a continuing debate which will not be considered here. However, if a fair use defence is introduced into our copyright law, that would provide an additional and, possibly far reaching, defence to copyright infringement.

The Amendment Bill[268] also introduces technological protection measures into South African Copyright law which is welcomed as it is both relevant and necessary to assist copyright owners in managing the enforcement of their rights insofar as 3D printing technologies are concerned. Having the ability to protect copyright works through the application of technological measures that may not be circumvented enables copyright owners to counter-

[266] See par. 4.5 supra
[267] [B13-2017]
[268] 259 supra

act infringement to the extent possible, before it occurs, thereby safe-guarding their interests. Such provisions will also bring the Act in line with the WIPO Copyright Treaty.[269]

South Africa has a form of safe harbour legislation in the Electronic Communications and Transactions Act ("ECTA").[270] Section 75 of the ECTA provides that a service provider cannot be held liable for damages in the event of infringement of third party rights, provided that the service provider does not have actual knowledge that an activity is infringing the rights of a third party or is not aware of facts or circumstances from which the infringing activity is apparent and, upon receipt of a take-down notice, acts expeditiously to remove or disable access to the content. The Section further states that, notwithstanding these provisions, a competent court may order a service provider to terminate or prevent unlawful activity in terms of any other law. A service provider is also exempted from liability for the wrongful removal of content in response to a notification.[271] Having submitted several take-down requests in practice to the Internet Service Providers Association, I can attest to the fact that the process seems to work fairly well where the service provider in question chooses to make use of these exemption provisions by complying with such requests for removal.

6.4 CONCLUSION

South Africa appears to be on par with the territories considered regarding the subject of this dissertation. No definitive rules have been developed yet through the interpretation of existing legislative provisions and their application in the field of 3D printing. How significant or unsurmountable the foreseeable difficulties will be, in counter acting uncontrolled infringements, effectively safe-guarding and enforcing rights, whilst also allowing the technology to fulfil its role in the growth and diversification of the economy, is uncertain.

South African legislation is not entirely lacking in offering both protection and relief to copyright owners at all stages of 3D printing processes. The finite list of fair dealing defences in the Copyright Act offers a measure of certainty to both copyright owners as well as

[269] Of 1996
[270] No. 25 of 2002
[271] Section 77

potential infringers. Moreover, the Act contains a *sui generis* defence in Section 15(3A) not found elsewhere which could benefit the adoption and development of 3D printing technologies locally. In my opinion, it is indeed this reverse engineering defence that may become a determining factor in the role which 3D printing technologies play in the local economy and it may very well be an enabler of the technology rather than an inhibiting factor. However, the extent of potential application of the defence necessitates closer investigation of the need for some form of limitation on it so as not to stifle investment by those copyright owners who stand possibly to be negatively affected by the defence as those copyright owners potentially constitute a very broad audience.

BIBLIOGRAPHY

BOOKS and PUBLICATIONS

1. The Constitution of South Africa 1996;
2. South African Journal of Industrial Engineering August 2015 Vol 26(2);
3. The Law of South Africa Third Edition Volume 10;
4. Dean: *Handbook of South African Copyright Law* Revision Service 15 OH Dean;
5. *It Will Be Awesome If They Don't Screw It Up: 3D Printing, Intellectual Property, and the Fight Over the Next Great Disruptive Technology* Michael Weinberg, November 2010 available at https://www.publicknowledge.org/files/docs/3DPrintingPaperPublicKnowledge.pdf
6. *Makers Empire: Australian Copyright Law, 3D Printing, And The 'Ideas Boom'* Prof. Matthew Rimmer available at https://eprints.qut.edu.au/96839/1/96839.pdf;
7. *"Clone Wars": Episode II - The Next Generation The Copyright Implications relating to 3D Printing and Computer-Aided Design (CAD) Files* Dr. Dinusha Mendis, December 2014 available at https://core.ac.uk/download/pdf/42142009.pdf;
8. *Copyright And The Digital Economy: 3D Printing A Submission To The Australian Law Reform Commission* Dr Matthew Rimmer available at http://www.alrc.gov.au/sites/default/files/subs/122.matthewrimmer_3d.pdf.

OFFICIAL TEXTS

9. Copyright Act no. 98 of 1978;
10. Electronic Communications and Transactions Act no. 25 of 2002;
11. Intellectual Property Policy of the Republic of South Africa Phase I 2018 at https://www.thedti.gov.za/news2018/IP_Policy2018-Phase_I.pdf
12. WIPO Copyright Treaty of 1996;
13. United States Code Copyright Act of 1976;
14. United Kingdom Copyright, Designs and Patents Act, 1988;
15. Australian Copyright Act of 1968.

CASE LAW

16. *Appleton v Harnischfeger Corporation* [1995] 2 All SA 693 (A);
17. *Haupt t/a Softcopy v Brewers Marketing Intelligence (Pty) Ltd* 2006 (4) SA 458 (SCA);
18. *Galago Publishers (Pty) Limited and Another v Erasmus* 1989 (1) SA 276 (A);
19. *Moneyweb (Pty) Limited v Media 24 Limited and Another* 2016 (4) SA 591 (GJ);
20. *South African Broadcasting Corporation SOC Ltd v Via Vollenhoven and Appollis Independent CC and Others* [2016] 4 All SA 623;
21. *Ashdown v Telegraph Group Ltd* EWHC Ch 28, [2001] 2 WLR 967;
22. *Condé Nast Publications Ltd v Jaffe* 1951 1 SA 81 (C) 86;

23. *Performing Right Society Ltd v Berman* 1966 2 SA 355 (R) 357;
24. *Phillip Morris Inc v Marlboro Trust Co* SA 1991 (2) SA 720 (A);
25. *Nu Metro Filmed Entertainment (Pty) Ltd And Others V Mr Video (Pty) Ltd And Others* 2008 BIP 317 (C);
26. *Mr Video (Pty) Ltd and Others v Nu Metro Filmed Entertainment (Pty) Ltd and Others* [2010] 2 All SA 34 (SCA);
27. *Atari, Inc. and Another v JB Radio Parts (Pty) Ltd* Case no. 17419/83 TPD;
28. *CCH Canadian Ltd v Law Society Upper Canada* 2004 SCC 13, 2004 CSC 13*;*
29. *CBS Inc v Ames Records and Tapes Ltd:* 1982*;*
30. *CBS Songs Ltd v Amstrad Consumer Electronics Plc: HL* 12 May 1988;
31. *Dramatico Entertainment Ltd and Others v British Sky Broadcasting Ltd and Others: ChD* 20 Feb 2012;
32. *Star Athletica v Varsity Brands* 580 U.S. ___ (2017);
33. *Lucasfilm Limited and others v Ainsworth and another* [2011] 3 WLR 487;
34. *Twentieth Century Fox Film Corporation and Others vs British Telecommunications Plc* [2011] EWHC 1981 (Ch);
35. *Cipla Medpro (Pty) Ltd v Aventis Pharma SA, Aventis Pharma SA and Others v Cipla Life Sciences (Pty) Ltd and Others 2013* (4) SA 579 (SCA);
36. *Esquire Electronics Ltd v Executive Video* 1986 (2) SA 576 (A);
37. *McKenzie v Van der Merwe* 1917 AD 41.

INTERNET

38. https://www.weforum.org/agenda/2016/01/what-is-the-fourth-industrial-revolution/ *World Economic Forum: What is the fourth industrial revolution?* Nicholas Davis 19 January 2016;
39. https://www.forbes.com/sites/bernardmarr/2018/08/13/the-4th-industrial-revolution-is-here-are-you-ready/#4e233c0e628b *The 4th Industrial Revolution Is Here - Are You Ready?* Bernard Marr, 13 August 2018;
40. http://www.bbc.com/future/story/20170207-what-if-the-internet-stopped-for-a-day *What if the internet stopped for a day* Rachel Nuwer, 7 February 2017;
41. https://en.wikipedia.org/wiki/Wheat_and_chessboard_problem;
42. https://3dprintingindustry.com/3d-printing-basics-free-beginners-guide#02-history;
43. https://www.3dsystems.com/our-story;
44. https://reprap.org/wiki/RepRaphttps://en.wikipedia.org/wiki/GNU_General_Public_License; https://www.gnu.org/licenses/gpl-3.0.en.html;
45. https://all3dp.com/history-of-the-reprap-project/;
46. https://3dprintingindustry.com/3d-printing-basics-free-beginners-guide#02-history;
47. https://3dprint.com/208122/wohlers-report-2018/;
48. https://wohlersassociates.com/;
49. https://www.forbes.com/sites/tjmccue/2018/06/04/wohlers-report-2018-3d-printer-industry-rises-21-percent-to-over-7-billion/#fb2b0cb2d1a4 *Wohlers Report 2018: 3D Printer Industry Tops $7 Billion* TJ McCue, 4 June 2018;
50. https://3dprinting.com/what-is-3d-printing/ ;
51. https://all3dp.com/what-is-stl-file-format-extension-3d-printing/ *STL File Format (3D Printing) – Simply Explained* Dibya Charavorty, 5 August 2018;

52. https://www.goprint3d.co.uk/blog/what-is-slicing-software-and-what-does-it-do/ *What is slicing software, and what does it do?* 6 July 2016;
53. https://en.wikipedia.org/wiki/3D_scanning;
54. https://www.bmw.com/en/innovation/3d-print.html 25 August 2018;
55. https://www.bmwblog.com/2018/04/16/bmw-announces-plans-to-build-specialized-3d-printing-facility/ *BMW Announces Plans to Build Specialized 3D Printing Facility* Gabriela Nica, 16 April 2018;
56. www.bmw.com;
57. http://www.abc.net.au/news/2017-03-27/saving-the-last-delage-type-s-grand-prix-car/8310958
58. https://www.reuters.com/article/us-norsk-boeing-idUSKBN17C264 *Printed titanium parts expected to save millions in Boeing Dreamliner costs* Alwyn Scott, 10 April 2017;
59. https://www.airbus.com/newsroom/news/en/2018/04/bridging-the-gap-with-3d-printing.html;
60. https://www.nasa.gov/content/international-space-station-s-3-d-printer;
61. https://www.createeducation.com/;
62. https://kidesign.org/kideville/;
63. https://3dprintingsystems.co.za/education/;
64. http://www.library.up.ac.za/makerspace/index.htm;
65. http://news.mandela.ac.za/News/Largest-3D-printer-in-Africa-built-at-NMMU;
66. http://blogs.sun.ac.za/idea2product/;
67. https://www.archdaily.com/881662/this-3d-printer-designed-specifically-for-architects-is-surprisingly-easy-to-use 16 October 2017;
68. https://www.engineering.com/Education/EducationArticles/ArticleID/12225/Dubai-Unveils-First-3D-Printed-Office-Building.aspx;
69. http://www.engineeringnews.co.za/article/concrete-3d-printed-house-showcased-in-milan-2018-04-26;
70. https://futureofconstruction.org/case/winsun/
71. https://www.livescience.com/58156-3d-printed-house-built-in-less-than-a-day.html *This House Was 3D Printed in Less Than 24 Hours* Kacey Deamer, 7 March 2017;
72. https://www.ibtimes.co.uk/china-recycled-concrete-houses-3d-printed-24-hours-1445981 *China: Recycled Concrete Houses 3D-Printed in 24 Hours* Mary-Ann Russon, 24 April 2014;
73. https://www.bbc.com/news/blogs-news-from-elsewhere-27156775 *China: Firm 3D prints 10 full-sized houses in a day* 25 April 2014;
74. https://www.laurelandwolf.com/blog/3d-printing-is-taking-custom-interior-design-to-a-whole-new-level/ ;
75. http://www.3dprinting.lighting/;
76. https://www.sculpteo.com/blog/2018/02/21/3d-printed-furniture-appliances-of-the-future/;
77. https://www.wsj.com/articles/SB10001424127887323372504578469560282127852 Wall Street Journal: *Printing Out Barbies and Ford Cylinders* Clint Boulton, 5 June 2013;
78. http://fortune.com/2016/02/12/mattel-3d-printing-toys/ ;
79. https://www.shapeways.com/superfanart/mylittlepony;
80. http://www.fatdragongames.com/fdgfiles/;
81. https://www.sculpteo.com/blog/2017/11/15/top-11-of-the-best-3d-printed-drone-projects/;
82. https://all3dp.com/3d-print-drone-parts/;

83. https://3dprint.com/46036/golf-equipment-manufacturer-ping-introduces-golfs-first-3d-printed-putter/ *Golf Equipment Manufacturer Ping Introduces Golf's First 3D-Printed Putter* Debra Thimmesch, 22 February 2015;
84. http://grismont.paris/;
85. https://www.techtimes.com/articles/107791/20151117/smart-baseball-softball-training-bat-provides-real-time-data-analytics.htm *Smart Baseball And Softball Training Bat Provides Real-Time Data, Analytics With Each Swing* Mark Lelinwalla, 17 November 2015;
86. https://all3dp.com/hockey-made-safer-3d-antibacterial-gloves/;
87. https://3dprint.com/176374/riddell-new-nfl-football-helmets/ *Riddell Uses 3D Scanning for New, Safer NFL Football Helmets* Bridget Butler O'Neal, 1 June 2017;
88. https://www.3dnatives.com/en/3d-printing-sport-201220174/;
89. https://www.disruptsports.com/3d-printing/;
90. https://3dprint.com/210316/dsm-3dmouthguard-partnership/ *DSM Helping Dutch Sports Initiative 3D Print Custom Sports Mouthguards On the Spot* Sarah Saunders, 16 April 2018;
91. https://www.sculpteo.com/blog/2014/06/05/3d-printed-football-equipments/ The world's first 3D printed football equipments by Nike Arthur Cassaignau 5 June 2014;
92. https://3dprint.com/164449/skelmet-3d-printed-sunglasses/ *3D Scanning & 3D Printing for a Perfect Fit: Meet Skelmet's 3D Printed Sports Sunglasses* Clare Scott, 13 February 2017
93. https://skelmet.com/;
94. https://www.athletics3d.com/;
95. https://inside3dprinting.com/news/tag/nike/;
96. https://inside3dprinting.com/news/nikes-3d-printed-shoe-uppers-first-in-london-marathon/45412/ *Nike's 3D-Printed Shoe Uppers First in London Marathon* Sandra Helsel, 24 April 2018;
97. https://inside3dprinting.com/news/nikes-redesigned-magista-2-football-boot-an-organic-extension-of-the-foot/40878/ *Nike's Redesigned Magista 2 Football Boot an 'Organic Extension of the Foot'* Sandra Helsel, 12 August 2016;
98. https://inside3dprinting.com/news/nikes-3d-printed-football-equipment-for-summer-2014/18094/ *Nike To Release 3D Printed Football Equipment for Summer 2014* Sandra Helsel, 2 June 2014;
99. https://inside3dprinting.com/news/nike-debuts-second-football-cleat-using-3d-printing-technology/14775/ *Nike Debuts Second Football Cleat Using 3D Printing Technology* Sandra Helsel, 28 February 2014;
100. https://inside3dprinting.com/news/nike-continues-just-do-it-with-3d-printed-carbon-vapor-shoe-for-super-bowl/13370/ *Nike Continues 'Just Do It' with 3D Printed Carbon Vapor Shoe for Super Bowl* Sandra Helsel, 16 January 2014;
101. https://www.sporttechie.com/reebok-unveils-3d-printed-floatride-running-shoe-liquid-factory/ *Reebok Unveils 3D-Printed Shoe And Commits To More 3D Production* Jen Booton, 26 March 2018;
102. https://3dprint.com/168953/under-armour-architech-futurist/ *Under Armour Presents Latest Athletic Shoe with 3D Printed Midsole: Meet the $300 ArchiTech Futurist Sneaker, Available Soon* Sarah Saunders, 24 March 2017;
103. https://techcrunch.com/2018/01/18/adidas-joins-carbons-board-as-its-3d-printed-shoes-finally-drop/ *Adidas Joins Carbons Board As Its 3D Printed Shoes Finally Drop* Brian Heater, 18 January 2018;
104. https://www.forbes.com/sites/andriacheng/2018/05/22/with-adidas-3d-printing-may-finally-see-its-mass-retail-potential/#57a4daa14a60 *How Adidas Plans To Bring 3D Printing To The Masses* Andrea Cheng, 22 May 2018;

105. https://3dprint.com/206664/3d-printing-olympics-gold/ *3D Printing Helped Chinese Team Win Gold at 2018 Winter Olympics* Clare Scott, 13 March 2018;
106. https://3dprint.com/204760/3d-printing-olympic-biathlon/ *3D Printing Prototypes Supports Reach for 2018 Olympic Gold in Men's Biathlon* Hannah Rose Mendoza, 22 February 2018;
107. https://3dprint.com/203737/us-luge-team-3d-printing/ *US Olympic Luge Team Hopes for a 3D Printed Advantage with Help from Stratasys* Clare Scott, 14 February 2018;
108. http://www.3ders.org/articles/20160909-how-3d-printing-will-power-the-paralympic-games.html 9 September 2016;
109. https://www.sculpteo.com/blog/2018/05/23/3d-printed-clothes-top-7-of-the-best-projects/ *3D printed clothes: Top 7 of the best projects* Lucy Gaget, 23 May 2018;
110. https://3dprint.com/182312/danit-peleg-3d-printed-jacket/ *3D Printing Goes Ready to Wear as Danit Peleg's Bomber Jacket Becomes the First Commercially Available 3D Printed Garment* Sarah Anderson Goehrke, 28 Juy 2017;
111. https://danitpeleg.com/about/;
112. https://www.levistrauss.com/unzipped-blog/2017/07/31/levis-tests-3d-printing-technology/;
113. https://www.designnews.com/materials-assembly/levi-strauss-experiments-3d-printed-denim/127098683857307 *Levi Strauss Experiments with 3D-Printed Denim* Elizabeth Montalbano, 14 August 2017;
114. https://3dprintingindustry.com/news/balenciaga-3d-printing-fashion-130162/ *Balenciaga 3d Scanning And 3d Printing For Luxury Fashion In Aw 2018 Collection* 9 March 2018;
115. https://www.allthat3d.com/3d-printing-medicine/;
116. https://3dprintingindustry.com/news/12-things-we-can-3d-print-in-medicine-right-now-42867/;
117. https://www.asme.org/engineering-topics/articles/manufacturing-design/top-5-ways-3d-printing-changing-medical-field *Top 5 Ways 3D Printing Is Changing the Medical Field* Nancy S Giges, May 2017;
118. https://3dprint.com/68527/medical-3d-printing-in-haiti/ *Disaster Relief in Three Dimensions: Medical 3D Printing in Haiti* Kayla Matthews, 29 May 2015;
119. http://foodink.io/press-kit/ *Official World Premiere*;
120. https://www.youtube.com/watch?v=xk9hNin_sag;
121. https://3dprinting.com/food/3d-printing-as-a-solution-to-global-food-crises/ *3D Printing As A Solution To Global Food Crises* 4 November 2016;
122. https://3dprinting.com/food/new-candy-printer-enter-market/ *A New Candy Printer to Enter the Market* 20 August 2014;
123. https://en.wikipedia.org/wiki/Maker_culture;
124. http://www.openair.org.za/wp-content/uploads/2018/02/WP-9-A-Scan-of-South-Africas-Maker-Movement.pdf *A Scan of South Africa's Maker Movement* Jeremy de Beer, Chris Armstrong, Meika Ellis and Erika Kraemer-Mbula 21 December 2017;
125. https://www.popsci.com/rise-makerspace-by-numbers *By The Numbers: The Rise Of The Makerspace* Nicole Lou and Katie Peek, 22 February 2016;
126. www.thingiverse.com ;
127. https://www.thingiverse.com/about/;
128. https://creativecommons.org/;
129. https://3dwarehouse.sketchup.com/?hl=en;
130. https://pinshape.com/3d-marketplace;
131. https://www.shapeways.com/;

132. https://i.materialise.com/en;
133. https://www.sculpteo.com/en/;
134. https://www.3dhubs.com/knowledge-base/advantages-3d-printing *The Advantages of 3D printing* Ben Redwood;
135. https://www.dst.gov.za/images/2018/Additive%20Manufacturing%20Strategy.pdf April 2016;
136. https://site.rapdasa.org/what-is-rapdasa/;
137. http://www.crpm.co.za/#portfolio;
138. https://www.brandsouthafrica.com/investments-immigration/business/economy/sectors/manufacturing-in-south-africa *Manufacturing in South Africa* 20 June 2017;
139. https://www.aerosud.co.za/;
140. https://www.thesouthafrican.com/aeroswift-biggest-3d-printer/ *Aeroswift: The biggest, state-of-the-art 3D Printer in SA* Erene Oberholzer, 1 Augustus 2018;
141. https://www.csir.co.za/project-aeroswift;
142. https://www.rapid3d.co.za/;
143. http://www.3dprintingstore.co.za/;
144. https://3dprintingsystems.co.za/;
145. https://www.fin24.com/Finweek/Entrepreneurs/how-3d-printing-gave-a-craftsman-his-hand-back-20151116 *How 3D printing gave a craftsman his hand back* Shandukani Mulaudzi, 16 November 2015;
146. http://robobeast.co.za/robobeast-3d-printer/;
147. https://site.rapdasa.org/additive-manufacturing-in-south-africa/;
148. https://site.rapdasa.org/wp-content/uploads/2017/02/Additive-Manufacturing-Global-Trends-and-SA-Opportunities.pdf Additive Manufacturing: Global trends and South African opportunities, May 2017;
149. https://www.rapid3dparts.co.za/;
150. http://www.3dforms.co.za/;
151. https://www.3dprinttech.co.za;
152. http://www.openair.org.za/wp-content/uploads/2018/02/WP-9-A-Scan-of-South-Africas-Maker-Movement.pdf *A Scan of South Africa's Maker Movement* Jeremy de Beer, Chris Armstrong, Meika Ellis and Erika Kraemer-Mbula, 21 December 2017 p.22 to p.24;
153. http://www.openair.org.za/;
154. http://themakerspace.co.za/;
155. http://makerlabs.co.za/;
156. http://makerstation.co.za/;
157. https://www.dst.gov.za/images/2018/Additive%20Manufacturing%20Strategy.pdf;
158. https://www.thedti.gov.za/news2018/IP_Policy2018-Phase_I.pdf Intellectual Property Policy of the Republic of South Africa Phase I 2018;
159. https://www.gov.za/sites/default/files/Executive%20Summary-NDP%202030%20-%20Our%20future%20-%20make%20it%20work.pdf;
160. http://digital-law-online.info/lpdi1.0/treatise33.html;
161. https://www.publicknowledge.org/files/What's%20the%20Deal%20with%20Copyright_%20Final%20version2.pdf *What's the Deal with Copyright and 3D Printing?* Michael Weinberg, January 2013 p.6;
162. https://3dprint.com/121262/makerbot-responds-to-jpi/ *MakerBot Responds to Shady eBay Store Selling Thingiverse Users' 3D Models* Scott J Grunewald, 24 February 2016;

163. https://all3dp.com/disney-pulls-star-wars-models-from-thingiverse/ *Disney Pulls Star Wars Models From Thingiverse: An Inside Look at Copyright Issues in the 3D Space* Tyler Koslow, 12 November 2017;
164. https://www.theregister.co.uk/2017/06/15/disney_fights_counterfeiting/ *Disney mulls Mickey Mouse magic material to thwart pirates' 3D scans* Thomas Claburn, 15 June 2017;
165. https://obamawhitehouse.archives.gov/blog/2013/02/13/president-obamas-2013-state-union;
166. https://www.shapeways.com/blog/wp-content/uploads/2016/05/white-paper-3d-scanning-world-without-copyright.pdf *3d Scanning: A World Without Copyright* Michael Weinberg, May 2016;
167. http://boingboing.net/2016/03/30/landmark-study-on-the-effects.html *Landmark Study on the Effects of Copyright Takedown Abuse on Online Free Expression* Cory Doctorow, 30 March 2016;
168. https://www.shapeways.com/wordpress/wp-content/uploads/2017/02/Kickstarter-et-al-512-second-comment-as-filed.pdf *'In the Matter of Section 512 Study: Notice and Request for Public Comment Docket No. 2015-7'* Kickstarter, Makerbot, Meetup, and Shapeways, 22 February 2017;
169. https://copyright.gov/policy/section512/ Section 512 Study;
170. http://am-uk.org/wp-content/uploads/2017/11/AM-UK_Strategy_Publication_Amends_Novermber_Digital.pdf;
171. http://www.copyright.org.au/ACC_Prod/ACC/News_items/2017/Safe_Harbour_Bill_Introduced.aspx *Breaking: Safe Harbour Bill Introduced Into Parliament And 2017 In Review* 5 December 2017;
172. https://www.alrc.gov.au/sites/default/files/pdfs/publications/summary_report_alrc_122.pdf Australian Government Australian Law Reform Commission Copyright and the Digital Economy Summary Report.