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**THE MAKINGS OF AN 'INDIVIDUALIZED-INDUSTRIAL'  
REVOLUTION:  
THREE-DIMENSIONAL PRINTING AND ITS IMPLICATIONS  
ON INTELLECTUAL PROPERTY LAW**

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**Abstract**

Three Dimensional (3D) Printing, or what is also referred to as "Additive Manufacturing", is a process of making three-dimensional solid objects from (generally) a digital file. In addition to its amazing potential, what is outstanding about this technology is that it will be accessible to most in the near future. This accessibility pertains to the machines and materials that are used for printing as well as to the ability to create such objects and to share object files digitally. It has the hallmarks of a new industrial revolution; which I refer to here as the Individualized-Industrial Revolution (i.e. the I.I. Revolution). As such, the conventional intellectual property system will soon come face to face with the great challenge that is posed by this new field. This paper explains why this challenge to intellectual property is three dimensional: the technological-industrial; the commercial-social; and the legal-regulative. In this research paper, that is part of a larger research project, I identify these challenges and propose conceptual approaches to dealing with them.

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## **Introduction**

### **The Reality of Three Dimensional Printing**

Every decade or so, a new innovation comes along that shuffles the cards as far as Intellectual Property law is concerned. Suffice it to mention: the printing press; home VCR; MP3; YouTube; P2P file sharing; and robust reverse engineering of medicines and machines.<sup>2</sup> Now a dramatic new 'shuffler' is upon us.<sup>3</sup> We are one foot in the door to the era of full 3D printing of physical items.<sup>4</sup>

3D Printing, or what is also referred to as "Additive Manufacturing", is a process of making three-dimensional solid objects from (generally) a digital file.<sup>5</sup> In this process of creation, the object is created by laying down successive layers of material until the entire object is created.<sup>6</sup> Effectively, each of these layers is a single thin horizontal layer in a cross-section of the object being created.<sup>7</sup> 3D Printing is, basically, the reverse of slicing an object into thin horizontal slices.<sup>8</sup>

This research is comprised of two chapters. In the first chapter I highlight and consider the far reaching impact of this technology

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<sup>2</sup> See Nathan Schissel, *3D Printing and Implications on Intellectual Property Rights*, TECH. L. ADVISOR (Nov. 10, 2014), archived at <http://perma.cc/7RDN-V7T6> (describing how changes in technology cause changes in intellectual property rights).

<sup>3</sup> See *id.* (characterizing how a single change in technology can affect the intellectual property landscape).

<sup>4</sup> See CHRISTOPHER D. WINNAN, 3D PRINTING - THE NEXT TECHNOLOGY GOLD RUSH: FUTURE FACTORIES AND HOW TO CAPITALIZE ON DISTRIBUTED MANUFACTURING 245 (2013) (describing the 3D printing capabilities of turning thoughts into actual 3D objects in the near future); see also HOD LIPSON & MELBA KURMAN, FABRICATED: THE NEW WORLD OF 3D PRINTING 46 (Mary James et al. eds., 2013) (observing the centralized process of manufacturing in factories and comparing the evolution of the telecommunications industry with 3D printing); CHRIS ANDERSON, MAKERS: THE NEW INDUSTRIAL REVOLUTION (2012) (describing the different ways people are using 3D printers).

<sup>5</sup> See LIPSON & KURMAN, *supra* note 4, at 11 (defining generally what the process of 3D printing entails).

<sup>6</sup> See LIPSON & KURMAN, *supra* note 4, at 12 (examining the 3D printing process).

<sup>7</sup> See LIPSON & KURMAN, *supra* note 4, at 12 (explaining the 3D printer's layering process to form three-dimensional objects).

<sup>8</sup> See LIPSON & KURMAN, *supra* note 4, at 12 (continuing to explain the layering process used by 3D printers).

in three levels (or dimensions): the technological-industrial; the commercial-social; and the legal-regulative. This first chapter is intended to allude to the challenges looming ahead and to identify and explain their conceptual background. As such, this chapter is intended to creating the awareness of the looming three dimensional challenges that 3D printing brings forth vis-à-vis intellectual property protection and regulation. In the second chapter, I discuss a host of specific issues that need to be considered when approaching this new challenge. As such, this chapter, indeed the entire paper, opens the door for a broader research project that is intended to provide a comprehensive model for resolving the challenges that are identified therein. In this capacity, my present paper lays the groundwork for a broader research project which is intended to provide specifically trailered rules and procedures for dealing with the challenges posed by 3D Printing. All of this is done with a view that this amazing new technology (which is now upon us) has many benefits but also may entail many costs. Thus, the ultimate aim of my research is to seek after and explore the path towards the optimal balance wherein we can reap the benefits of this technology without paying too hefty a price (in all of the above-mentioned dimensions) for its use.

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## Chapter One

### The Nature and Three Dimensional Impact of 3D Printing

What is printing? Well, simply stated it is a way to clone stuff.<sup>9</sup> Until now we have done it with words, images, and music.<sup>10</sup> In this regard, the process of replicated content that exists is part of our reality as we know it.<sup>11</sup> However, when printing becomes three dimensional; that is, when it allows the user to regenerate 3D objects, then the entire paradigm of printing, as we know it today, changes.<sup>12</sup> It is no longer about seeing the object; it is now about having it, possessing it and using it.<sup>13</sup> Now, we are faced with the reality, that the tools that have been set up to protect intellectual property are thrust into a new theater where the rules of engagement (for lack of a better term) are drastically different from what we have come to know thus far.<sup>14</sup>

In this chapter, I shall show why 3D printing has a three dimensional impact on the protection of intellectual property. The aim here is to create awareness to the scope of the challenge and to show why we are at the doorstep of a new Industrial Revolution, no less! But this revolution, indeed as the entire field is of a new nature, it is an 'Individualized' Industrial Revolution. It is one that empowers the individual to be the master of his choices. Crucially, this empowerment has costs that are detailed in this chapter.

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<sup>9</sup> See Thomas Margoni, *Not for Designers: On the Inadequacies of EU Design Law and How to Fix It*, 4(3) J. OF INTELL. PROP., INFO. TECH. & E-COM. L. 225, 226 (2013) (describing that the purpose of 3D printers is to manufacture physical objects).

<sup>10</sup> See LIPSON & KURMAN, *supra* note 4, at 11 (describing the difference between an inkjet printer and a 3D printer).

<sup>11</sup> See LIPSON & KURMAN, *supra* note 4, at 11 (comparing 2D with 3D printing process).

<sup>12</sup> See LIPSON & KURMAN, *supra* note 4, at 11 (discussing the changes with 3D printing).

<sup>13</sup> See LIPSON & KURMAN, *supra* note 4, at 11 (illustrating future convenience of 3D printing).

<sup>14</sup> See Margoni, *supra* note 9, at 227 (warning about future protection requirements for 3D printing).

## **1.1 The Technological-Industrial Impact of 3D Printing**

As stated above, Three Dimensional Printing or what is also referred to as “Additive Manufacturing”, is a process of making three-dimensional solid objects from (generally) a digital file.<sup>15</sup> In this process of creation, the 'new' (printed) object is created by first copying the 'target' object, including its functional features and then by laying down successive layers of material until the entire new object is created.<sup>16</sup> Crucially, the real drama is that these printers are not only capable of replicating the shape of a target object, but that they are able to replicate its form as well!<sup>17</sup> That is to say, that the printed object can function, (or be utilized), in the same way as its related target object.<sup>18</sup> This functional printing is a reality; it has already been achieved in the case of wrenches, handguns, and other tools and gadgets.<sup>19</sup> There is no longer room for doubt: 3D printing is on a rapid rise and about to take the world by storm.<sup>20</sup>

From the outset, it is worth noting that “the use of printing machinery to manufacture physical objects created digitally . . . [(e.g. Computer-Aided Design (CAD)) is not new,] . . . and it is actually the standard in many industrial fields, [such as] aeronautics and home furniture.”<sup>21</sup> But this is only the beginning.<sup>22</sup> According to Margoni: “[t]he change in recent years that has the potential to be a paradigm-shifting factor is a combination between the popularization of such

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<sup>15</sup> See LIPSON & KURMAN, *supra* note 4, at 12 (describing the process manufacturing a 3D object from a digital file).

<sup>16</sup> See LIPSON & KURMAN, *supra* note 4, at 12 (indicating that each of these layers is a single thin horizontal layer in a cross-section of the object being created. 3D Printing is, basically, the reverse of slicing an object into thin horizontal slices).

<sup>17</sup> See LIPSON & KURMAN, *supra* note 4, at 11 (articulating how 3D Printing adds a tangible aspect).

<sup>18</sup> See LIPSON & KURMAN, *supra* note 4, at 11 (demonstrating how 3D Printed objects are different from paper).

<sup>19</sup> See National Geographic Channel, *ZCorp's 3D Printer replicates a wrench*, YOUTUBE (Jul. 11, 2011), archived at <http://perma.cc/9A27-CB7P> (illustrating the process of replicating a wrench with a 3D printer).

<sup>20</sup> See Christopher Mims, *3D Printing Will Explode in 2014, Thanks to the Expiration of Key Patents*, QUARTZ (Jul. 21, 2013), archived at <http://perma.cc/764J-P2ND> (discussing the growing availability of 3D printing).

<sup>21</sup> Margoni, *supra* note 9, at 225.

<sup>22</sup> See Margoni, *supra* note 9, at 226 (discussing the changes that have occurred and will continue to occur).

technologies (price, size, usability, quality) and the diffusion of a culture based on access to and reuse of knowledge. We will call this blend Open Design.”<sup>23</sup> My prediction (based on what we already know) is that this type of Open Design through 3D Printing is set to change the world, no less, and in this process Intellectual Property (IP) is expected to be greatly impacted by this.<sup>24</sup> Even now, 3D Printing is creating the miraculous, almost tele-transporting objects into being.<sup>25</sup> These 3D Printing machines (or robots) are now being able to print objects, tools, gun parts, and even human bone tissue and human organs.<sup>26</sup> In essence, the replication of the unthinkable is now becoming a reality.<sup>27</sup>

According to Schissel “[l]ike many new technologies, 3D printing raises a number of legal questions and challenges, particularly challenges related to the unauthorized reproduction of products protected by intellectual property (IP) rights.”<sup>28</sup> Indeed, this type of observation is now typical of the general recognition of the impending impact of 3D printing.<sup>29</sup> According to Brean, “3D printers fundamentally alter the traditional allocation of manufacturing infrastruc-

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<sup>23</sup> Margoni, *supra* note 9, at 226.

<sup>24</sup> See Margoni, *supra* note 9, at 226 (articulating how important Open Design 3D Printing may become).

<sup>25</sup> See James Grimmelmann, *Indistinguishable from Magic: A Wizard’s Guide to Copyright and 3D Printing*, 71 WASH. & LEE L. REV. 683, 697-98 (2014) (generalizing the effect 3D printing has on intellectual property).

<sup>26</sup> See Alaadien Khalyfa et al., *Development of a New Calcium Phosphate Powder-binder System for the 3D Printing of Patient Specific Implants*, 18 J. MATERIALS SCI.: MATERIALS IN MED. 909, 910 (2007) (providing an example of an object that 3D imaging can create); see also Christian Bergmann et al., *3D Printing of Bone Substitute Implants Using Calcium Phosphate and Bioactive Glasses*, 30 J. EUR. CERAMIC SOC’Y 2563 (2010) (discussing the advantages to using 3D printed bone implants).

<sup>27</sup> See Kevin J. O’Neill, *Is Technology Outmoding Traditional Firearm Regulation? 3-D Printing, State Security, and the Need for Regulatory Foresight in Gun Policy* (May 3, 2012) (unpublished paper, University of Iowa College of Law) (referencing new uses for 3-D Printing); F. Rengier et al., *3D Printing Based on Imaging Data: Review of Medical Applications*, 5 INT’L J. COMPUTER ASSISTED RADIOLOGY & SURGERY 335, 338 (2010) (describing new possibilities enabled by 3D printing in medicine); Matthew Hollow, *Confronting a New ‘Era of Duplication’? 3D Printing, Replicating Technology, and the Search for Authenticity in George O. Smith’s Venus Equilateral Series*, (May, 2013) (unpublished paper, Durham University) (comparing past science fiction to science now).

<sup>28</sup> See Schissel, *supra* note 2 (discussing legal problems arising from 3-D printing).

<sup>29</sup> See Schissel, *supra* note 2 (stating many people are discussing the legal issues surrounding 3D printing).

ture and sales activity, whereby, manufacturers no longer need to make, sell, and ship physical products in their physical states.”<sup>30</sup> Rather, Brean points out that “consumers may download digital representations of products over the Internet for printing in the comfort of their own homes”.<sup>31</sup> Osborn goes further in observing that “[t]hree-dimensional printing is invading society, bringing with it the ability to “print” objects (atoms) from computer files (bits).”<sup>32</sup> Posting a computer CAD file of an object (an illegal gun or an infringing shoe) to the internet essentially makes the physical object available to the world.<sup>33</sup>

Imagine, if you will, the impact that this technology will soon have on large scale manufacturing, shipping, warehousing, outsourcing, mass production and others.<sup>34</sup> All of these are set to dramatically plummet as the demand curve is altered given that individuals can now print (indeed create) much of what they need and effectively produce it at home.<sup>35</sup> These machines are projected to become to industry what the digital camera became to the photography industry.<sup>36</sup> Essentially, 3D will soon shift a large part of what is (legally speaking) in the private domain to the private dominion of the individual

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<sup>30</sup> See Daniel Harris Brean, *Asserting Patents to Combat Infringement via 3D Printing: It's No 'Use'*, 23 FORDHAM INTELL. PROP., MEDIA & ENT. L. J., 771, 771 (2013) (describing the ways 3D printers are changing manufacturing).

<sup>31</sup> See *id.* (identifying how individual consumers may begin to use 3D printing). Brean alerts us to the fact that “in existing [patent] law, the distributors of digital representations of products are not “making,” “selling,” or “using” the patented products or any “component” thereof”. According to Brean’s view, with which I agree, while copyright law might be able to deal with the aesthetic rather than functional side of the issue, a specific patent oriented solution needs to be introduced to patent law in order to fill this void. *Id.* at 771-72.

<sup>32</sup> See Lucas Osborn, *Regulating Three Dimensional Printing: The Converging Worlds of Bits and Atoms*, 51 SAN DIEGO L. REV. 553, 555 (2014) [hereinafter Osborn, *Regulating Three Dimensional Printing*].

<sup>33</sup> See *id.* at 581 (indicating that posting a CAD file of a firearm to the Internet may raise free speech and Second Amendment concerns).

<sup>34</sup> See Brean, *supra* note 30, at 774 (describing changes to production, manufacturing, and distribution).

<sup>35</sup> See Brean, *supra* note 30, at 771 (discussing the increase of consumer freedom to print products at home due to 3D printers).

<sup>36</sup> See David DiSalvo, *The Fall of Kodak: A Tale of Disruptive Technology and Bad Business*, FORBES, (2011), archived at: <http://perma.cc/53LR-2GQS> (describing industry struggles to keep up with technology). This is something that corporations such as KODAK came to experience first-hand. *Id.*

user or consumer.<sup>37</sup> With the advent of 3D printing, gone are the days when people were restricted from producing complex items and designs that needed special machinery.<sup>38</sup> The power now is shifting (fast) into the hands of the people – that is to say the individuals in their business and, more crucially, in their homes are now masters of their respective domains.<sup>39</sup> It is the era of 'Democratization' of technology and production and as such, it is, I believe, destined to be a major 'shuffler'.<sup>40</sup> It is indeed, tantamount to a revolution, no less.<sup>41</sup> I would refer to this as the 'Individualized-Industrial' Revolution (The "I.I. Revolution").<sup>42</sup> It is an apt name for this phenomenon that can turn the individual from a passive consumer to an active producer.<sup>43</sup>

Indeed, I don't use my coined term (the I.I. Revolution) lightly, because to my mind, the similarity between the original Industrial Revolution and the I.I. Revolution is striking. In both it is about breaking the existing paradigm of its time.<sup>44</sup> In both it is possible to

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<sup>37</sup> See Brean, *supra* note 30, at 771 (discussing home printing options).

<sup>38</sup> See Alexander Maund, *3D Printed '28- Geared Cube' – Printed Fully Assembled*, YOUTUBE (Apr. 9, 2013), archived at <https://perma.cc/N39A-SKKE> (demonstrating an example of 3D printing).

<sup>39</sup> See Brean, *supra* note 30, at 771 (describing some potential personal uses for 3-D printing that were once solely in the realm of manufacturing); see also Sukamal Banerjee, *3D: Are You Ready for the New Decentralized Revolution?*, WIRED, archived at <http://perma.cc/R9F9-DH69> (explaining the transition to consumers).

<sup>40</sup> See Michael Wolf, *The New Era of Democratized Business*, FORBES (Nov. 5, 2012), archived at <http://perma.cc/9NXM-YB7U> (asserting democratization of technology is sure to “change the lives of people globally”).

<sup>41</sup> See Barry Berman, *3-D printing: The New Industrial Revolution*, 55 Business Horizons 155 (2012), archived at <http://perma.cc/RYB8-URSR> (describing the effects the internet will have on society's ability to utilize CAD-CAM programs); see also Pedro Malaquias, *The 3D Printing Revolution: An Intellectual Property Analysis* (Aug. 8, 2014) (unpublished paper, Queen Mary, University of London) (discussing impact 3D printing will have on IP law based on the need to adjust existing protections for intellectual property owners).

<sup>42</sup> See Ludwig von Mises, *Individualism and the Industrial Revolution*, MISES INST. (Nov. 28, 2011), archived at <http://perma.cc/QJL5-NY33> (characterizing the progressive and liberal nature as to “permit[ting] the development of the faculties of every individual”).

<sup>43</sup> See PBS, *What is 3D Printing and How Does it Work??*, YOUTUBE (Aug. 18, 2013), archived at <http://perma.cc/R76R-JM5T> (demonstrating the capabilities of 3D printing).

<sup>44</sup> See T. S. ASHTON, *THE INDUSTRIAL REVOLUTION 1760-1830* 1-2 (Gilbert Murray et al. eds., 1948) (discussing the rise of the middle class and the increase in entrepreneurship); see also Giorgio Riello & Patrick K. O'Brien, *Reconstructing the Industrial Revolution: Analyses, Perceptions and Conceptions Of Britain's Preco-*

find the following themes: challenging the nature of production; empowerment; personal entrepreneurship; creating a prosperous middle class; allowing people more accessibility to more types of products; changing production; reinvigorating production and prompting producers to cooperate together.<sup>45</sup> These fit well into both narratives, but the I.I. Revolution differs from its predecessor.<sup>46</sup> The latter is set to challenge the long existing paradigm of the Industrial Revolution in branding, patent and copyright, and challenging the paradigms of production and consumption.<sup>47</sup> According to Osborn, the influence of this (3D printing) technology will “erode the dividing line between the physical and the digital worlds and will bring millions of lay people into intimate contact with the full spectrum of intellectual property laws. One of the areas most affected by 3D printers will be three-dimensional art.”<sup>48</sup> This is especially true given that affordable 3D printers are entering the home market.<sup>49</sup> Soon, a 3D printer will be a standard machine in every home in advanced countries and even in emerging economies.<sup>50</sup> Before committing to acquiring a personal 3-

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*cious Transition to Europe's First Industrial Society* 22-23 (London Sch. of Econ., Working Paper No. 84/04 2004) (elucidating European travelers' perceptions and conceptions of the British Industrial Revolution).

<sup>45</sup> See ASHTON, *supra* note 44, at 11 (describing the changes that were happening during the Industrial Revolution).

<sup>46</sup> See Allister Heath, *3D Printing: the New, Bottom-up Industrial Revolution*, THE TELEGRAPH (May 7, 2013), archived at <http://perma.cc/YJ4B-NKFY> (arguing 3D technology will challenge traditional top-down economics by giving individuals ability to create goods previously available only through mass production of manufactured goods).

<sup>47</sup> See Ceci Joannou, *Can IP Law Protect Brands Against 3D Printing?*, BRAND & COM. (Mar. 27, 2013), archived at <http://perma.cc/CT2K-MM8P> (describing challenges with 3D printing related to protecting copyright, patent and brands).

<sup>48</sup> See Lucas Osborn, *Of PhDs, Pirates, and the Public: Three-Dimensional Printing Technology and the Arts*, 1 TEX. A&M L. REV. 811 (2014) (familiarizing the average person with 3D technology and intellectual property and explaining how 3D printing will influence the creation of 3D art).

<sup>49</sup> See *id.* at 814 (stating how affordability of 3D printers will lead to more household usage).

<sup>50</sup> See Brean, *supra* note 30, at 771 (describing home uses for 3-D printing); see also Richard A. D'Aveni, *3-D Printing Will Change the World*, HARV. BUS. REV. (Mar. 2013), archived at <https://perma.cc/3GJX-49DT> (announcing that goods previously produced on large scale centralized plants may now be produced locally and therefore, eliminating shipping and buffer inventories).

D printer, there are already websites, like Shapeways, that allow 3-D printed items to be personally designed and ordered.<sup>51</sup>

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The I.I. Revolution is set to make all individuals potential producers and designers.<sup>52</sup> The marginal loss in experimentation will become negligible, thus empowering and emboldening the individual designer to explore new designs and products.<sup>53</sup> What is more, with the ability to self-print objects, there will be less need to deal with the costs and hassle of delivery of products.<sup>54</sup> In this way, the world becomes a collage of privately-owned personalized factories, or rather of privately owned idea-generating individuals.<sup>55</sup> Consequently, 3D printing is also set to impact creativity as well as IP ownership.<sup>56</sup> This will be discussed in the next two subsections.

## **1.2 The Commercial-Social Impact of 3D Printing**

Based on the nature of this technology, it is not far-fetched to predict that it will be accessible to most in the near future.<sup>57</sup> In this regard, Lemley proposes that 3D Printing, along with three other developments (i.e. the Internet, robotics, and synthetic biology) can create a world without scarcity.<sup>58</sup> In his view, with which I agree: “it is

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<sup>51</sup> See Ashlee Vance, *The Wow Factor of 3-D Printing*, NY TIMES (Jan. 12, 2011), archived at <http://perma.cc/8LAH-PMCN> (identifying alternatives to obtaining 3-D printed objects without having to personally purchase a 3-D printer).

<sup>52</sup> See Berman, *supra* note 41, at 161 (predicting the trend for increased individualized 3D Printing).

<sup>53</sup> See Elizabeth Schaeffer Brown, *3D Printing, Ethical Fashion, and Collaborative Manufacturing*, HUFFINGTON POST (Jan. 22, 2015), archived at <http://perma.cc/D5PY-BP9L> (highlighting the economic advantages of 3D Printing).

<sup>54</sup> See Berman, *supra* note 41, at 157 (discussing the low fixed costs of 3D Printing).

<sup>55</sup> See Brown, *supra* note 53 (discussing individual and manufacturing collaboration).

<sup>56</sup> See Berman, *supra* note 41, at 158 (noting the impact on intellectual property rights).

<sup>57</sup> See Vance, *supra* note 51 (stating new 3D printers are now affordable for consumers).

<sup>58</sup> See Mark A. Lemley, *IP in a World Without Scarcity* 1 (Stanford Pub. Law Working Paper No. 2413974, 2014), archived at <http://perma.cc/2NEW-ZZ8Z> (commenting on how technological advances end scarcity).

entirely plausible to envision a not-too-distant world in which most things that people want can be downloaded and created on site for very little money.”<sup>59</sup> This too, will no doubt affect the IP régime that we are, presently, accustomed to and which is based on a scarcity-induced reality of a well-fenced and (relatively) well-guarded private domain.<sup>60</sup> The accessibility of 3D printing pertains to three crucial elements that appear to be coming together in the past 5 years: access to the printing machines, access to materials for printing (the raw materials), as well as the ability to create such objects and to share object files digitally.<sup>61</sup> Indeed, the interface between human and machine in this regard is becoming exceedingly (even exponentially) user friendly and, as such, most will be able afford it and to use it.<sup>62</sup> Just as we print from a printer or even place an item in the microwave, the degree of simplicity of using 3D Printing is expected to become easier.<sup>63</sup> Clearly, this is dramatic both for technology and for the law.<sup>64</sup>

To my mind, 3D industry is set to alter the way in which we consider the measure of commercial success.<sup>65</sup> That is to say, no longer is there a need for a broad client base for a product to succeed; no longer is there a need for holding inventory or shifting it around to the different stores.<sup>66</sup> A seller can sell one million items as easily as he can sell one item; and can sell in 100 locations as easily as he can sell in one.<sup>67</sup> Home printed 3D objects are set to change the deep-set paradigm of marketing; namely that is for a product to succeed there needs to be a broad demand for it and an ability to get it physically to the buyers in the shortest time possible.<sup>68</sup> Now, the buyers can simp-

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<sup>59</sup> *See id.* at 2 (suggesting that in the future, all items will be downloadable for a small fee).

<sup>60</sup> *See id.* at 2-3 (identifying the classical view of IP law).

<sup>61</sup> *See Vance, supra* note 51 (noting accessibility of materials and designs).

<sup>62</sup> *See Berman, supra* note 41, at 158 (listing advantages of 3D Printing).

<sup>63</sup> *See Vance, supra* note 51 (describing the easy use of a 3D Printer and design software).

<sup>64</sup> *See Vance, supra* note 51 (inferring the changes in technology were drastic).

<sup>65</sup> *See Brown, supra* note 53 (showing how 3D Printers could help improve the manufacturing process).

<sup>66</sup> *See Brown, supra* note 53 (allowing for smaller businesses to be able to compete in global marketplace).

<sup>67</sup> *See Brown, supra* note 53 (demonstrating that even small businesses can now keep up with market demands with ease).

<sup>68</sup> *See Berman, supra* note 41, at 159 (illustrating how 3D Printing is changing marketing).

ly print the items from home, thus circumventing the middle man.<sup>69</sup> What is more the consumer is also potentially a producer in that he is able to formulate the shape and even the form of items to his own liking.<sup>70</sup> Thus, true and pure customization is now at hand.<sup>71</sup> This is the I.I. Revolution that I have referred to above.<sup>72</sup>

In correlation with that reality, one can expect a weakening in the impact of brands.<sup>73</sup> Brands function (primarily) as a source indicator.<sup>74</sup> They are intended to create a medium of communication between producer/seller and the public whereby the latter trust the qualities of the product as reflected by the brand so much so that consumers tend to manifest loyalty to specific brands.<sup>75</sup> In an I.I. Revolution era, this would be of lesser importance given that the consumer will be merely taking the physical design and creating it himself.<sup>76</sup> In essence, it is the consumer who will be responsible and in control of the materials that are used to create the product that he (or she) needs.<sup>77</sup> Consider for example printing a wrench; in this case the consumer would determine the quality of resin that he uses, the same applies for printing jewelry, or making shoes, in all of these cases the raw materials will be in the hands of the consumer, so he would not need a brand in order to be assured of the quality of the

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<sup>69</sup> See Berman, *supra* note 41, at 159 (showing the instantaneous nature of 3D Printing products from home).

<sup>70</sup> See Berman, *supra* note 41, at 156-57 (discussing the ease of creating individualized objects using a 3D Printer).

<sup>71</sup> See PBS, *supra* note 43 (showing the 3D printing process).

<sup>72</sup> See *supra* Sections 1.1, 1.2. (discussing how intellectual property will be greatly impacted by three dimensional printing, which will result in a new Industrial Revolution).

<sup>73</sup> See Lemley, *supra* note 58 (describing issues with trademarks and name brands).

<sup>74</sup> See Lemley, *supra* note 58 (discussing issues with logo protection).

<sup>75</sup> See Amir H. Khoury, *Brands as Food For Thought: The Case for Regulating Food Brands*, 4 INDIAN J. INTELL. PROP. L. 1, 8 (2012) [hereinafter Khoury, *Brands as Food For Thought*] (describing how consumers become brand devoted); see also Amir H. Khoury, *Brand Loyalty & Loyalty of Brands: A Symbiotic Relationship*, 32 J. L. & COM. 173, 174-76 (2014) [hereinafter Khoury, *Brand Loyalty & Loyalty of Brands*] (discussing the impact of brands on consumer choice and loyalty).

<sup>76</sup> See Berman, *supra* note 41, at 161-62 (explaining how consumers will be able to use the 3-D printing to produce customized products at home).

<sup>77</sup> See Berman, *supra* note 41, at 160-62 (explaining how developments in 3-D printing will like bring down material costs allowing consumers to create and produce customized products at home).

end product, since it is he who effectively creates it.<sup>78</sup> This downsizing of the impact of brands is likely to allow the consumer to regain his freedom of choice in that he would focus purely on design and quality rather than what he thinks the branded product conveys to him.<sup>79</sup> What is more, by allowing various object-design owners to sell online, it is conceivable that newcomers into the branding world could benefit from this by way of allowing them more level playing field access to wider markets.<sup>80</sup> In addition to all of these, it might be possible to envision a tendency to shift toward personalized brands or 'brandless' items.<sup>81</sup> We can see signs of a shift to boutique brands even today.<sup>82</sup>

### **1.3 The Legal-Regulative Level**

Notwithstanding, this impressive technological process that is fast approaching, and as things stand today, there is neither a comprehensive understanding of what 3D Printing will mean for IP, nor are there laws that presently regulate this field.<sup>83</sup> This is true not only at the national level but also on the regional level as well (e.g. the EU).<sup>84</sup> It is worth noting that the regulative challenge that 3D printing is already becoming a well-recognized issue.<sup>85</sup> There is an innate

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<sup>78</sup> See Berman, *supra* note 41, at 159 (clarifying that consumers would be able to choose which material they would like to be used in the printing of their product).

<sup>79</sup> See Khoury, *Brand Loyalty & Loyalty of Brands*, *supra* note 75, at 176 (explaining the lack of autonomy in the choices consumers make because of branding).

<sup>80</sup> See Amir H. Khoury, *A NeoConventional Trademark Regime for "Newcomer" States*, 12 U. PA. J. BUS. L. 351, 357 (2010) (discussing importance of opening markets to newcomers in the branding field).

<sup>81</sup> See Khoury, *Brands as Food For Thought*, *supra* note 75, at 11 (discussing the cultural disadvantages of branding).

<sup>82</sup> See Roy Maugham, *Boutique spirits follow craft beer revolution with trebling in number of new distillers*, UHY HACKER YOUNG (Sept. 22, 2014), archived at <http://perma.cc/775B-U4FA> (discussing the recent consumer shift to craft micro brewers).

<sup>83</sup> See Osborn, *Regulating Three Dimensional Printing*, *supra* note 32, at 600-601 (highlighting that default rules that allow for parties to deviate from them in new fields like 3D printing).

<sup>84</sup> See Osborn, *Regulating Three Dimensional Printing*, *supra* note 32, at 562-663 (noting the potential disparity in the regulations on the national and regional perspective).

<sup>85</sup> See Osborn, *Regulating Three Dimensional Printing*, *supra* note 32, at 620 (recognizing the potential regulatory challenges 3D printing poses to IP regulation).

awareness to the impact of 3D on various industries.<sup>86</sup> In this regard Osborn observes that the 3D printing technology “portends dramatic shifts in manufacturing, trade, medicine, and other fields and will require an integrated legal regime for the world of bits and atoms.”<sup>87</sup> In this regard, Margoni highlights the inadequacies of the current legal system in dealing with 3D Printing.<sup>88</sup> Margoni explains that while EU legislature has successfully regulated an otherwise heterogeneous field of law, it has focused on the industry sector rather than on designers themselves.<sup>89</sup> Specifically, he contends that “digitally based, individual or small-sized, 3D printing, open designers and their needs are largely neglected by such legislation.”<sup>90</sup> As this technology grows in strength and agility and availability, more legal challenges will arise.<sup>91</sup> That is to say that the new 3D printing technology is set to clash with existing IP rights that we tend to view as basic to IP protection and as a prerequisite to ensuring the continued momentum of creativity and innovation.<sup>92</sup> An additional legal hurdle relates to the ability of the regulator and of the courts to deal with the (anticipated) influx of legal issues pertaining to 3D printing.<sup>93</sup> Indeed, as the technology becomes more publically open and readily accessible, so too the flashpoints will increase; there is, after all, a linear relationship between both.<sup>94</sup>

Importantly, the impact of 3D printing on IP (in addition to brands as discussed above), will be deep and far-reaching.<sup>95</sup> Suffice

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<sup>86</sup> See Osborn, *Regulating Three Dimensional Printing*, *supra* note 32, at 554-58 (articulating the inherent impact of 3D printing on various industries).

<sup>87</sup> See Osborn, *Regulating Three Dimensional Printing*, *supra* note 32, at 556.

<sup>88</sup> See Margoni, *supra* note 9, at 225 (introducing proposal to develop legal analysis to refine EU law structure).

<sup>89</sup> See Margoni, *supra* note 9, at 225 (asserting tools more focused on industry sector than designers).

<sup>90</sup> Margoni, *supra* note 9, at 225.

<sup>91</sup> See Margoni, *supra* note 9, at 242 (arguing a lack of legal certainty in regards to 3D printers and IP protection).

<sup>92</sup> See Margoni, *supra* note 9, at 243 (discussing generally the inadequacy of existing law).

<sup>93</sup> See Margoni, *supra* note 9, at 244 (stating a possible legal issue that may arise within 3D printing).

<sup>94</sup> See Amanda Scardamaglia, *Flashpoints in 3D Printing and Trade Mark Law*, 23 J.L. INFO. & SCI. 30 (2015) (contextualizing the relationship between 3D printing and trade mark law).

<sup>95</sup> See Melissa Barnett, *The Next Big Fight: 3D Printing and Intellectual Property*, TECH. L. SOURCE (Jan. 31, 2014), archived at <http://perma.cc/8PHX-CRXT> (portraying breadth of impact 3D printing has on IP).

it to mention at this point some examples relating thereto: First, in the patent context disclosure and best-mode can easily become the indirect facilitator for private printing of said objects.<sup>96</sup> The patent disclose in this regard instead of being the backbone of sharing knowledge becomes the blueprint for covet and private copyright of the patented item.<sup>97</sup> That is to say, patents might experience death by a thousand cuts.<sup>98</sup> Second: In the case of copyright this ability to copy designs and art as well as other copyrightable objects is a further empowering of peer-to-peer networking that was (and still is) a substantial issue that copyright has had to deal with.<sup>99</sup> The recent *Viacom v. YouTube* case is a prime example of this, wherein it is no longer clear if the 'notice and take down' clause will continue to stand the test of time.<sup>100</sup> In this regard it is worth noting that it is not clear whether notice and take down measure would suffice to curb the innate consumer tendency to act in private beyond the copyright rules.<sup>101</sup> In the context of trademarks, and as alluded to above, 3D printing is expected to change and overtime completely alter the branding paradigm.<sup>102</sup> Here, information will no long be harnessed in

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<sup>96</sup> See Deven R. Desai & Gerard N. Magliocca, *Patents, Meet Napster: 3D Printing and the Digitization of Things*, 102 GEO. L.J. 1691 (2014) (describing one way how 3D printing impacts IP). Observing that: “3D Printing is a general-purpose technology that will do for physical objects what MP3 files did for music. The core patent bargain—sharing [the plans on] how to make something in exchange for exclusivity—may be meaningless in a world of digitized things.” *Id.*

<sup>97</sup> *See id.* (describing how patents are affecting copyrights). Stating that: Digitization has reached things. This shift promises to alter the business and legal landscape for a range of industries. Digitization has already disrupted copyright-based industries and laws. As cost barriers fell, individuals engaged with copyrighted work as never before. Business-to-business . . . models of industrial copyright faltered and, in some cases, failed. Industries were forced to reorganize, and the foundations of copyright were reexamined.

*Id.*

<sup>98</sup> *See id.* at 1715 (acknowledging why patents have the potential to be infringed).

<sup>99</sup> *See id.* at 1691 (2014) (highlighting the issues posed by business-to-business models of copyright).

<sup>100</sup> *See Viacom Int'l, Inc. v. YouTube, Inc.*, 676 F.3d 19, 27 (2012) (delineating the term “takedown notice”).

<sup>101</sup> *See id.* at 27-28 (acknowledging that the existence of a takedown notice may not affect infringement on private copyright).

<sup>102</sup> *See Joannou, supra* note 47 (discussing the expectations that will change branding).

the brand, since the product itself will be created by the consumer at home or in his private workshop.<sup>103</sup>

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Scientists and the industry are clearly moving rapidly, towards the ability of empowering all to produce whatever they desire (in their businesses or their homes).<sup>104</sup> While this seems to be a great scientific leap forward it does not appear to come without cost.<sup>105</sup> The risk of free-riding here is expected to rise exponentially, and the question is going to be if, in light of this new technology, IP rights will continue to be sustainable.<sup>106</sup>

The idea of trying to make sense of new technology and how it interacts with conventional law is not new.<sup>107</sup> Indeed, every time that a new medium or tool or method of communication enters the market, there is a ripple effect that needs to be looked upon on the regulative level.<sup>108</sup> Time and again, it has been proved that current IP law, is never a match for the past moving technological progress.<sup>109</sup> That progress is ever pushing the envelope in all new directions.<sup>110</sup> Thus, a nimble legal oriented reaction is warranted.<sup>111</sup> In my view, the sooner a new innovation is understood and addressed on the conceptual, legal and regulative levels, the less likely are there to arise

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<sup>103</sup> See Joannou, *supra* note 47 (describing how consumers privately manufacturing name brands replicas of products).

<sup>104</sup> See Kathleen Hall, *How 3D Printing Impacts Manufacturing*, COMPUTERWEEKLY (Feb. 2013) archived at <http://perma.cc/MA78-PDXS/> (speaking to the freedom consumers possess in creating their own products).

<sup>105</sup> See Lemley, *supra* note 58, at 3 (illustrating the difficulties in protecting IP rights caused by 3D Printing).

<sup>106</sup> See Hall, *supra* note 104 (explaining the problems with copyright protection with 3D printing analogous with Napster).

<sup>107</sup> See Hall, *supra* note 104 (showing that as technology changes the law has to change concurrently).

<sup>108</sup> See Hall, *supra* note 104 (exposing how the rapid pace of new technology requires frequent updates to existing regulations).

<sup>109</sup> See Vivek Wadhwa, *Laws and Ethics Can't Keep Pace with Technology*, MIT TECH. REV. (Apr. 15, 2014), archived at <http://perma.cc/6DZG-UHEX> (suggesting the laws cannot keep up with technological changes).

<sup>110</sup> See *id.* (discussing the ethical issues surrounding technological advances).

<sup>111</sup> See *id.* (showing a disconnect between technology and the law that governs it).

costly and time consuming clashes amongst the various market actors.<sup>112</sup> Suffice it to mention the domain name saga.<sup>113</sup>

On the legal-regulating level, the primary challenge which parameters I have described above, is that 3D printing is set to dramatically alter the process of copying and replicating items, rendering individual production common-place this I have referred to above as the II Revolution.<sup>114</sup> This type of 'Decentralized Production' will make it more difficult for IP owners to enforce their rights because the laws in IP are essentially macro-industry geared and not micro industry proof!<sup>115</sup> That is to say, these laws envision a clearly defined (and accessible) defendant with deep pockets.<sup>116</sup> Such a defendant can be taken to court and legal remedies can be sought and enforced against him.<sup>117</sup>

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<sup>112</sup> See *id.* (explaining how a deeper understand of technology contributes to law making).

<sup>113</sup> See Terrence Fernbach, "What is in a Name?" A Comparative Look at the ICANN Uniform Domain Name Dispute Resolution Policy and the United States Anti-Cybersquatting Consumer Protection Act (2012) (unpublished Master thesis, Munich Intellectual Property Law Center) (describing the history of domain names); see also Danielle Weinberg Swartz, Comment, *The Limitations of Trademark Law in Addressing Domain Name Disputes*, 45 UCLA L. REV. 1487 (1998) (discussing the history of trademarks and domain names); Laurence R. Helfer & Graeme B. Dinwoodie, *Designing Non-National Systems: The Case of the Uniform Domain Name Dispute Resolution Policy*, 43 WM. & MARY L. REV. 141, 274 (2001) (summarizing the conflicts and disputes surrounding domain names). In that field, a large number of needless and costly legal conflicts took place because of the initial lack of in-depth understanding of the nature of domain names and of their role and how they fit into the world of trademarks and brands. Consider for example, the initial approach of first-come basis for registration of vacant domain, and how that has been altered over time by the ICANN domain name registration policy. *Id.*

<sup>114</sup> See Catarina Mota, *The Rise of Personal Fabrication*, in PROCEEDINGS OF THE 8<sup>TH</sup> ACM CONFERENCE ON CREATIVITY AND COGNITION 279, 279-288 (2011) (observing the rise of personal 3D printing and the new class of producers created by it).

<sup>115</sup> See Peter K. Yu, *The Escalating Copyright Wars*, 32 HOFSTRA L. REV. 907, 910 (2004) (highlighting the concerns of intellectual property holders regarding new digital technology).

<sup>116</sup> See *id.* at 913 (pointing out the costliness of defending of intellectual property claims).

<sup>117</sup> See *id.* (indicating that the industry has seen a number of lawsuits against defendant companies).

In such legal reality of 'uncharted waters' it is advisable to first seek understanding from similar challenges that have faced IP laws in the past; and to possibly learn from them.<sup>118</sup> Indeed, over the past two decades, various challenges to IP protection have come about.<sup>119</sup> One striking example is that involving the copyright industry wherein the ability to share content (e.g. music, movies) over the internet has become a very harsh reality for copyright owners trying to protect their rights.<sup>120</sup> But, I would have to say that the challenges to intellectual property, thus far, appear to be merely a 'promo' to the 'real deal' that is 3D Printing.<sup>121</sup> That is because 3D printing goes much further in challenging the IP paradigm by facilitating the physical replication of objects and parts thereof.<sup>122</sup> It allows for printing such objects 'at-will' and for the sharing of design files.<sup>123</sup> This technology creates a deep-set connection between virtual designs and tangible objects and products.<sup>124</sup> Therefore, this technology is set to impact not only the social-economic sphere but also the personal and

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<sup>118</sup> See *id.* at 938 (highlighting how intellectual property lawsuits have been challenged because of changes in the industry).

<sup>119</sup> See *id.* at 907 (suggesting that piracy has posed a challenge to intellectual property in the past two decades).

<sup>120</sup> See *id.* at 945 (exemplifying the copyright industry's failure to protect their content online from consumers). See also Pieter Kleve & Feye Kolff, *MP3: The End of Copyright as We Know it?*, in PROCEEDINGS OF THE IASTED INTERNATIONAL CONFERENCE LAW AND TECHNOLOGY 32, 32-37 (1999) (discussing the foreseeable challenges copyright owners face due to the expiring protection laws); Stan J. Liebowitz, *Will MP3 Downloads Annihilate the Record Industry? The Evidence so Far*, in 15 I.P. & ENTREPRENEURSHIP, ADVANCES IN THE STUDY OF ENTREPRENEURSHIP, INNOVATION & ECONOMIC GROWTH 229-60 (Gary D. Libecap ed., Emerald Group Publishing Limited, 2003) (exemplifying how Napster presented copyright challenges).

<sup>121</sup> See Catherine Jewell, *3-D Printing and the Future of Stuff*, WIPO MAGAZINE (Apr. 2013), archived at <http://perma.cc/5PPY-HDB5> (explaining challenges regarding balancing tension between intellectual property protection and copyright law).

<sup>122</sup> See *id.* (discussing the "paradigm shift" initiated by 3D printing).

<sup>123</sup> See *id.* (examining the challenges for IP policymakers due to the increased availability of design files).

<sup>124</sup> See Desai & Magliocca, *supra* note 96 (speculating challenges of protecting the legal integrity of physical products will soon be similar to those faced by digital music). "While 3D printers will unleash the creativity of producers and reduce costs for consumers, they will also make it far easier to infringe patents, copyrights, and trade dress." *Id.*

(even) collective sphere of national security, hence the need for formulating a deep understanding of this new era of 3D printing.<sup>125</sup>

Much work remains to be done, both on the national and on the international levels.<sup>126</sup> That is because, the law as it stands today is not equipped to adequately deal with the potential sea-change in form of individualized industrialized production that does not adhere to the centralized typeset of production.<sup>127</sup> Metaphorically speaking, in the classic IP (business and legal) 'battlefield', the IP owner erects a fence, identifies a foe and launches an (legal) assault (preemptive or otherwise) on that foe in order to halt production or shipments, and to seek retribution (compensation) for damage that has been inflicted.<sup>128</sup> But, (to continue with the metaphor) how can this be defense be sustainable in, so to speak, "guerrilla" type warfare?<sup>129</sup> Indeed, when the 'foe' is no longer a clearly defined competitor with a defined "command and control" (or a clear business presence) but rather individuals downloading and/or printing, in the privacy of their own homes (and place of business)?<sup>130</sup>

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<sup>125</sup> See THOMAS CAMPBELL ET AL., *COULD 3D PRINTING CHANGE THE WORLD? TECHNOLOGIES, POTENTIAL, AND IMPLICATIONS OF ADDITIVE MANUFACTURING 1* (2011), archived at <http://perma.cc/Q8J3-M5TS> (discussing ideas about the immense potential impact of 3D printing that are already being debated). "Now another new technology is gaining traction that may change the world. 3D Printing/Additive Manufacturing (AM) is a revolutionary emerging technology that could up-end the last two centuries of approaches to design and manufacturing with profound geopolitical, economic, social, demographic, environmental, and security implications." They refer to this technology as a "Transformative technology." *Id.*

<sup>126</sup> See Simon Bradshaw et al., *The Intellectual Property Implications of Low-Cost 3D Printing 7* SCRIPTED, 5, 5 (2010), archived at <http://perma.cc/XP8K-ZBF2> (examining IP legislation and case law in relation to 3D printing for personal use).

"[W]ithin the UK at least - private 3D printer owners making items for personal use and not for gain are exempt from the vast majority of IP constraints, and that commercial users, though more restricted, are less so than might be imagined." *Id.*

<sup>127</sup> See CAMPBELL, *supra* note 125, at 9 (discussing the need for a new policy and answers to novel legal questions raised by 3D printing).

<sup>128</sup> See Joachim Henkel & Markus Reitzig, *Patent Sharks* (June 2008), archived at <https://perma.cc/7SWW-MM27> (explaining patent litigation as a battlefield, including the use of injunctions against competitors); see also Irfan A. Lateef & Marko R. Zoretic, *The U.S. Patent Litigation Process*, KNOBBE (Dec. 2010), archived at <http://perma.cc/L3Q9-UWB5> (describing the patent litigation process).

<sup>129</sup> See Henkel, *supra* note 128 (drawing a parallel between IP litigation and warfare).

<sup>130</sup> See Henkel, *supra* note 128 (continuing to elaborate on the war-like tactics among competitors in the patent litigation arena).

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Finally, it is important to take note of the fact that the WTO-TRIPS Agreement much like other WIPO administered treaties (e.g. the Paris Convention and the Berne convention), do, technically speaking, provide a legal basis for protecting IP rights that have been infringed by 3D printing.<sup>131</sup> However, no attention has (thus far) been given within the international IP system to the fact that 3D Printing is not merely another industrial challenge to IP infringement, but that it also constitutes a paradigm shift.<sup>132</sup> Indeed, from my study thus far, I can determine that 3D Printing is much more than a passing challenge to IP or a passing phase in the history of technology.<sup>133</sup>

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<sup>131</sup> See Scardamaglia, *supra* note 94, at 37 (explaining that 3D shapes can be protected under the TRIPS agreement through trademarks).

<sup>132</sup> See Bryan J. Vogel, *IP: 3D Printing and Potential Patent Infringement*, INSIDECOUNSEL (Oct. 2013), archived at <http://perma.cc/9VQ8-KNQZ> (explaining that 3D printing is a new technology that can change the market all together leading to IP litigation).

<sup>133</sup> See Deven R. Desai, Symposium, *The New Steam: On Digitization, Decentralization, and Disruption*, 65 HASTINGS L.J. 1469 (2014) (writing about how technology like 3D printing is undergoing a change from centralized production to small, local production). As alluded to above, there is strong evidence to suggest that 3D Printing is set to have a deep and lasting impact on IP. 3D Printing is set to affect how IP can be used (and abused) and how IP rights can be effectively enforced in light of 3D design files (what I would refer to as - "3DDF"). *Id.* These 3DDFs, I predict, will become commonplace, and will be, as a matter of course, shared on Peer-to-Peer platforms. My research is intended, hopefully, to contribute towards filling that void.

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## Chapter Two

### The Road Ahead: Formulating a Reaction to Three Dimensional Printing

In the previous sections, I have illustrated how 3D Printing is set to affect the way in which we deal with IP and how we need to reformulate its protection in view of the three dimensional challenges that 3D printing brings forth.<sup>134</sup> This is of crucial importance given that 3D Printers are set to become a full-fledged player in the production industry and even, in time, (which, I expect, will be in less than a decade) will also become household items.<sup>135</sup> The interface (indeed the clash) between these 3D machines and conventional intellectual property rights in innovation, design, expression and marketing, will grow in scope and severity.<sup>136</sup> Hence, I believe that the 3D printing technology will challenge us to reevaluate well-established ideas in IP law such as the private and public domains; the idea of use; the nature of enforcement of IP rights; the international protection of IP rights; and the idea of sharing content over the internet.<sup>137</sup>

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<sup>134</sup> See Michael Weinberg, *What's the Deal with Copyright and 3D Printing?*, PUBLIC KNOWLEDGE, at 1 (Jan. 2013), archived at <https://perma.cc/NF2H-X3RA> (discussing why 3D printing requires different protections than other intellectual property); see also, Michael Weinberg, *It Will Be Awesome if They Don't Screw it Up: 3D Printing, Intellectual Property, and the Fight Over the Next Great Disruptive Technology*, PUBLIC KNOWLEDGE, at 1 (Nov. 2010), archived at <https://perma.cc/84SG-ETKA> (stressing importance of being prepared for restrictive intellectual property laws to emerge regarding 3d printing).

<sup>135</sup> See Real Times, *3D printers get set to join the mainstream*, ORANGE BUSINESS SERVICES (Sept. 2014), archived at <http://perma.cc/48BS-72S2> (acknowledging that 3D printing is set to become a \$12 billion dollar industry by 2025 and could save families money on 3D printing household items).

<sup>136</sup> See Michael Rüberg, *3D Printers and Intellectual Property Rights*, BOEHMERT & BOEHMERT (Aug. 2014), archived at <http://perma.cc/MHV2-M7G8> (stating that inevitable issues will arise between 3D printers and intellectual property law).

<sup>137</sup> See Schissel, *supra* note 2 (predicting that in Canada, and I would add in all advanced countries: "Many are predicting that these laws will need to evolve to adapt to the nuanced issues raised by 3D printing."); see also 16x9onglobal, *3D Printing: Make anything you want*, YOUTUBE (Jan. 28, 2013), archived at <https://perma.cc/6SHV-ZZEC> (demonstrating 3D Printing); The Creators Project, *Leaders of the 3D Printing Revolution*, YOUTUBE (Jan. 14, 2013), archived at <https://perma.cc/4D6A-N5MK> (depicting leaders in the 3D Printing market).

In my view, the questions that needs to be raised with respect to 3D printing in the context of IP law can be summarized by the next few questions: What is and (more specifically) what should be the reaction to this innovation on the legal-regulative level?<sup>138</sup> Should these 3D printers be banned?<sup>139</sup> Or be kept under strict governmental control?<sup>140</sup> Or not be allowed to enter homes?<sup>141</sup> Or be contingent on a permit?<sup>142</sup> Or, should they simply be viewed as a natural extension of science and technology?<sup>143</sup> Where, on this scale should the regulator intervene and set the benchmark?<sup>144</sup> How will this technology affect our consumption habits, demand and the attainability of products (and product parts)?<sup>145</sup> Should the legal culture be oriented towards promoting the property in IP or should it be of a more pragmatic nature in a diligent search for a more utilitarian optimum even at the expense of conventional property interests?<sup>146</sup> Indeed, the core question would be: How should IP law prepare for the new era of proliferation of 3D Printers?<sup>147</sup> As an intellectual exercise, imagine if you will the same debate playing our in 1690 relating to Guttenberg's printing press.<sup>148</sup> Now, as then, the same questions would have aris-

<sup>138</sup> See Schissel, *supra* note 2 (raising the intellectual property issues with 3D Printing).

<sup>139</sup> See Olivia Sundberg, *This House Would Ban the Sale of 3D Printers to Households*, INT'L DEBATE EDUC. ASS'N, archived at <http://perma.cc/DZ9X-2BN2> (questioning a potential ban on 3D Printers).

<sup>140</sup> See Daniel Castro, *Should Government Regulate Illicit Uses of 3D Printing?*, INFO. TECH. & INNOVATION FOUND., at 3 (May 2013), archived at <http://perma.cc/37BY-EFAH> (querying about government regulations on 3D Printing).

<sup>141</sup> See Sundberg, *supra* note 139 (hypothesizing that 3D Printers could be banned from households).

<sup>142</sup> See Sandra Helsel, *Four Ways 3D Printing Will Disrupt the Commercial Real Estate Industry*, INSIDE 3D PRINTING CONF. & EXPO (Mar. 27, 2015), archived at <http://perma.cc/J5KJ-VT8G> (discussing potential permit requirements).

<sup>143</sup> See Castro, *supra* note 140 (discussing alternative 3D Printing regulations aside from just treating it as an extension of existing science and technology).

<sup>144</sup> See Osborn, *Regulating Three Dimensional Printing*, *supra* note 32, at 608-09 (questing possible standards of regulating 3D Printing).

<sup>145</sup> See Kelsey B. Wilbanks, *The Challenges of 3D Printing to the Repair-Reconstruction Doctrine in Patent Law*, 204 GEO. MASON L. REV., 1147, 1150 (2013) (discussing new availability of products with 3D Printing).

<sup>146</sup> See Schissel, *supra* note 2 (noting the property right implications that 3D printing heralds under existing IP law in Canada).

<sup>147</sup> See Schissel, *supra* note 2 (predicting the need for the evolution of Property law in the era of 3D Printing).

<sup>148</sup> See Castro, *supra* note 140 (discussing previous debates about new technology).

en, that of empowering the individual over the writers (of the time) who effectively had a monopoly over texts and the copying thereof.<sup>149</sup>

Clearly, providing answers to these questions requires the study of empirical data.<sup>150</sup> The collaboration between various industries can make this data readily available and provide a vivid account of 3D printing technology: its industrial landscape and its proliferation in all walks of life and industry.<sup>151</sup> This will not only illuminate the technology but also highlight its barriers.<sup>152</sup>

In order to effectively treat the interface between 3D Printing and IP, it is not sufficient to mechanically cite existing laws.<sup>153</sup> It is clear that existing IP law protects all manner of IP subject matter including copyrights, designs, patents as well as three dimensional marks.<sup>154</sup> The challenge as such is not in these laws, but rather in how they need to be recalibrated in order to deal with the I.I. Revolution that will be brought about by 3D Printing.<sup>155</sup>

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The need to move fast on this response to 3D printing is not theoretical.<sup>156</sup> That is because technology is not standing still. In fact, while this research is being conducted, already 4D technologies are also on the way.<sup>157</sup> This new 4D technology reflects the ability to

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<sup>149</sup> See Schissel, *supra* note 2 (describing the potential pros and cons for copyright owners and consumers in the realm of 3D printing).

<sup>150</sup> See Desai & Magliocca, *supra* note 96 (arguing that future investigation will be needed).

<sup>151</sup> See Matthew A. Susson, Watch the World "Burn": Copyright, Micropatent and the Emergence of 3D Printing 20 (Jan. 2013) (unpublished manuscript) (explaining how manufacturers can help find information about 3D Printing).

<sup>152</sup> See *id.* at 4 (distinguishing between 3D printing technology's advantages and disadvantages).

<sup>153</sup> See Schissel, *supra* note 2 (stating that there are emerging legal issues with 3D Printing).

<sup>154</sup> See Schissel, *supra* note 2 (reviewing intellectual property protections).

<sup>155</sup> See Schissel, *supra* note 2 (stating that laws need to adjust for the advances in 3D Printing).

<sup>156</sup> See Schissel, *supra* note 2 (urging the adaptation of law for regulating new technology).

<sup>157</sup> See TED Talks, Skylar Tibbits: *The emergence of "4D Printing"*, YOUTUBE (Apr. 4, 2013), archived at <http://perma.cc/RZ3J-UPPP> (demonstrating 4D technology).

create self-changing objects.<sup>158</sup> Using Nano-Technology and Bio-Technology, it is possible to program objects to change shape and properties and to build themselves.<sup>159</sup> This is not a theoretical issue.<sup>160</sup> Already there is software called CAD-Nano that assists in this regard, and which assists in supporting the ability of physical objects to build themselves.<sup>161</sup> Some of these objects are designed to react to water and others are designed to react to other substances.<sup>162</sup> While 4D objects are beyond the scope of this research, I make passing mention of them here in order to show that 3D printing is deemed to already be conventional technology in some circles.<sup>163</sup> Thus, the need to formulate an apt legal response to dealing with 3D technology is acute.<sup>164</sup> In a fast moving technological reality there is a need to make rapid determinations and to formulate rules to regulate this field in a way that, on the one hand, ensures technological progress but also takes into account the challenges and potential costs relating thereto.<sup>165</sup>

Thus, I believe that there is an urgent need to create a task force comprised of industry, regulators and academia in order to definitively map-out the 3D Printing landscape against the backdrop of Intellectual Property and to provide solutions to the flashpoints therein.<sup>166</sup> Ideally, the aim of this task force would be to preempt flashpoints before they become a real problem for the IP regulators, both

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<sup>158</sup> See *id.* (defining 4D technology as multi-material transformation of parts from one shape to another on their own with no human interaction).

<sup>159</sup> See Dennis S. Karjala, *Protecting Innovation in Computer Software, Biotechnology, and Nanotechnology*, 16 VA. J.L. & TECH. 42, 56, 61 (2011) (describing how properties are programmable with nanotechnology and biotechnology capabilities).

<sup>160</sup> See TED Talks, *supra* note 157 (explaining and demonstrating 4D technology and self-assembly).

<sup>161</sup> See *CAD at Nano Scale*, ASME (AUG. 2014), archived at <http://perma.cc/5MCB-U6DG> (discussing construction of geometric models for microstructures).

<sup>162</sup> See TED Talks, *supra* note 157 (showing 4D materials self-assembling in water).

<sup>163</sup> See TED Talks, *supra* note 157 (unveiling recent innovations in self-assembling objects).

<sup>164</sup> See TED Talks, *supra* note 157 (describing industry needs for updated regulations).

<sup>165</sup> See Schissel, *supra* note 2 (describing difficulties in detecting individual copyright infringers and costly nature of pursuing action against them).

<sup>166</sup> See Scardamaglia, *supra* note 94, at 52-57 (proposing solutions to keep industry regulations current).

nationally, as well as internationally.<sup>167</sup> Such a collaborative approach would not be reactive, but rather proactive, in that it attempts to meet head-on the challenges that loom over the immediate horizon.<sup>168</sup> To ignore this challenge is tantamount to ignoring an approaching storm (no less!).<sup>169</sup> Consequently, I would argue that a new way or thinking needs to be introduced, by way of acknowledging both the benefits and the costs of this awesome technology.

On the legal level, there needs to be a structured set of rules and regulations that would be applicable to both the international and/or national level.<sup>170</sup> This is primarily to the trans-border orientation of digital 3D printing.<sup>171</sup> Here it may be helpful to assess the impact of 3D printing on intellectual property including on utility patents, design patents as well as copyright law.<sup>172</sup> This assessment needs to be conducted on various levels including: the theoretical; public domain issues; competition; abuse of rights; and enforcement.<sup>173</sup> Furthermore, given that 3D printing belongs to the broader genre of 'Replication Technology', there is also a need to go one step further and to consider a unified and comprehensive approach to all manner of 3D replication technology.<sup>174</sup>

But before one embarks on such an ambitious endeavor, there is a need to formulate, if possible, a single unified theory that covers all manner of 3D printing vis-à-vis intellectual property.<sup>175</sup> This would effectively charter the path towards a coherent and compre-

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<sup>167</sup> See Scardamaglia, *supra* note 94 (explaining the purpose of a proactive regulatory oversight committee).

<sup>168</sup> See Scardamaglia, *supra* note 94 (describing desired goals for impending legal issues).

<sup>169</sup> See Scardamaglia, *supra* note 94 (forecasting inevitable consequences of reactive regulatory response).

<sup>170</sup> See Daniel T. Kane, Comment, *Printing a War in Three Dimensions: Expanding "Article" to Include Electronic Transmissions Before the ITC*, 23 COMM.LAW CONSP. 427, 462 (2015) (setting forth arguments for international regulation to govern 3D printing).

<sup>171</sup> See *id.* (discussing rules that ITC should promulgate).

<sup>172</sup> See Alexander J. Mendoza, *Legal and Social Implications of the 3D Printing Revolution* 1, 2 (Dec. 1, 2014) (unpublished senior thesis, Claremont McKenna College) (discussing need for assessment of impact of 3D printing on IP law).

<sup>173</sup> See *id.* at 15-16 (discussing the difficulty of enforcing patent protection).

<sup>174</sup> See *id.* at 19 (explaining the phenomenon that is replication technology).

<sup>175</sup> See John Hornick & Carlos Rosario, *3D Scanning: the Achilles Heel of IP Protection for 3D Printing*, 3D PRINTING INDUSTRY (July 28, 2015), archived at <http://perma.cc/XR5B-WHV6> (inferring that the theory covering 3D printing and intellectual property is marred with infringement problems).

hensive legal approach to the entire topic.<sup>176</sup> In my view, such a theory should be based on the premise that all of the three elements which I have highlighted in the preceding chapter are essentially interdependent and even symbiotic.<sup>177</sup> That is to say that 3D printing needs to be addressed and regulated in a way that considers the technological-industrial; the commercial-social, and the legal-regulative as integrated elements.<sup>178</sup> All of these elements need to be assessed and researched collectively in order to formulate a convincing response to the advent of mass 3D printing.<sup>179</sup>

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From my study thus far, I can conclude that this cloud of legal haze sounding the 3D printing technology appears to be typical of all the IP subject matter and in all countries and regions.<sup>180</sup> Furthermore, it is striking that not only is the legal system on the national and regional levels not ready to deal with the influx of said challenges, but also the international system as represented by the World Trade Organization (WTO) and The World Intellectual Property Organization (WIPO) seem to have (as of yet) not devoted sufficient resources to examining the ramifications of 3D Printing on IP.<sup>181</sup> It is worth noting that most of the World Trade Organization's attention to 3D Printing seems to be (narrowly construed) on trade.<sup>182</sup> As of yet,

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<sup>176</sup> See *id.* (setting forth possible paths of legal regulations for 3D Printing).

<sup>177</sup> See Vance, *supra* note 51 (demonstrating the various elements of 3D Printing).

<sup>178</sup> See Schissel, *supra* note 2 (discussing how laws need to adapt to the legal challenges 3D Printing brings).

<sup>179</sup> See Oliver Reichardt, *3D Printing and Its Impact on Society*, RSA (Jan. 23, 2014), archived at <http://perma.cc/WE85-FAJ8> (discussing difficulties regulating 3D Printing); CSC, *4 Ways 3D Printing Will Impact Your Life*, archived at <http://perma.cc/HY8L-RQZZ> (showing how 3D Printing will change consumers day-to-day life).

<sup>180</sup> See Nicole A. Syzdek, Comment, *Five Stages of Patent Grief to Achieve 3D Printing Acceptance*, 49 U.S.F. L. REV. 335, 337 (2014) (highlighting the bizarre relationship between the IP system and IP infringement); Marc Mimler, *3D Printing, the Internet and Patent Law – A History Repeating?*, 62 LA RIVISTA DI DIRITTO INDUSTRIALE 352, 357 (2013) (explaining the complicated relationship between IP law and IP enforcement).

<sup>181</sup> See Kati Suominen, *3 Ways Coming “Mega-Regional” Trade Agreements Benefit U.S. Exporters*, TRADEUP (Apr. 24, 2014), archived at <http://perma.cc/6NKE-TQVQ> (discussing confusion of international agreements surrounding IP rights).

<sup>182</sup> See WORLD TRADE ORG., WORLD TRADE REPORT 270 (2013), archived at <https://perma.cc/HLG5-RC93> (discussing trade related problems).

I have found no reference being made to 3D printing as a trade-related factor that affects the use and enforcement of IP rights.<sup>183</sup> Furthermore, I have not come across a study of the interrelationship between 3D printing the WTO-TRIPS Agreement or any other WIPO administered treaty for that matter.<sup>184</sup> Hence, the situation as it stands is not satisfactory, in that, it appears that, we are not ready, on the conceptual level nor on the regulative level to deal with this new technology that is set to overwhelm us in the next decade or so.<sup>185</sup>

I can at this point merely theorize about a specially tailored treaty covering all aspects of 3D Printing.<sup>186</sup> Such a treaty would be designed to provide comprehensive answers all aspects of this technology vis-à-vis IP, namely; definition of infringement; property rights; international jurisdiction; (virtual) customs role; DMCA-style laws; and specific internet standards similar to the WPPT and the WCT (in the context of copyright).<sup>187</sup> Also, it may be possible to envision extending the Creative Commons concept to encompass the new technology.<sup>188</sup> It may also be possible to entertain the idea of creating a completely new set of rules for this new Inverse (or living)

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<sup>183</sup> See ERMIA S. T. BIADGLEN G & JEAN-CHRISTOPHE MAUR, THE INFLUENCE OF PREFERENTIAL TRADE AGREEMENTS ON THE IMPLEMENTATION OF INTELLECTUAL PROPERTY RIGHTS IN DEVELOPING COUNTRIES: A FIRST LOOK, UNCTAD-ICTSD (Nov. 2011), archived at <http://perma.cc/994W-ZZ4S> (describing the need to increase enforcement in IP rights).

<sup>184</sup> See Suominen, *supra* note 181 (highlighting briefly the world trade agreements require more investigation into IP issues with 3d Printers). But, even if such mention is made, it remains merely a footnote in this world-changing project of innovation and, thus, I am convinced, much more needs to be done. *Id.*

<sup>185</sup> See Schissel, *supra* note 2 (arguing changes need to be made to IP laws to keep up with the new legal issues created by 3D Printers).

<sup>186</sup> See Desai & Magliocca, *supra* note 96 (discussing changes Congress needs to make to better aid IP enforcement).

<sup>187</sup> See Desai & Magliocca, *supra* note 96 (arguing Congress needs to be more aggressive with IP law creation). Desai and Magliocca assert that 3D printing technology “will compel firms to rethink their business practices and courts to reconsider not only patent law but also long-established doctrine in areas ranging from copyright merger to trademark post-sale confusion. Moreover, Congress will need to consider establishing some sort of infringement exemption for 3D printing in the home and expanding the notice-and-takedown provisions of the Digital Millennium Copyright Act to websites that host software enabling 3D printing of patented items and distinctive trade dress. While a 3D printer is not yet a common household item, the time to start thinking about that future is now.” *Id.*

<sup>188</sup> See Jonathan Paleck, *3D Printing: CC and the 3D Printing Community*, CREATIVE COMMONS (Jan. 4, 2012), archived at <http://perma.cc/5XLR-VYW8> (discussing the possible extension of creative commons to 3D Printing).

Virtual Reality brought about by 3D Printing (wherein virtual designs and concepts become reality)!<sup>189</sup> But no matter what final form my conclusions will bear, my over-arching aim remains constant, namely; to attempt to search and (hopefully) to find a new equilibrium that, allows us to benefit from this new technology, while ensuring that other social interests that are intertwined in the field of intellectual property are not (disproportionally) sacrificed in the process.<sup>190</sup>

### Summary

Based on what I have learned thus far, I project that over the next few years, 3D creations and products (as well as data) will be traded in massive quantities around the world and deep questions pertaining to IP rights therein will arise. I would even go as far as saying that it is highly likely that the 3D printing industry will soon overshadow conventional production and trade altogether, hence, the need for understanding this technology and its impact on IP.<sup>191</sup> Ultimately, the regulators (both on the national and international level) will need to set rules in order to resolve the negative implications and challenges resulting from this technology.<sup>192</sup> As of yet, it seems as though a legal vacuum awaits a historic technological age that will soon be upon us.<sup>193</sup>

In closing I should add that, while I welcome this amazing technology with awe and with great respect for the scientists behind it, I have a deep conviction that we should not be mesmerized by this technology and that we need to think about its ramifications and implications vis-à-vis intellectual property; the great engine of human ingenuity and creativity.

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<sup>189</sup> See Desai & Magliocca, *supra* note 96 (stating possible regulations on this new type of interface).

<sup>190</sup> See Schissel, *supra* note 2 (concluding that the law is being constantly readjusted to maintain the necessary balance between law and new technology).

<sup>191</sup> See Vance, *supra* note 51 (describing the increase in manufacturing and distributing capabilities).

<sup>192</sup> See Schissel, *supra* note 2 (stating the rising IP issues with 3D Printers).

<sup>193</sup> See Schissel, *supra* note 2 (arguing laws need to keep up with technological advances).