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Three-Dimensional Printing: Fabricating a Liability Framework

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THREE-DIMENSIONAL PRINTING: FABRICATING A LIABILITY FRAMEWORK

I. INTRODUCTION

"I do not think there is any thrill that can go through the human heart like that felt by the inventor as he sees some creation of the brain unfolding to success."[1] So begins a famous quote by Nikola Tesla describing the thrill of invention. Is it any wonder, then, that modern enthusiasts have flocked in greater and greater numbers to the process of three-dimensional printing?[2] With the increasing demand for three-dimensional printing also comes a proliferation of resources for the distribution of designs and products made via that process.[3] From hobbyists producing designs on their home computers to large manufacturers now mass-producing parts, a wide array of actors have entered this emerging market.[4]

However, with an increasing number of actors and an increasing market presence, three-dimensional printing represents a unique series of challenges for the courts.[5] Lower barriers to entry into the manufacturing arena have meant that home enthusiasts can design and manufacture products in their homes that may enter the broader stream of products.[6] This has allowed micro-manufacturers, individuals rather than companies, to enter the stream of commerce in larger numbers than previously encountered by the courts.[7] As a result, previous methods of assigning liability to manufacturers via product liability may not be appropriate to resolve the challenges faced by micro-manufacturers and

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1 Nikola Tesla, BRAINYQUOTE, https://www.brainyquote.com/quotes/nikola_tesla_127569 [https://perma.cc/XP7B-GKAB].

2 *See What Is 3D Printing? The Definitive Guide to Additive Manufacturing*, 3D HUBS, https://www.3dhubs.com/what-is-3d-printing [https://perma.cc/QF9K-82JZ] (graphing the estimated quantity of 3D printers sold).

3 *See, e.g.*, THINGIVERSE, https://www.thingiverse.com [https://perma.cc/7M35-87QA] (sharing designs for 3D printing between designers and enthusiasts).

4 *See* Lucas Mearian, *3D Printing is Now Entrenched at Ford*, CIO (Aug. 21, 2017), https://www.cio.com/article/3214471/3d-printing/3d-printing-is-now-entrenched-at-ford.html [https://perma.cc/9ZFB-QDJX] (providing an example of the impact of 3D printing on mass-manufacturers).

5 *See What is 3D Printing? The Definitive Guide to Additive Manufacturing*, *supra* note 2 (displaying the increasing rate of sales for 3D printers).

6 *See* Brandon Stapper, *What Is 3D Printing and How Does It Work?*, NONSTOP SIGNS & GRAPHICS (Apr. 12, 2018), https://www.nonstopsigns.com/blog/what-3d-printing-how-does-work/ [https://perma.cc/XNH5-SDY7] (describing the cost reduction during prototyping by 3D printers).

7 *See What is 3D Printing? The Definitive Guide to Additive Manufacturing*, *supra* note 2 (listing the number of 3D printers sold).

consumers alike, as solutions which were appropriate for larger manufacturers may not fit within the paradigm of micro-manufacturing.

Further, three-dimensional printing carries unique challenges due to the nature of the process itself.[8] The manufacturer of the printer, like the manufacturer of a screwdriver, has almost no foreseeability as to how the printer will be used.[9] Yet the manufacturer of the screwdriver should at least know that it will be used to turn screws. This is not true of three-dimensional printers, however. Here, the printer manufacturer does not necessarily know whether a printer will be used to make cups, a heart valve, or even the aforementioned screwdriver.[10] Due to this lack of predictability, should manufacturers of three-dimensional printers all be held to the exacting standards needed for heart valves? Or should manufacturers be held to the lesser standards of manufacturing cups? Or should those manufacturers be held to some other standard altogether? This is just one example of the unique challenges the courts face in determining how to assess liability when injuries occur from the products of this industry.

In order to assess liability, the courts first need to develop a framework of liability to protect consumers and others from potential accidents and harm caused by this new technology. In fact, as this Note demonstrates, the absence of a widely applicable framework of liability for new technologies and new markets has been a challenge for the courts for many decades.[11] Such a framework will need to produce predictable results, provide notice to those who may be exposed to liability, protect and make whole those injured by the products of three-dimensional printing, and avoid overburdening this new and innovative field. Of these, predictability and notice are most vital.[12]

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8 *See id.* (illustrating the process of 3D printing).

9 *See The 9 Different Types of 3D Printers,* 3D INSIDER, https://3dinsider.com/3d-printer-types/ [https://perma.cc/S3WS-KALK] (explaining the different capabilities of the various printer types currently on the market).

10 *See, e.g.*, Eddie Krassenstein, *It's a Screw Driver, It's a Pliers, It's a 3D Printed Super Multi-Tool!*, 3DPRINT.COM (June 26, 2015), https://3dprint.com/75194/3d-printed-multi-tool/ [https://perma.cc/4U5W-FZ7S] (describing a screwdriver that can be made with a 3D printer).

11 *See infra* Part II (demonstrating the challenges courts have faced in the past involving emergent technologies).

12 Indeed, predictability in commerce is one of the founding principles of American democracy. Predictability and uniformity were considered necessary components by the founders of the Constitution to achieve a result that would permit commerce to grow and flourish, particularly between the several States. *See James Wilson and the American Constitution*, LIBR. OF LIBERTY, http://oll.libertyfund.org/pages/james-wilson-and-the-american-constitution [https://perma.cc/KN4S-JPJ4] (listing predictability as a key component of commercial growth for America).

This Note first explores the fundamentals of three-dimensional printing, with a brief overview of the process itself to provide the reader with a basic background. Second, it discusses various traditional processes for assigning liability. Third, it identifies the actors within the realm of three-dimensional printing and explains their roles. Fourth, it analyzes these actors and their roles against the backdrop of traditional liability theories. This is followed by a discussion of the potential production of inherently dangerous objects. Finally, public policy objectives are considered as those policies may broadly impact potential liability frameworks for three-dimensional printing. From this review and analysis, this Note defines a framework of liability that rests on three axioms: (1) whether the product is inherently dangerous; (2) whether the actor is a professional or amateur; and (3) the degree of attenuation and foreseeability between the actor and the injury. This framework will be applicable not just to three-dimensional printing but broadly to other new technologies and sectors as well.[13] The basis for this framework will be for courts to adopt a negligence approach to injuries caused by three-dimensional printing. This negligence approach should apply varying duties of care similar to bailment theory in order to better assign liability to actors based on their role relative to the injury.

II. BACKGROUND

A. The Evolution of Three-Dimensional Printing

In 1986, one of the earliest forms of three-dimensional printing, stereolithography, was patented.[14] With stereolithography, an ultraviolet (UV) laser strikes a special acrylic compound, creating a solid plastic at the location the laser strikes.[15] This early form of three-dimensional printing was unreliable: parts warped, materials were very limited, and the overall process was exceptionally slow.[16] More importantly, three-dimensional printers at the time were extraordinarily expensive and beyond the reach of casual consumers.[17] Fast forward to 2018, and

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[13] For example, the framework proposed in this Note would apply equally to the emerging sector of legal recreational and medical marijuana sales as well as to new windmill technologies that have quickly spread across the country in recent years.

[14] *See* Elizabeth Palermo, *What Is Stereolithography?*, LIVE SCI. (July 16, 2013), https://www.livescience.com/38190-stereolithography.html [https://perma.cc/N59P-VVAY] (defining the fundamentals of stereolithography).

[15] *See id.* (explaining the basic processes within a printer during stereolithography).

[16] *See The History of 3D Printing*, CASES2GO (July 31, 2017), https://www.cases2go.co.uk/history-of-3d-printing/ [https://perma.cc/EG6G-3TWC] (describing the early challenges of the 3D printing process).

[17] *See id.* (mentioning the expensive nature of 3D printing in the early 1990s).

consumers can buy an introductory three-dimensional printer from Amazon for $109.00.[18] More advanced printers and innovations in material, printing, design, and software technologies have led to printers that can make metal and materials that can withstand high temperatures, achieve greater precision in final parts, and operate faster and more cost-efficiently.[19]

The applications for this technology have also grown exponentially, ranging from invaluable medical applications to highly divisive uses in weapons manufacturing.[20] Along with widening applications, the number of printers being introduced into the marketplace has also soared, going from an industry estimate of just 66 in 2007 to 232,336 printers sold in 2015.[21] As the pervasiveness of this new technology continues to grow, state legislatures, Congress, and the courts have only weighed in on exceptionally narrow issues, such as California's requirement that firearms have a serial number or Congress's requirement that all firearms have a component that is detectable by a metal detector.[22] These narrow cases do not address the myriad potential risks faced by consumers of printed parts, however.[23] In order to ensure that manufacturers, designers, and others involved in the three-dimensional printing business are given proper notice of potential liability and to provide sufficient

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[18] *See generally iNSTONE Desktop DIY 3D Printer with Instruction Video*, AMAZON, https://www.amazon.com/iNSTONE-instruction-accuracy-Self-assembly-Printing/dp/B071FQVB2F/ref=sr_1_4?s=industrial&ie=UTF8&qid=1537069732 [https://perma.cc/M3JZ-UUPP] (listing a desktop model 3D printer for sale).

[19] *See* Anatol Locker, *2018 Metal 3D Printer Guide–All about Metal 3D Printing,* ALL3DP (Jan. 5, 2019), https://all3dp.com/1/3d-metal-3d-printer-metal-3d-printing/ [https://perma.cc/R3KE-YKMN].

[20] *See* Robert J. Szczerba, *No Donor Required: 5 Body Parts You Can Make with 3-D Printers*, FORBES (June 17, 2015), https://www.forbes.com/sites/robertszczerba/2015/06/17/no-donor-required-5-body-parts-you-can-make-with-3-d-printers-2 [https://perma.cc/ECA2-W46B] (describing the creation of artificial heart valves with 3D printers). *See also* Hanna Watkin, *In Australia, Digital Blueprints for 3D Printed Guns Carry 14 Year Prison Sentence*, ALL3DP (Nov. 23, 2015), https://all3dp.com/3d-printed-guns-australia-prison/ [https://perma.cc/W2TP-6C2Z] (describing Australia's attempts to quell the growing availability of undetectable and untraceable guns).

[21] *See* Mani Raj Prasad, *10 New Future Business Ideas You Need To Know*, STARTUP COLL. (Oct. 22, 2018), https://www.startupcolleges.com/10-new-future-business-ideas-you-need-to-know/ [https://perma.cc/U8NR-K568] (projecting how many 3D printers have been sold).

[22] *See* To Reauthorize the Ban on Undetectable Firearms, H.R. 3348, 108th Cong. (2003) (defining the ban enacted by Congress on nonmetal firearms). *See also* Pena v. Lindley, 898 F.3d 969, 989–90 (9th Cir. 2017) (adjudicating the reach of California's handgun ban).

[23] *See* Nora Freeman Engstrom, *3-D Printing and Product Liability: Identifying the Obstacles*, 162 U. PA. L. REV. ONLINE 35, 38 (2013) (identifying as uncontroversial the increase in the number of actors manufacturing potentially dangerous objects with 3D printing).

protections for consumers, it is necessary to enact a more broad-based framework within which liability issues can be resolved.

B. A Level-Zero Synopsis of Historic Doctrinal Negligence Theory

With the increase in prevalence of three-dimensionally printed parts and products comes a corresponding increase in the risk of product-based injuries.[24] The implications for product-liability jurisprudence have yet to be fully mapped, with scholarly opinion ranging from the dire prediction that three-dimensional printing will be the end of traditional product liability to the notion that traditional product liability is sufficiently broad to cover this new technology without major refinement.[25] This Note proposes an appropriate liability framework for approaching this emerging technology. First, it is necessary to consider, at a high level, traditional methodologies that courts have applied to determine liability.

Over time, courts have developed many regions of jurisprudential doctrine to accommodate the needs of those who have been injured and seek relief in a court of equity.[26] Three regions that should be understood to better frame the liability of the individual actors within the realm of three-dimensional printing are: negligence, product liability, and bailment.[27] These theories can be distinguished from each other by considering the way in which they assign duty to the actor whose actions predicate the harm, the foreseeability of that harm, the degree of attenuation tolerated between the actors' behavior and the precipitate harm, the value of the activity to the actor, and the gravity of the harm.[28]

The first major area is ordinary negligence theory, which relies on a complex and shifting nexus of reasonable foreseeability and gravity of

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24 As with any new technology, from the automobile to the cellphone, as the product becomes more widespread, more interactions between the public and the product begin to take place, obviating an increase in risk that injury will ensue.

25 *See, e.g.*, Engstrom, *supra* note 23, at 38 (describing the strong possibility that designs of this type are not products and would not fall within the bounds of product liability as a result).

26 *See* JOE F. CANTERBURY, JR. & ROBERT J. SHAPIRO, TX CONSTRUCTION LAW MANUAL § 9:12 (3d ed. Nov. 2018) (defining the elements of the modern negligence doctrine).

27 *Cf.* United States v. Carroll Towing Co., 159 F.2d 169 (2d Cir. 1947). In *Carroll Towing*, Judge Learned Hand defined duty of care as a function of the probability of harm, the gravity of the harm, and the burden of taking adequate precautions against the harm. *Id.* at 173. Judge Hand also previously described these factors as "the likelihood that [the defendant's] conduct will injure others, taken with the seriousness of the injury if it happens, and balanced against the interest which he must sacrifice to avoid the risk." Conway v. O'Brien, 111 F.2d 611, 612 (2d Cir. 1940). *See also* VINCENT R. JOHNSON, STUDIES IN AMERICAN TORT LAW 246–51 (5th ed. 2013) (elaborating on Judge Learned Hand's theory and Alan Gunn's economic theory of negligence).

28 *See Carroll Towing Co.*, 159 F.2d at 173 (assigning liability for negligence based on the probability of harm, gravity of harm, and burden incurred by avoiding the harm).

potential harm to determine liability.[29] Here, the actors' duties are defined partly by the foreseeability of harm precipitating from their actions, the attenuation of the actors from the precipitate harm due to the length of the causal chain between their actions and the eventual harm, the question of whether intervening causes may have broken that causal chain, and the gravity of the harm to be avoided.[30]

The second major area is product liability, which places the burden on manufacturers for the fruits of their commercial activities.[31] With three-dimensional printing, much scholarly thought seems to either find extension of modern products liability as a desirable conclusion or treat that extension of liability as fait accompli.[32] Within product-liability doctrine, the actor's duty is defined by the role the actor plays in the process: designer, manufacturer, or labeler.[33] The courts have provided for broad liability for manufacturers, beyond the scope of ordinary negligence for many reasons.[34] Among these reasons are: a complex and costly process to prove where the negligence took place, deeper pockets among manufacturers both to make the injured whole and to defend against potential wrongful suits if necessary, and a heightened concern for overall consumer welfare.[35]

The third major area is bailment theory, which relies on the degree of attenuation between the temporary possessor of an object's interest in that

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29 *See id.* (outlining the famous Learned Hand balancing test for negligence).

30 *See id.* (including gravity of harm as well as foreseeability in determining the duty of care).

31 *See* JOHNSON, *supra* note 27, at 697–701 (outlining the development of product liability as a doctrine for holding manufacturers strictly liable for defects in their products).

32 *See* Alexander E. Ackel, Note, *Extending Liability to the Micro-Manufacturers of the Future: Applying the Casual Seller Exception in the Context of 3-D Printing*, 8 UC IRVINE L. REV. 122, 138 (2018) (recommending the adoption by the courts of a traditional product liability model for the resolution of cases involving 3D printing). *See also* Evan M. Malloy, Note, *Three-Dimensional Printing and a Laissez-Faire Attitude Towards the Evolution of the Products Liability Doctrine*, 68 FLA. L. REV. 1199, 1224 (2016) (positing that the person who clicked print may be held strictly liable).

33 *See Understanding the Different Types of Product Defects*, CRANWELL & MOORE, P.L.C., https://www.cranwellmoorelaw.com/Articles/Understanding-the-different-types-of-product-defects.shtml [https://perma.cc/K9SV-CD8U] (describing the types of defects under product liability).

34 *Cf.* Escola v. Coca Cola Bottling Co. of Fresno, 150 P.2d 436, 441 (Cal. 1944) (Traynor, J., concurring) (explaining the reasons for extending broad liability to manufacturers under product-liability theory).

35 *See* David W. Louisell & Harold Williams, *Res Ipsa Loquitur – Its Future in Medical Malpractice Cases*, 48 CAL. L. REV. 252, 255 (1960) (describing the expensive nature of proving fault in a product-liability case without strict liability).

object to determine liability.[36] Here, the actor's duty is defined by the value of the possessory interest to the bailor as compared to the bailee.[37] A bailor possessing an object in which the bailor has little or no interest is said to owe a slight duty of care to the bailee.[38] A bailor whose interests in the object are balanced by the bailee's interests in the bailor having that object is said to have accrued an ordinary duty to that object.[39] A bailor possessing an object in which the bailor's interests far outstrip the bailee's interests is said to owe a great duty of care toward the object of the bailment.[40] Courts then use this trichotomy of duties to assign standards of care that will trigger liability: gross negligence, where the duty owed is slight; ordinary negligence, where the duty owed is ordinary; and slight negligence, where the duty owed is great.[41]

These three traditional approaches, ordinary negligence, product liability, and bailment, assign alternative theories relative to the duty of care imposed.[42] Ordinary negligence imposes a balancing of duties of care between the parties based on a finding of fault.[43] Product liability encumbers manufacturing actors with strict liability, placing the duty of care almost exclusively on those manufacturers.[44] Bailments impose a

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36 *See* Pitman v. Pitman, 717 N.E.2d 627, 631 (Ind. Ct. App. 1999) (stating that a bailment is an agreement between two parties to temporarily entrust property to one, with a shifting duty of care dependent upon the benefit derived by each party).

37 *See* Hanes v. Shapiro & Smith, 84 S.E. 33, 35 (N.C. 1915) (showing how duty shifts depending on whether the bailment has value to the bailor).

38 *See id.* (outlining circumstances in which only a slight duty of care exists). *See also* Norris Auto. Serv. v. Melton, 526 N.E.2d 1023, 1026 (Ind. Ct. App. 1988); United Farm Family Ins. v. Riverside Auto, 753 N.E.2d 681, 685 (Ind. Ct. App. 2001).

39 *See Hanes*, 84 S.E. at 35 (illustrating circumstances in which an ordinary duty of care exists). *See also Norris*, 526 N.E.2d at 1026; *United Farm Family Ins.*, 753 N.E.2d at 685; *Pitman*, 717 N.E.2d at 631.

40 *See Hanes*, 84 S.E. at 36 (asserting the conditions under which a duty of great care exists). *See also Norris*, 526 N.E.2d at 1026; *United Farm Family Ins.*, 753 N.E.2d at 685; *Pitman*, 717 N.E.2d at 631.

41 *See Hanes*, 84 S.E. at 35 (summarizing and categorizing the various duties of care within bailment theory); *Norris*, 526 N.E.2d at 1026; *United Farm Family Ins.*, 753 N.E.2d at 685; *Pitman*, 717 N.E.2d at 631.

42 *See* Brian Farkas, *Bailment: What It Means under the Law*, LAWYERS.COM, https://www.lawyers.com/legal-info/business-law/business-law-basics/bailment-leaving-your-belongings-behind.html [https://perma.cc/V9GR-8ZBF] (defining the duty of care under a bailment).

43 *See Negligence*, LEGAL INFO. INST., https://www.law.cornell.edu/wex/negligence [https://perma.cc/QVH4-DFRZ] (placing the limits of negligence at whether or not a breach of a duty has occurred).

44 *See* JOHNSON, *supra* note 27, at 697–701 (discussing the evolution of product liability and including the theory of enterprise liability, which holds a profiting party liable for injuries caused by the product from which profits were made).

shifting duty of care on individuals based on the degree of benefit that accrues to the bailee versus the bailor.[45]

C. Plotting the Players on the Three-Dimensional Grid of Liability

After understanding potential liability theories that a court may apply, the next step in a review of the product-liability implications of three-dimensional printing is to consider the actors involved in that printing process. This involves defining the actors and their roles, identifying potential challenges that are unique or heightened within the field of three-dimensional printing, and further framing the tapestry of interactions that may incur liability.

Within the paradigm of three-dimensional printing, there exists many varied actors.[46] Of primary concern when formulating a liability framework are: (1) the maker of the printer; (2) the operator of the printer; (3) the seller of the printed parts and designs; (4) the designer of the parts; (5) the consumer of the parts; and (6) the maker of the raw materials used during the three-dimensional printing process (also known as the filament manufacturer).[47] These actors may all have a role in a traditional theory of products liability or ordinary negligence if those liability frameworks were extended to micro-manufacturers.[48] It is important to consider, at least in broad strokes, the potential liability of each of these actors in order to understand the boundaries of liability today and to properly frame the policy arguments for where those boundaries should exist.

1. Printer Manufacturers

The manufacturer of the three-dimensional printer is the creator of the printer itself.[49] This manufacturer has little insight into the types of tools and products that will be manufactured by the printer.[50] Three-dimensional printers can be used to fabricate virtually anything given enough material and time; therefore, predicting the exact products that

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45 *See, e.g.*, *United Farm Family Ins.*, 753 N.E.2d at 685; *Pitman*, 717 N.E.2d at 631; *Norris*, 526 N.E.2d at 1026.

46 *See generally What Is 3D printing?*, 3D PRINTING, https://3dprinting.com/what-is-3d-printing/ [https://perma.cc/5HXX-4DUS] (outlining many of the actors involved in the process of 3D printing).

47 *See id.* (describing the basics of the three-dimensional printing process).

48 *See generally* Engstrom, *supra* note 23, at 37 (expounding a line of thought that 3D designs may not be classified as products at this time).

49 *See id.* at 35 (defining the initial manufacturer of the 3D printer's role).

50 *See What Is 3D printing?*, *supra* note 46.

will be printed on any particular printer is, by nature, an inexact science.[51] While stereolithography uses plastic photopolymers, certain types of three-dimensional printers can print in metal as well as plastics and are being adapted to other types of materials as well.[52] As a result, the universe of products that can be developed using three-dimensional printing techniques is an ever-expanding and unpredictable one.[53] Demand for more complex hybrid printers may soon see the emergence of more inexpensive printers that can handle multiple types of materials simultaneously to make composite parts, which would expand the universe of available products that can be fabricated.[54]

2. Printer Operators

The operator of the printer is "the person who clicked 'print.'"[55] This person may be a professional running a service printing products, a micro-manufacturer, or a large corporation.[56] Put another way, this may be a small home enthusiast with limited resources, a large traditional manufacturer, or an operator anywhere on the continuum between the two. As a result, in many cases the printer may not have the economy of scale enjoyed by many traditional manufacturers today.[57]

3. Sellers of Parts and Designs

The seller of the printed parts is not the manufacturer in the traditional sense of the word.[58] They may not be involved in the actual creation or design of the product, as many enthusiasts rely upon websites for the propagation of their products and designs with those websites having almost no direct interaction with the sellers themselves.[59] Further, the sellers may be the home enthusiasts themselves and may only be selling

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51 *See generally What Is 3D printing?*, *supra* note 46 (explaining the potential to print nearly any object through additive manufacturing).

52 *See The 9 Different Types of 3D Printers,* 3D INSIDER, https://3dinsider.com/3d-printer-types/ [https://perma.cc/9E97-33PB].

53 *See What Is 3D printing?*, *supra* note 46 (discussing the increasing expenditures and applications within various industries of 3D printing).

54 *See* Ricardo Pires, *Multi-Material 3D Printing–2018 Overview*, ALL3DP (Sept. 2, 2018), https://all3dp.com/2/multi-material-3d-printing-an-overview/ [https://perma.cc/D4FM-B6DC] (describing the currently available printing techniques for multi-material printers).

55 Malloy, *supra* note 32, at 1204–06.

56 *See* Mearian, *supra* note 4 (illustrating the use of 3D printing at a major manufacturer).

57 *See infra* note 224 and accompanying text (explaining the average income of an individual household compared to the average valuation of a large manufacturer).

58 *See generally What Is 3D printing?*, *supra* note 46.

59 *See, e.g.*, THINGIVERSE, *supra* note 3 (offering designs for hobbyists and designers to share for 3D printing).

designs.[60] Due to the nature of three-dimensional printing, it is quite common for consumers to simply purchase the design and then manufacture the actual product in their own home, a feat virtually unique to the environment of three-dimensional printing.[61]

Additionally, consider the purveyor or possessor of three-dimensional designs. As mentioned previously, there exist a number of websites dedicated to sharing three-dimensional designs with the general public.[62] These websites permit amateur designers to share their designs with the public, allowing consumers to access those designs, download them locally, and run them on their local three-dimensional printer.[63] These design websites act as a virtual marketplace of ideas, with no clear protections for the end consumer that may be harmed by defective products promulgated by those websites.[64]

4. Designers

The designer of the three-dimensionally printed products is unlike the designer in traditional manufacturing organizations. In a traditional manufacturing paradigm, the design and prototyping process can be lengthy and expensive and is usually partaken either by the manufacturer itself or by another organization that hands the design over to the manufacturer as part of a bargained-for exchange.[65] One of the attractive features of three-dimensional printing is that it shortcuts much of the traditional design costs.[66] This allows amateur actors to enter markets that previously would have had an impenetrable barrier to entry due to cost.[67] Indeed, even some Fortune 500 companies have seen the advantages of three-dimensional printing and are electing to use this process over more traditional design approaches.[68] As mentioned above, some websites even

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60 *See id.* (allowing anyone who wishes access to upload designs).

61 *See id.* (permitting a customer to select and purchase a design to download).

62 *Id*. *See also* Makezine, MAKE:, https://www.makezine.com [https://perma.cc/4N67-CY56] (displaying 3D designers' wares).

63 *See, e.g.*, THINGIVERSE, *supra* note 3 (allowing access to upload and download features for both designers and printers of products); Makezine, *supra* note 62.

64 *See* Makezine, *supra* note 62 (providing an example of a marketplace of 3D designs).

65 *See, e.g.*, Christopher Lampton, *How Much Does it Cost to Build a Concept Car?*, HOW STUFF WORKS, https://auto.howstuffworks.com/cost-to-build-concept-car.htm [https://perma.cc/GZG5-WHVZ] (showcasing the costs of design in a modern manufacturing environment).

66 *See What Is 3D Printing? The Definitive Guide to Additive Manufacturing*, *supra* note 2 (explaining cost reduction via 3D printing techniques).

67 *See id.* (explaining the high cost of entry previously found in 3D printing).

68 *See* Mearian, *supra* note 4 (showcasing the rapid permeation of 3D printing into the wider marketplace).

exist for designers to freely share their downloadable designs with third-party consumers.[69]

5. Consumers

The consumer of the three-dimensionally printed parts may also be the manufacturer as discussed above.[70] Also, if a consumer is involved in the printing process of a three-dimensionally printed product, or has actual notice[71] that a product was printed in this way, does that affect the consumer's reasonable expectation of the uses of that product?[72] Three-dimensionally printed parts are becoming more ubiquitous with every passing year, and consumer exposure to those parts is increasing.[73] With this increasing popularity comes questions regarding the durability and properties of the products manufactured with those processes as opposed to more traditional manufacturing techniques.[74] Because the properties of printed parts depend on both the printer and the printer material used, it logically follows that products *will* vary from their ordinarily manufactured counterparts.[75]

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[69] *See generally* THINGIVERSE, *supra* note 3 (illustrating how websites exist today that allow professionals and amateurs alike to share their designs with the public). These websites often include disclaimers describing their activities as noncommercial. While too vast to consider in this Note, this disclaimer by itself does not facially appear to remove the product from commerce nor to escape design liability. *See, e.g.*, *Puzzle Cube*, THINGIVERSE, https://www.thingiverse.com/thing:2975065/files [https://perma.cc/8HJX-VD7Y] (providing an example of this type of disclaimer).

[70] *See supra* Section II.C.1 (defining the role of the manufacture in the 3D printing paradigm).

[71] And, what, if any, would be the appropriate notice for a consumer of such a product? This is a topic out of scope for this Note, but it is an issue worth considering: how much notice should consumers be given when part or all of a product they are utilizing was built using 3D printing techniques?

[72] While in traditional manufacturing, unanticipated uses and even some misuse of a product are potential sources of liability, whether a consumer would reasonably expect to be able to use or misuse a 3D product in similar ways is a topic that is outside the scope of this Note but warrants consideration.

[73] *See generally Ford Tests Large-Scale 3D Printing with Light-Weighting and Personalization in Mind*, FORD MEDIA CTR. (Mar. 6, 2017), https://media.ford.com/content/fordmedia/fna/us/en/news/2017/03/06/ford-tests-large-scale-3d-printing.html [https://perma.cc/URX8-68ED] (describing the broadening application of 3D printing in car manufacturing).

[74] *See* Richard Baguley, *3D Printing Materials: The Pros and Cons of Each Type*, TOM'S GUIDE, https://www.tomsguide.com/us/3d-printing-materials,news-24392.html [https://perma.cc/J84N-6PST] (presenting the different properties of different printing materials).

[75] *See* Sean Rohringer, *3D Printer Filament Guide–All You Need to Know in 2018*, ALL3DP (Jan. 13, 2019), https://all3dp.com/1/3d-printer-filament-types-3d-printing-3d-filament/ [https://perma.cc/95VV-PRPX].

6. Filament Manufacturers

Finally, consider the filament manufacturer. The filament is the "ink" of a three-dimensional printer that enables it to create a product.[76] As mentioned previously, three-dimensionally printed parts will have different properties if printed using different filaments.[77] However, in this burgeoning new industry, exact properties of the individual filament types are not easily ascertained.[78] Without properties such as tensile strength, seepage, UV tolerance, and others, the filament may be unsuitable for many potential uses.[79] Also, there are few guarantees of the purity or consistency of the filament being used, so a product that needed to be printed with a high degree of precision might incur additional risk if manufactured using a standard filament. [80]

D. A Comparison of Three-Dimensional Printing to Other Emergent Technologies

Three-dimensional printing is hardly the first emergent technology to challenge our legal system.[81] Computers, automobiles, the internet, and cellphones have all posed challenges as well.[82] Studying the way in which the courts and Congress have evolved rules for handling those other emergent technologies provides some insight into rules that could be applied to three-dimensional printing as well. Here, the focus shifts to the challenges associated with slowly evolving jurisprudence regarding the automobile and cellphones specifically.

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[76] *See id.* (explaining how filament is used in the actual printing process to create the final products).

[77] *Id.*

[78] *See generally Filament Blue ABS 0.07" 1KG*, DIGI-KEY ELECS., https://www.digikey.com/product-detail/en/mg-chemicals/ABS17BL1/473-1274-ND/6873769 [https://perma.cc/ECN7-WHSD] (illustrating the types of details that are given by filament manufacturers).

[79] *See generally* Ed Tyson, *Guide to Selecting and Buying 3D Filament in 2018*, 3DPRINT (Mar. 19, 2018), https://3dprint.com/206413/guide-to-selecting-filament/ [https://perma.cc/P37A-2ZHB] (outlining the need for the correct filament to accommodate a 3D printing job).

[80] The author found no guarantees of quality or consistency by any major filament manufacturer as of the time of this writing. In fact, one noteworthy producer of filament specifically mentioned that temperatures needed for printing may vary among printers using that filament. *See ABS*, MG CHEMICALS, https://www.mgchemicals.com/products/3d-printing-supplies/3d-printer-filaments/abs [https://perma.cc/AGA6-YJYL] (showcasing standard filament verbiage).

[81] *See, e.g.*, *Internet Law: The Regulation of Internet Crime*, FINDLAW, https://corporate.findlaw.com/law-library/internet-law-the-regulation-of-internet-crime.html [https://perma.cc/2TRM-W7MM] (providing an example of the struggles faced by the courts in connection with rapidly evolving technology).

[82] *See id.* (illustrating the challenges faced by courts in keeping pace with internet crime).

Ford unveiled the first production Model T on October 1, 1908.[83] By 1930, the automobile had become an everyday part of American life, with there being over two hundred cars for every thousand Americans.[84] As early as 1905, the Court in *Indiana Springs Co. v. Brown* considered the question of negligence relative to an automobile.[85] The court found the driver not negligent for the act of driving the automobile on the road, holding that driving a new invention on the road was not negligent by itself provided that conveyance was in keeping with the general safety and use of the road.[86] Fast forward to more modern times, and strict rules apply to vehicle designs and safety standards that can be used on public thoroughfares, down to the minutiae of labelling standards for tires.[87]

Jurisprudence and regulation only become more confusing when viewed through the lens of product liability. Consider the modern example of autonomous vehicles or driverless cars. Here, due to the absence of sufficiently clear regulations, there are numerous scholarly examples of potential liability risks that are uncertain at this time.[88] Perhaps most telling is the currently answerless question, if two driverless automobiles are in an accident with each other, who is at fault?[89] Autonomous vehicles have been envisioned for years with multiple major companies investing in the technology recently.[90] Still, Congress has remained largely dormant on the issues of potential liability raised by this seemingly inevitable technological advancement, leaving states to provide

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83 *See Ford Motor Company Unveils the Model T*, HIST., https://www.history.com/this-day-in-history/ford-motor-company-unveils-the-model-t [https://perma.cc/9VWA-AFNM] (describing the advent of the affordable automobile).

84 *See Motor Vehicle*, WIKIPEDIA, https://en.wikipedia.org/wiki/Motor_vehicle [https://perma.cc/MV64-7F9Q] (graphing historical vehicle ownership rates).

85 *See* Ind. Springs Co. v. Brown, 74 N.E. 615, 616–17 (Ind. 1905) (assigning a duty of care to an individual driving a car on a public road relative to others using that road).

86 *See id.* at 616 (holding that the act of using a new product does not support a negligence cause of action in and of itself).

87 *See* National Traffic Motor Vehicle Safety Act of 1966, 80 Stat. 718 (1966) (describing the specifics of automobile safety and manufacturing standards).

88 *See generally* Mark A. Geistfeld, *A Roadmap for Autonomous Vehicles: State Tort Liability, Automobile Insurance, and Federal Safety Regulation*, 105 CAL. L. REV. 1611, 1621 (2017) (positing numerous hypotheticals involving tort liability and autonomous cars).

89 *See* Keith Naughton & Margaret Cronin Fisk, *Driverless Cars Give Lawyers Bottomless List of Defendants*, INS. J. (Dec. 22, 2015), https://www.insurancejournal.com/news/national/2015/12/22/392781.htm, [https://perma.cc/BEA5-VELD] (posing the hypothetical fault question involving two autonomous vehicles).

90 *See, e.g.*, Danielle Muoio, *Google Spent at Least $1.1 Billion on Self-Driving Cars before It Became Waymo*, BUS. INSIDER (Sept. 15, 2017), https://www.businessinsider.com/google-self-driving-car-investment-exceeds-1-billion-2017-9 [https://perma.cc/N4MM-K784] (outlining the investment by Google in the autonomous automobile industry).

a patchwork quilt of legislation on the topic.[91] Now, it would seem, time has run out on taking action to define the scope of product liability for autonomous vehicles, with the first fatality involving a driverless car occurring in March 2018.[92] What will be the reach of product liability tort suits for such a situation? If the vehicle was operating within expected norms but could not react or anticipate an emergency situation like a human driver, will courts extend liability to that failure to anticipate harm? Absent legislation, the possible answer based on the broad reach of product liability is that this, too, may become a source of previously unknown liability.[93]

The history of widening and shifting potential liability is no different with cellphones. Texting while driving is a serious risk factor for automobile accidents.[94] What may not be as widely known is that Apple currently holds a patent on technology that would block texting while driving.[95] Now the question logically follows, by not implementing or releasing that technology, could Apple be found liable in accidents involving texting while driving when using an Apple phone?[96] Almost certainly, Apple did not anticipate this type of liability exposure when it first released the iPhone; yet, the threat of a finding of liability is now becoming a consideration.[97]

Another area of shifting liability for cellphones has been concern over a potential link between the radiation emitted by cellphones and brain cancer.[98] While there has been no confirmed medical link between brain cancer and the use of cellular phones, the public and legislators have

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91 *See, e.g.*, CAL. VEH. CODE § 38750 (Westlaw through 2018); FLA. STAT. § 319.145 (Westlaw through 2018); NEV. REV. STAT. ANN. § 482A.070 (Westlaw through 2017) (defining various state efforts to regulate the emerging autonomous vehicle market).

92 *See* Daisuke Wakabayashi, *Self-Driving Uber Car Kills Pedestrian in Arizona, Where Robots Roam,* N.Y. TIMES (Mar. 19, 2018), https://www.nytimes.com/2018/03/19/technology/uber-driverless-fatality.html [https://perma.cc/XU7T-NCPV] (describing the first recorded fatal accident involving a self-driving vehicle).

93 *See, e.g.*, CAL. VEH. CODE § 38750; FLA. STAT. § 319.145; NEV. REV. STAT. ANN. § 482A.070 (illustrating new forms of legislation that may result in liability for autonomous vehicle manufacturers).

94 *See* Kellam T. Parks, *Should Apple Be Blamed for Distracted Driving Accident?*, PARKS ZEIGLER, http://www.pzlaw.com/blog/product-liability-for-distracted-driving.cfm [https://perma.cc/U8DY-BRLE] (discussing the high risk that texting while driving poses to young drivers).

95 *Id.*

96 *Id.*

97 *Id.*

98 *See California Releases Cell Phone Radiation Guidelines*, WEB MD, https://www.webmd.com/a-to-z-guides/news/20171218/california-releases-cellphone-radiation-guidelines [https://perma.cc/NU65-PGQV] (describing new legislation limiting radiation from cellular phones).

developed sufficient concern over the possibility of a link that legislation has already been enacted to reduce the potential threat.[99] Even absent scientific confirmation of such a link, product liability lawyers have already begun advertising their services to recover for those who have developed brain cancer that may be attributable to their cellular use.[100] This pattern of shifting an ever-widening potential liability is emblematic of the problem with evolving jurisprudence over time. Namely, that manufacturers or other actors involved in the production process may not have sufficient notice to properly indemnify themselves against the potential liability for their actions.[101]

E. Three-Dimensional Printing and Inherently Dangerous Objects

Along with the printing of more traditional objects, three-dimensional printers pose a special risk because of their ability to print objects that might rightly be classified as inherently dangerous.[102] Much debate has been sparked and several legislative attempts at regulating the three-dimensional printing of guns have been made.[103] However, these attempts often are micro-directional, seeking to legislate exceedingly narrow rules around specific instruments rather than provide broad strokes within which those involved in the fabrication and distribution of dangerous objects can understand and limit their potential liability.[104]

Additionally, a micro-manufacturer engaged in three-dimensional printing can produce objects that come with a foreseeably high risk.[105] For example, a doctor could use a printer to produce a heart valve or an artificial spleen, articles whose failure could have catastrophic results for

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99 *See id.* (confirming that, despite growing consumer worry, no link has been scientifically proven between cell phone use and brain cancer).

100 *See Cell Phone Cancer Attorneys*, BAILEY, COWAN & HECKAMAN, https://www.bpblaw.com/product-liability/cell-phone-cancer-lawsuit/ [https://perma.cc/9K2T-G8X4].

101 *See, e.g.*, *id.* (providing an example that, even though no connection to cancer and cell phone use has been proven, attorneys are already exploring potential liability in this field).

102 While a possible subject of serious and fascinating debate, it is beyond the scope of this Note to consider whether the congressional tort immunity extended to gun manufacturers would apply to micro-manufacturers of firearms as well. For now, assume that this immunity is not extended to those manufacturers at this time. For an example, Defcad offered downloadable AR-15 designs until a recent court injunction shut down the website. *See Discover, Download, Contribute*, DEFCAD, https://web.archive.org/web/20180717021716/https://defcad.com/ [https://perma.cc/T6Y5-YMU8].

103 *See, e.g.*, Undetectable Firearms Act of 1988, 18 U.S.C. § 922(p) (2012) (defining the requirement that a metal part be included in all firearms).

104 *See, e.g.*, CAL. PENAL CODE § 11106(b)(2)(D) (Westlaw thorugh 2018) (imposing a registry of firearms with the manufacturer stamped on the firearm itself).

105 *See* Engstrom, *supra* note 23, at 35 (mentioning the deeply held concern about the Liberator, a 3D gun that has been widely disseminated).

the patient.[106] Should designers that design a heart valve or a braking mechanism for an automobile be held to have greater foreseeability of injury from their products and thus be held liable for those injuries incurred? While courts have held that nearly all physical objects can be inherently dangerous when dropped, fallen from, or interacted with in a way that involves an accident, should special attention be paid to objects that can more foreseeably result in injury?[107] Justice Stevens famously defined proximate cause as the line of demarcation beyond which an injury was too attenuated from the actor's behavior to be found within that injury's causal chain.[108] Absent legislation or case law as guidance, Stevens's concerns that this demarcation is too nebulous and invites "rough justice" echoes too well with regards to where such a line may be rightly drawn in the causal chain of a three-dimensionally printed object.[109] In the alternative, however, courts have long-recognized the distinction "between an act of negligence imminently dangerous to the lives of others, and one that is not so."[110]

III. ANALYSIS

A. The Shortcomings of Liability Frameworks for Three-Dimensional Printing

Having established the traditional models of liability theory, the actors involved in three-dimensional printing, the challenges commonly incurred in adopting a liability framework for an emerging technology, and the particular concerns associated with the printing of inherently dangerous objects, the next step in developing a liability framework will delve more deeply into an analysis of the pitfalls of applying traditional liability models to this technology. Here, the framework shifts from the challenges of emerging technologies as a whole to the specific and sometimes unique challenges of three-dimensional printing in particular.

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106 *See* Szczerba, *supra* note 20 (describing how doctors can use 3D printers in treating patients).

107 *See* Jamieson v. Woodward & Lothrop, 247 F.2d 23, 26 (D.C. Cir. 1957) (outlining the rationale that all objects can be inherently dangerous under the right circumstances).

108 *See* Palsgraf v. Long Island R.R. Co., 162 N.E. 99, 104–05 (N.Y. 1928) (delineating Stevens's view of proximate cause).

109 *See id.* (defining Stevens's concerns that such a nebulous concept as the causal chain proposed by Cardozo would result in "rough justice").

110 Thomas v. Winchester, 6 N.Y. 397, 410 (1852). At this point, as this Note transitions from background to analysis, a rule emerges that a framework of liability for three-dimensional printing should pay special consideration to those objects that are foreseeably dangerous to a reasonably prudent individual. Particularly, those actors that should be on notice that the object they are creating or designing is foreseeably dangerous should not be shielded from liability for those products due to the actors' attenuation from the causal chain of the injury incurred.

As discussed previously, products liability is a form of strict liability in which all that is necessary to recover is a showing that the product was defective in its manufacturing, design, or labeling; this allows the injured party to recover from the party who introduced the defect, regardless of whether reasonable precautions were taken.[111] A product can even work as intended yet still be the source of tort liability when the injured party claims that labeling was insufficient in warning of the dangers associated with using the product.[112] But where and how would a warning label be created with regards to three-dimensional printing? In the case of a firearm, proposed legislation suggested placing some minimal information about the manufacturer on the firearm itself.[113] Such a label would be impractical in other cases such as heart valves and other structures that require a degree of precision or minute detail that would render the minor occlusions associated with an engraved label impracticable.[114] Perhaps the label should appear on the website from which the user downloads the design, but what happens when the user is not involved in downloading the design?[115]

1. Manufacturing Defects

Some scholars believe that traditional product-liability doctrine would best apply where manufacturers produce a three-dimensionally

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111 *See* RESTATEMENT (SECOND) OF TORTS § 402A (AM. LAW INST. 1965) [hereinafter RESTATEMENT] (defining product liability); JOHNSON, *supra* note 27, at 700–01 (discussing enterprise liability, which attaches liability for injuries caused by a product to those who profited). *See, e.g.*, Linden v. CNH Am., LLC, 673 F.3d 829, 834 (8th Cir. 2012) (elaborating on manufacturing defects); Pannu v. Land Rover North Am., Inc., 120 Cal. Rptr. 3d 605 (Ct. App. 2011) (analyzing design defects); Richetta v. Stanley Fastening Sys., L.P., 661 F. Supp. 2d 500 (E.D. Pa. 2009) (noting the difference in product-liability theories between the *Restatement (Second) of Torts* and *Restatement (Third) of Torts* is that *Restatement (Third)* "emphasizes foreseeable risks of harm," but the *Restatement (Second)* "focuses on "whether the product was being used as intended by an intended user").

112 *See* Goins v. The Clorox Co., 926 F.2d 559, 561 (discussing the potential for liability where warning labels are insufficient). *See also* Allan E. Korpela, LL. B., *Failure to Warn as a Basis of Liability under Doctrine of Strict Liability in Tort*, 53 A.L.R. 3d 239 (1973) (describing the basic concepts of product liability).

113 *See, e.g.*, CAL. PENAL CODE § 11106(b)(2)(D) (defining the requirements for those firearms that are undetectable through standard means). This is one of only a handful of legislative attempts to resolve the risks posed by 3D printing. *Id.* As with most of the other attempts, it is illustrative in both its narrow applicability and limited jurisdictional reach. *Id.* This further illustrates the need for the courts to adopt a broader approach to this technology as the legislatures have thus far been unable to produce widely applicable laws governing liability for injuries from 3D printing.

114 *See* Szczerba, *supra* note 20 (discussing the ability to print a heart valve).

115 *See, e.g.*, *Puzzle Cube*, THINGIVERSE, https://www.thingiverse.com/thing:2975065/files [https://perma.cc/8HJX-VD7Y] (showing a warning regarding the product design to be downloaded).

printed product.[116] This comes with several challenges, though. First, who is the manufacturer of a three-dimensionally printed product? Is a manufacturer that simply distributes designs to end consumers, who actually perform the printing themselves, a "manufacturer" or merely a "seller" or "distributer," and does the distinction actually matter?[117] In other cases, a micro-manufacturer who engages in three-dimensional printing may merely be performing a service similar to facsimile and scanning services offered at various retailers today and be divorced from involvement in the product itself beyond offering a service to print that product.[118]

Alternatively, courts could apply ordinary negligence to manufacturers, but this comes with the inherent problems that made courts turn away from this in the first place, including difficulty of proving negligence and the inherent issues with causality.[119] And with so many actors involved in the process of three-dimensional printing, this would prove a difficult and unwieldy area of the law to adopt a res ipsa approach; simply put, the manufacturer of the printer can point to the operator, the operator can point to the designer, the designer can point to the type of filament used, and so on.[120] None of this liability deflecting gets the injured party closer to reliably and fairly being made whole.

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116 *See* Ackel, *supra* note 32, at 139 (advocating for extension of traditional products-liability approaches to 3D printing).

117 *See* COLO. REV. STAT. § 13-21-401(3) (permitting a products-liability action against a seller-distributor of a product). *But see* Johnson v. Recreational Equip., Inc., 247 P.3d 18, 20 (Wash. Ct. App. 2011) (stating that a seller could only be held liable under a products-liability theory where the product was branded or marketed in the seller's name).

118 *See, e.g.*, *Same-Day Services*, OFF. MAX, https://www.officedepot.com/cm/print-and-copy/same-day-printing [https://perma.cc/3CLV-27XZ] (offering printing and scanning services).

119 *See generally* Palsgraf v. Long Island R.R. Co., 162 N.E. 99 (N.Y. 1928) (describing the differing and challenging problems associated with defining the boundaries of causation).

120 *See, e.g.*, Wright v. Carter, 622 N.E.2d 170, 172 (Ind. 1993) (illustrating the need to determine which actor had exclusive control in finding liability based on res ipsa loquitur). Some may analogize this liability deflecting to *Summers v. Tice*. Summers v. Tice, 199 P.2d 1 (Cal. 1948) (holding liability shifted to two defendants when plaintiff was shot by one but was unable to prove which defendant because the plaintiff was placed "in the unfair position of pointing to which defendant caused the harm" and both defendants were "in a far better position" to exonerate themselves). However, in *Summers*, defendants were still responsible for ensuring the instrumentalities within their control (guns) were not negligently used. *Id*. Here, not only are 3D printers no longer within any alleged manufacturer's control but also manufacturers of 3D printers cannot reasonably be held responsible for how their products are used and for what products their product later produces. Additionally, *Summers*' theory of alternative liability requires proof that all defendants have acted tortuously, which is too high of a bar for the plaintiff in cases involving all the various actors involved in the process of manufacturing 3D products. JOHNSON, *supra* note 27, at 390 (citing *Garcia v. Joseph Vince Co.*, 148 Cal. Rptr. 843 (Ct. App. 1978). Finally, *Summers* has yet to be universally accepted.

Nor would an adaptation of the last-carrier rule work in this instance.[121] There are many reasons for this. First, there is no clear chain of custody in many cases.[122] Second, actors can assume multiple and shifting roles during the production process.[123] Finally, and perhaps most importantly, by the nature of the printing process, a three-dimensionally printed product can defy standard approaches to inspection and detection of defects such that it would unfairly burden the final actor.[124] Courts may reason that this would incentivize those final actors to monetize their risk and pass those burdens onto other actors, achieving a cost-spreading effect, but without some pre-existing framework of liability to rely upon, this approach may also be inadequate.[125]

2. Design Defects

The next area to consider is whether extending traditional product liability to the designer of three-dimensionally printed objects would be sound policy. "A person who never made a mistake never tried anything new," and this can certainly be said of the vast number of designers who

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See, e.g., id. (citing *Leuer v. Johnson*, 450 N.W.2d 363 (Minn. Ct. App. 1990) (declining to follow *Summers* "on nearly identical facts")).

121 The last-carrier rule states that, where damage occurs during a multi-stage voyage to a parcel involving multiple carriers, the burden is on the last carrier to show that the damage did not occur during that stage of the journey. Here, the author hypothesizes a kind of "last manufacturer" rule in which the chain of actors involved in the production of the product would be subject to a type of res ipsa inquiry beginning with the final actor and working backwards. *See, e.g.*, Transatlantic Marine Claims Agency v. M/V "OOCL Inspiration," 137 F.3d 94, 100 (2d Cir. 1997) (applying last carrier logic).

122 A manufacturer can actually be the home hobbyist who is consuming designs published either freely or for sale online. *See generally* THINGIVERSE, *supra* note 3 (providing an example of a website that specializes in sharing 3D printing designs). Would this person, as the manufacturer, be in the unenviable position of being the last carrier when she suffered the injury and thus forced to rebut the presumption that the issue occurred during her part of the custody chain? *See, e.g.*, *M/V "OOCL Inspiration*," 137 F.3d at 99–100 (explaining the application of the last-carrier rule).

123 *See, e.g.* THINGIVERSE, *supra* note 3 (illustrating a website in which actors can fill varying or multiple roles).

124 The difficulty here is that three-dimensionally printed products are, in vast majority, opaque structures whose inner portions, while potentially vital to the functional capacity of the final product, are virtually impervious to traditional error detection. For some view of the enormity of this problem and the complexity of proposed solutions, an excellent article on the topic is included here. *See generally* Cole D. Brubaker et al., *Nondestructive Evaluation and Detection of Defects in 3D Printed Materials Using the Optical Properties of Gold Nanoparticles*, 1 ACS APPL. NANO. MATER., no. 3, 2018, at 1377, 1377–84 (proposing a possible solution to defect detection).

125 *See* Basil S. Markesinis, *Tort Law*, https://www.britannica.com/topic/tort [https://perma.cc/D3XH-P27P] (describing the loss-spreading goal of tort law as a means to protect individuals from being unduly burdened as individuals from the effects of accidents).

are constantly experimenting in the realm of three-dimensional printing.[126] Ordinarily, under product liability, designers are liable for any defects in the designs they produce.[127] Several problems with this approach are self-evident upon closer examination, however. First, designers in a traditional manufacturing environment are ordinarily highly incentivized for their work, and there is a high barrier to entry for designers due to the expensive process of prototyping and previously exorbitant costs of design software.[128] As mentioned previously, one of the greatest advantages to three-dimensional printing is that these barriers to entry are greatly lessened.[129] The side result is that this permits amateurism and hobbyist involvement in producing designs.[130] If an amateur designer came up with a new brake pad, would it be appropriate for an automotive company to purchase that design for a miniscule amount and then refer potential tort suits due to a design defect back to that designer? This is a facially unacceptable outcome.

Another issue with placing traditional products liability on designers is that designers may not always be easily identifiable, and if they are identifiable, they may be uncompensated.[131] In traditional manufacturing, designs are ordinarily rigorously tested and designers often highly compensated.[132] Due to the hobbyist nature of the three-dimensional printing environment, many designers may choose to post designs to websites with or without compensation and even without sharing their names.[133] If liability for a design defect is placed solely with the designer, an injured party might be faced with trying to track down an anonymous designer. Further, there is a genuine debate as to whether a designer can be liable for three-dimensional designs as these are not

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126 Albert Einstein, BRAINYQUOTE, https://www.brainyquote.com/quotes/albert_einstein_148788 [https://perma.cc/N3MA-TFW9].

127 *See* Pannu v. Land Rover N. Am., Inc., 120 Cal. Rptr. 3d 605, 615 (Ct. App. 2011); Richetta v. Stanley Fastening Sys., L.P., 661 F. Supp. 2d 500 (E.D. Pa. 2009) (determining that a design defect exists when a product is manufactured according to the intended design but that design is inherently defective).

128 *See, e.g.*, Lampton, *supra* note 65 (setting the cost of car design for a major manufacturer as high as $300,000, most of which is in designer salaries).

129 *See What is 3D Printing? The Definitive Guide to Additive Manufacturing*, *supra* note 2 (reducing expenses through the use of 3D printing).

130 *See* Katie Macdonald, *How To Get Started In 3D Printing*, POPULAR MECHANICS (Apr. 4, 2016), https://www.popularmechanics.com/technology/gadgets/a19698/get-started-3d-printing/ [https://perma.cc/FHS5-BYVA] (providing a how-to guide for starting as a home hobbyist 3D printer for under $2000).

131 *See, e.g.*, THINGIVERSE, *supra* note 3 (providing an example of a website where 3D printing designs can be exchanged).

132 *See, e.g.*, Lampton, *supra* note 65 [https://perma.cc/GZG5-WHVZ].

133 *See, e.g.*, THINGIVERSE, *supra* note 3.

"products" in the traditional sense but rather can be likened to information or code.[134]

Ordinary negligence cannot be an appropriate solution either. Ordinary negligence for a designer would have to entail a difficult foray into discerning whether appropriate measures of care were taken during the design process.[135] This foray would be further complicated by the myriad unexpected uses to which a three-dimensionally printed object might be placed.[136] For example, a designer may have created a mask based on the movie, *V for Vendetta*.[137] Has the designer considered whether the mask would be safe for children of all ages? For pets? These are considerations that are likely outside the purview of a hobbyist designer and unlikely to be foreseeable.[138] Attempting to apply ordinary negligence to such situations would burden the courts with the unenviable task of assigning reasonable and foreseeable standards to hobbyist activities.[139] This would almost certainly result in verdicts that either leave injured parties absent compensation or overburden those designers who are too attenuated from the end consumer to truly have contemplated the injury and its avoidance during their design.[140] For these reasons, ordinary negligence would be inadequate as a solution encumbering courts, victims, and designers alike.

As discussed above, traditional tort liability models of product liability and ordinary negligence are insufficient to address the unique issues raised by three-dimensional printing. This is partly due to the lack of a traditional manufacturer in many cases, the lack of a "product" where data is treated like information, the presence of amateurs and hobbyists in the manufacturing process, and limited means of effectively cost-spreading risks. Therefore, a liability framework needs to be adopted that serves the crucial purpose of insulating consumers while simultaneously

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134 *See* Engstrom, *supra* note 23, at 38 (discussing a scenario that some members of the legal community have taken to indicate that 3D designs are not products and therefore incapable of sustaining a cause of action based in product liability).

135 *See* Pattman v. Mann et al., 701 S.E.2d 232, 236 (Ga. Ct. App. 2010) (defining the need for proximate cause to support ordinary negligence).

136 *See, e.g.*, *Mask of Vendetta 046 3D Print Model*, CGTRADER, https://www.cgtrader.com/3d-print-models/art/other/mask-of-vendetta-046 [https://perma.cc/JWN2-8M47] (providing an excellent example of a Vendetta-style mask).

137 *Id.*

138 *See* Amir Tikriti, *Foreseeability and Proximate Cause in an Injury Case*, ALLLAW, http://www.alllaw.com/articles/nolo/personal-injury/foreseeability-proximate-cause.html [https://perma.cc/56BP-HDKK] (defining the relationship between foreseeability and proximate cause in a tort suit based on a cause of action for negligence).

139 *See* Engstrom, *supra* note 23, at 36 (describing the means by which 3D printing breaks the traditional tort foundation of manufacturer-to-consumer relationships).

140 *See* Tikriti, *supra* note 138 (outlining the need for foreseeability in a personal injury liability suit).

addressing both the unique nature of the product in three-dimensional printing as well as being sufficiently predictable in the assignment of liability to provide notice to the actors of their potential liability.

3. Challenges Unique to the Various Actors

Up to now, this Note has considered the broader challenges to applying traditional liability theories to the three-dimensional printing paradigm as a whole.[141] Now this Note will narrow the focus to consider the challenges faced by the specific actors within the field of three-dimensional printing. Narrowing the view of the liability question to individual actors will provide further insight into the practical challenges of applying existing liability approaches to this technology.[142]

a. Printer Manufacturers

Some may argue that the manufacturer of the printer itself should not be liable, as the printer operated as designed (*i.e.*, created a three-dimensional object).[143] However, legal theory has been presented that the manufacturer of the printer may be liable, and that theory appears, at first glance, to have sound underpinnings when one considers that three-dimensional printing naturally involves a heightened potential for the creation of objects that are best left to standard manufacturing processes.[144] For example, one would not want to print a braking mechanism for an automobile, even though such a part could be manufactured on a three-dimensional printer because such parts undergo rigorous safety considerations in standard manufacturing as well as post-manufacturing inspections. This encapsulates the issue with three-dimensional printers: due to the nature of the printer, there are virtually limitless uses to which the printer can be put, and many of those uses are not reasonably foreseeable to the maker of the printer.[145] The issue, then,

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141 *See supra* Section II.C.1 (explaining some of the risks associated with traditional forms of liability as applied to 3D printing).

142 *See supra* Part II.C (defining the types of actors engaged in 3D printing today).

143 *See* RESTATEMENT, *supra* note 111, § 402A (describing the ways in which liability attaches during manufacturing).

144 *See* Shen Wang, *When Classical Doctrines of Products Liability Encounter 3D Printing: New Challenges in the New Landscape*, 16 HOUS. BUS. & TAX L.J. 104, 125 (2016) (stating that, while difficult from a pragmatic view, manufacturers of printers may be liable for defective products produced on those printers). This is a common theme amongst scholars in this area—not that printer manufacturers would not be liable but that they would be difficult to prove defective. *Id.*

145 *See, e.g.*, THINGIVERSE, https://www.thingiverse.com/thing:387266 [https://perma.cc/3EQQ-6RG3] (offering the design for a screw and nut to the downloader). While it is predictable that a downloader would use the screw and nut to hold something

becomes that the makers of printers could find themselves liable for a host of unforeseeable uses of the printers those makers manufacture.[146]

b. Printer Operators

The operator of the printer most closely approximates the "manufacturer" in traditional product liability, but the operator is not truly a manufacturer in the traditional sense. The operator may simply own or lease the means of production of the final part and have limited involvement in that product's design or intended use.[147] Further, while operators could be presumed to have knowledge of the parts they are printing, they may have limited negotiations or involvement in the final use of the products.[148] Worse, as time goes on, a traditional manufacturer may lease or sell three-dimensional printers to home consumers and charge a subscription fee to print products on it, not dissimilar to the sales model cable operators use today.[149]

c. Parts Sellers

The seller of the printed parts is not the manufacturer in the traditional sense of the word.[150] Sellers may not be involved in the actual creation or design of the product.[151] Using the subscription-based example above,

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together, would the seller reasonably foresee that it might be used to hold a critical piece of scaffolding together?

146 *Cf.* Palsgraf v. Long Island R.R. Co., 162 N.E. 99, 102 (N.Y. 1928) (Andrews, J., concurring) (defining a wider duty of a party to those who generally could be injured by the results of their actions).

147 *See, e.g.*, *3D Printing Service*, STRATASYS, https://land.stratasysdirect.com/3d-printing-service [https://perma.cc/V2JJ-RL4H] (offering third-party printing services for those seeking 3D printing).

148 *See, e.g.*, THINGIVERSE, https://www.thingiverse.com/thing:3023372 [https://perma.cc/NJK9-QT8G] (illustrating a drill guide which could be 3D printed). Like so many products that can be 3D printed, the final use of the part by the consumer may be unknown to the designer and may exceed tolerances the designer had in mind when designing that part.

149 *See, e.g.*, *Xfinity Equipment*, XFINITY, https://www.xfinity.com/learn/digital-cable-tv/x1/equipment [https://perma.cc/372F-YBY8] (providing an example of the different equipment rental options for Comcast). Additionally, a home operator could be harmed by a product that was printed off the printer in his home, but who would be liable? Is the home operator the "manufacturer," or does that distinction belong to the company that leased the printer to the home operator? That company could probably escape liability under a traditional products-liability approach by no longer being considered the true "manufacturer."

150 *See* C.P. Jhong, *What Constitutes a Manufacturer and Who Is a Manufacturer under Tax Laws* 17 A.L.R. 3d 7 (1968) (illustrating the means by which courts have attempted to define a manufacturer as one who makes something). Here, the seller did not make the product in question.

151 *See supra* Section II.C.3 (defining the role of the seller in 3D printing).

though, sellers could potentially evade liability under a products liability approach because they are not involved in the manufacture or design of the product they are selling, even though the end consumer is not in a negotiating position with the seller and lacks the sophistication to protect himself through properly testing the printed products.[152]

Currently, traditional product liability models may not reach purveyors of three-dimensional product designs, such as websites that specialize in these designs, as they are neither manufacturers nor designers themselves and therefore fall outside those models of liability.[153] Further, ordinary negligence may be insufficient due to the aforementioned limited foreseeability of harm, particularly with websites that permit posting by the general public yet may fail to serve the general public's need for consumer protection.[154]

d. Designer of the Parts

The designer of the three-dimensional products, as previously mentioned, may be an individual who is working as a professional designer for a large manufacturer, or he may be a home enthusiast designing as a hobby with limited experience or expertise.[155] In the example of the three-dimensionally printed brake pad, consider the differences between these two actors. Under a traditional theory of product liability, a design defect would be the responsibility of the designer, not the manufacturer.[156] Therefore, a large car manufacturer might escape liability based on design defects by utilizing designs by third parties, even amateurs.[157] This result leads to unrecoverable damage awards and injured parties who will not be made whole. Under a negligence theory, the consumer would be placed in the unenviable

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[152] *See* Engstrom, *supra* note 23, at 35 (outlining some of the potential problems of introducing micro-manufacturers to the marketplace).

[153] *See, e.g.*, THINGIVERSE, *supra* note 3 (exposing 3D printing designs to the consuming public via a website). *See also* Engstrom, *supra* note 23, at 35 (describing the limitations of traditional product liability in reaching the actors involved in 3D printing).

[154] *See* JOHNSON, *supra* note 27, at 418–19 (noting that some scholars use "foreseeability" as "the key consideration in proximate cause inquiries"). *See also* Hanes v. Shapiro & Smith, 84 S.E. 33, 35–36 (N.C. 1915) (explaining when ordinary negligence may apply to a bailment).

[155] *See* Section II.C.4 (defining the role of the designer in 3D printing).

[156] *See, e.g.*, Saller v. Crown Cork & Seal Co., 187 Cal. App. 4th 1220, 1231 (2010) (outlining the assignment of liability to those who are responsible for defective designs in product liability).

[157] *See* D.F. v. Sikorsky Aircraft Corp., No. 13-cv-00331-GPC-KSC, 2017 WL 4922814 (S.D. Cal. Oct. 27, 2017) (finding that lack of involvement in the design or manufacture of a helicopter part that failed was sufficient to grant summary judgment to one of the parties).

position of attempting to show how the car manufacturer was negligent.[158] The reasons for the development of product liability in the first place included the expense, complexity, and difficulty of proving negligence in cases such as these.[159]

For these reasons, traditional liability frameworks are not an appropriate fit to accommodate the challenges of the three-dimensional printing paradigm. Instead, a framework must be developed that shifts the burden to the party best positioned to prevent the loss.

e. End Consumers

One of the largest concerns with three-dimensional printing is that end consumers may take the place of the manufacturer by printing the product themselves.[160] This is particularly concerning when professional manufacturers offer designs for sale for consumers to download and print.[161] When an end consumer prints a brake pad and installs it, the end consumer has now usurped the place of the manufacturer.[162] Under product liability, if that brake pad fails and causes an injury to an innocent bystander, the consumer may not be able to repay the harm caused to the bystander and may face a lengthy and uncertain process of attempting to show any liability on the part of the design that he downloaded.

Alternatively, a negligence framework might make more sense, but the courts would have to untangle who is actually liable between the printer manufacturer, the designer, the purveyor of the design, and the end consumer that downloaded the design.[163] This would necessitate

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158 *Cf.* Eisner v. Fields, 998 S.W.2d 421, 430 (Ark. Ct. App. 1999) (illustrating in the words of an expert witness the "difficult to prove" challenge in complex negligence cases that led the courts to the doctrine of res ipsa loquitur).

159 *See* Escola v. Coca Cola Bottling Co. of Fresno, 150 P.2d 436, 441 (Cal. 1944) (Traynor, J., concurring).

160 *See, e.g.*, THINGIVERSE, *supra* note 3 (showcasing an example of an open marketplace for designers and consumers to freely exchange transactions).

161 *See, e.g.*, *Printable 3D Models*, THE FORD 3D STORE, http://3d.ford.com/3d-printables.html [https://perma.cc/LKC4-2PE7] (providing an illustrative example of a major manufacturer now selling products for the consumer to download and print).

162 Or, as discussed previously, the end consumer may attempt to point to the manufacturer of the printer itself, but this will be a difficult avenue to prove due to the lack of foreseeability of this use of the printer and the number of other actors involved. *See* discussion *supra* note 120. For example, the person running the printer often must manually clear some of the detritus and scaffolding created during the process of printing. It will be virtually impossible to know whether some failure-causing irregularity resulted from the printer, the filament manufacturer, or the end user of the printer.

163 *Sindell v. Abbott Laboratories* extended *Summers v. Tice* based, in part, because identifying the manufacturer was "impossible" and could not "reasonably be said that one [either plaintiff or defendants] is in a better position than the other to make the identification. . . ." *See* Sindell v. Abbott Labs., 163 Cal. Rptr. 132 (Cal. 1980) (assigning liability to multiple

complex litigation to resolve the injury and be administratively inefficient.[164] Instead, a liability framework should place the burden on the professional actor where that actor can reasonably foresee the eventual injury.

f. Filament Manufacturers / Distributors

Neither would the producer of the filament, the "ink," used by the three-dimensional printers to make the products, be an appropriate candidate for traditional theories of product liability. Here, at last, there is a manufacturer in the usual sense, as filament makers are typically manufacturers.[165] However, the manufacturer does not actually produce the product.[166] Rather, the filament is a fuel to produce the final product.[167] As such, the filament manufacturer would not likely be reachable under a standard product-liability theory.[168] Because the filament manufacturer would not be involved directly in the manufacture of the final product, the filament manufacturer could not be said to be on notice as to potential liability, nor could such a manufacturer be reasonably held to foresee the universe of products to which the filament might be applied.[169] Because there is a lack of foreseeability, and the decision to use the filament to manufacture a product that could not reasonably have been foreseen would likely be treated as a superseding act breaking the causal chain, it is unlikely that any recovery theory based

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defendant drug manufacturers, marketers, and promoters based on proportion of market share unless each defendant could show "it could not have made the product which caused plaintiff's injuries"); Summers v. Tice, 199 P.2d 1 (Cal. 1948). But again, this case is unlike manufacturing of three-dimensionally printed products because here, the consumer is actually using the product to manufacture more products that are both unpredictable and uncontrollable. Thus, any market-share-liability approach would be insufficient. *See* JOHNSON, *supra* note 27, at 402–03 (citing multiple sources elaborating on the conflicting views regarding adoption of market-share liability).

164 *See* Louisell & Williams, *Res Ipsa Loquitur–Its Future in Medical Malpractice Cases*, 48 CAL. L. REV. 252, 255 (1960) (defining the high cost of traditional methods of proving causation).

165 *See, e.g.*, 3DXTECH, https://www.3dxtech.com/ [https://perma.cc/377X-VFQC] (providing a representative example of a filament manufacturer's website).

166 *See* Matt Petronzio, *How 3D Printing Actually Works*, MASHABLE, https://mashable.com/2013/03/28/3d-printing-explained [https://perma.cc/72E9-XSD4] (describing how filament is merely the fuel or "ink" that 3D printers rely upon).

167 *See id.* (explaining how filament is used within a 3D printer to produce a final product).

168 *Cf.* JOHNSON, *supra* note 27, at 424 (outlining the limitations of foreseeability and negligence). *See also* Linden v. CNH Am., LLC, 673 F.3d 829, 834 (8th Cir. 2012) (demonstrating that a defect in manufacturing requires a departure from the design). Because the design of the filament is not limited by any specific content guarantees, proving a departure from that design would be a very difficult task for the consumer.

169 *See* Petronzio, *supra* note 166 (highlighting the uses of filament in 3D printing). *Cf.* Palsgraf v. Long Island R.R. Co., 162 N.E. 99 (N.Y. 1928) (illustrating the differing views on the boundaries of causation between Justice Cardozo and Justice Stevens).

on ordinary negligence would apply as well.[170] For these reasons, traditional liability models may be inappropriate when applied to filament manufacturers.

From this analysis of the actors involved in the three-dimensional process, a pattern of common issues among the actors is identified: limited notice due to degrees of separation between the various actors; limited foreseeability of harm; the absence of a traditional "manufacturer" to whom to assign a duty of care; and amateur involvement in this innovative field. A successful liability framework for three-dimensional printing should therefore address these unique challenges while accomplishing traditional tort goals.[171]

4. Inherently Dangerous Objects

Any discussion of three-dimensional printing in a contemporary sense inevitably must contain some mention of the debate surrounding the use of this technology to print guns.[172] Recently, Defense Distributed went live with its DefCad website, a marketplace for sharing and downloading the designs to three-dimensionally print guns.[173] This marketplace offered users the opportunity to buy and sell their designs for three-dimensional guns and featured plans to download an AR-15 before the marketplace was temporarily halted by a federal judge.[174] Prior to the temporary restraining order, 3263 downloads were recorded of the design for the AR-15, and the AR-15 was not even the most popular model by number of downloads.[175]

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170 *See* Tikriti, *supra* note 138 (defining the interaction between foreseeability and proximate cause in a suit for negligence).

171 *Cf.* JOHNSON, *supra* note 27, at 7–10 (outlining popular policy arguments in tort law).

172 *See* Emma Woollacott, *Debate over 3D-Printed Guns Ramps Up*, FORBES (Aug. 10, 2018), https://www.forbes.com/sites/emmawoollacott/2018/08/10/debate-over-3d-printed-guns-ramps-up/ [https://perma.cc/C5AB-AKTL] (describing the facts of the current debate between Defense Distributed and others over restrictions on file sharing of 3D-printed gun designs).

173 *See* Charlie Osborne, *Defense Distributed Now Sells 3D Gun Blueprints Online, 'Pay What You Want*,' ZDNET (Aug. 29, 2018), https://www.zdnet.com/article/defense-distributed-now-sells-3d-gun-blueprints-online/ [https://perma.cc/9AU3-KF4K].

174 *See* DEFCAD, https://www.defcad.com/ [https://perma.cc/MEG2-DQBR] (providing a digital marketplace for 3D-printed guns). *See also* Mon Berenguer, *DEFCAD.COM Goes Dark as Judge Blocks Release of 3D Printing of Guns*, GUN WORLD (Aug. 6, 2018), https://www.gunworld.com/news/defcad-com-goes-dark-as-judge-blocks-release-of-3d-printing-of-guns/ [https://perma.cc/YUY6-DD45] (reporting that the DefCad website had been blocked by a temporary restraining order by a federal district judge in Seattle).

175 *See* DEFCAD, https://www.defcad.com/ [https://perma.cc/MEG2-DQBR] (listing the number of downloads of the most popular gun designs for 3D printing).

Nothing on the internet is ever really gone.[176] Once a high number of people have downloaded a particular piece of information from the internet, any one of those people could share that information again by posting it to any number of poorly-regulated websites.[177] Even more problematic, these guns can be made undetectable and untraceable.[178] As a result, these guns pose a special risk to public safety.[179] Traditional theories of product liability are exceptionally unlikely to reach the manufacturers of these guns.[180] This is because there is no manufacturer other than the end consumer, and the gun itself may not have a defect other than the danger it poses to the public at large.[181] And that danger is real. A three-dimensionally printed gun was seized at a U.S. airport in 2018.[182]

Who then is liable for these guns if they are used in the commission of a crime if product liability cannot effectively reach purveyors, designers, and manufacturers of these weapons? Ordinary negligence theory may offer some grounds for a case because the foreseeability of harm from a three-dimensionally printed gun is far more reasonable than that of other objects.[183] Even here, though, the remaining issue is whether the sharing of digital information is too attenuated from the actual injury.[184] If *Bell* is followed, the answer is almost certainly "yes."[185] In *Bell*, the court found

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176 *See generally Experts: Deleted Online Information Never Actually Goes Away*, TRIBUNE WIRE REP. (Aug. 21, 2015), http://www.chicagotribune.com/bluesky/technology/chi-deleted-online-information-never-goes-away-20150821-story.html [https://perma.cc/6VU9-TFDF] (describing retention of online data by companies).

177 *See, e.g.*, *Top 10 File Sharing Services: Which One Is the Best?*, FINANCESONLINE, https://financesonline.com/top-10-file-sharing-services/ [https://perma.cc/4KMD-JKB9] (providing examples of file-sharing services to which a user could post a 3D-printing design file).

178 *See* Marrian Zhou, *3D-Printed Gun Controversy: Everything You Need to Know*, CNET (Sept. 25, 2018), https://www.cnet.com/news/the-3d-printed-gun-controversy-everything-you-need-to-know/ [https://perma.cc/USV5-4XHQ] (mentioning the concerns about traceability of 3D-printed guns).

179 *See id.* (illustrating how a 3D-printed firearm can be manufactured to be undetectable).

180 *Cf.* D.F. v. Sikorsky Aircraft Corp., No. 13-cv-00331-GPC-KSC, 2017 WL 4922814 (S.D. Cal. Oct. 27, 2017) (finding that lack of involvement in either a defective design or a defective manufacture was insufficient grounds to extend product liability to a party).

181 *See id.* (explaining the limits of the scope of product liability).

182 *See* Scott Sonner, *TSA: 3D-Printed Gun Seized at Reno Airport*, RENO GAZETTE J. (Aug. 10, 2016), https://www.rgj.com/story/news/2016/08/10/tsa-printed-gun-taken-reno-airport/88521032/ [https://perma.cc/4QAF-74A3] (reporting on the gun seized in a carry-on luggage at the Reno airport).

183 *See* Tikriti, *supra* note 138 (defining negligence as determined by the interplay of foreseeability and proximate cause).

184 *See* JOHNSON, *supra* note 27, at 420–21 (discussing the rise of the "remoteness doctrine," which requires a close causal link to establish the causation element for establishing liability). *See, e.g.*, Owens Corning v. R.J. Reynolds Tobacco Co., 868 So. 2d 331 (Miss. 2004).

185 *See* Bell v. Campbell, 434 S.W.2d 117, 122 (Tex. 1968).

that an accident that occurred when three men were cleaning up the debris from a prior accident was too attenuated from the original accident to hold the source of the original accident liable for the secondary accident as well.[186] Applying this logic to the gun designer or purveyor, a secondary action by the recipient of that design would be a secondary incident separate and apart from the initial act of conveying that design to the recipient.[187] Therefore, ordinary negligence may not be sufficiently broad to compensate those who suffer injury from three-dimensionally printed guns.[188]

Here, the problem becomes clear: ordinary negligence may be too attenuated from the process to indemnify consumers and the general public from injuries caused by inherently dangerous three-dimensionally printed objects, and traditional product liability may have little to no effect where a digital object or information may be treated by the courts as not a "product" at all. Therefore, a framework of liability for three-dimensional printing would be incomplete without a clear and unambiguous assignment of liability on those actors who are directly responsible for the design, creation, and promulgation of inherently dangerous objects via this new technology.

B. Public Policy Considerations, the Art of Innovation, and Micro-Manufacturers

Up to now, this Note has identified the various reasons two of the traditional causes of action in tort may prove insufficient to properly compensate those injured by three-dimensionally printed objects. Armed with an understanding that traditional remedies may be insufficient, turn

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186 *See id.* at 122 (holding that clean up following the accident was too remote from the causal chain to induce liability).

187 *See id.* at 120 (describing secondary incidents as attenuated from the initial causation of an accident).

188 The author acknowledges that many other concerns may act to indemnify purveyors and sellers of guns and gun designs including, but not limited to, rights conveyed by: Second Amendment, Free Speech, and Congressional Acts, which have indemnified gun manufacturers from liability for non-defective firearms. These questions are deserving of significant discussion but are beyond the scope of this Note. The challenge here is that traditional notions of product liability are arguably insufficient to encompass the myriad issues associated with 3D-printed firearms. A key area of distinction is that ordinarily a manufacturer is only liable when the gun acts in a way other than a gun ordinarily should (*i.e.*, it blows up in the user's hand). Three-dimensionally printed guns present a unique risk to security for three reasons: (1) limited detectability; (2) limited traceability; and (3) unlimited proliferation by a single user. For these reasons, the special risks posed by three-dimensionally printed guns should not be limited to merely traditional forms of product liability, but courts should take a much more expansive view of liability due to the extreme risks posed by placing 3D gun designs and the physical guns themselves into commerce without sufficient checks on the purchasers.

now to consider the public policies at play involving this emergent technology, which may inform an alternative liability framework.

First, emergent technologies are important social goods.[189] Emergent technologies create jobs, improve quality of life, increase economic growth, and are critical to retaining a competitive posture in a global market.[190] There has been an entrenched desire to prevent the restraint of those technologies—for example, politicians generally avoid any attempt at significantly regulating the internet beyond non-divisive issues such as child pornography.[191] Cell phones were famously made possible when the Federal Communications Commission broke up the monopoly Bell Labs held on cellular technology.[192] Viewed through this lens, the goal of fostering innovation must weigh on policy makers and the courts when determining how to manage the three-dimensional printing industry.

One means by which courts permit amateurs and hobbyists greater leeway is by distinguishing between professional negligence and ordinary negligence.[193] This approach assigns a greater duty of care to those who are professionals or who market themselves as professionals.[194] In developing a framework of liability for those engaged in three-dimensional printing, a similar distinction may allow the larger

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189 *See, e.g.*, Vijay Eswaran, *How Emerging Technology Is Driving Job Creation, New Industries,* CHIEF EXEC. (Aug. 9, 2018), https://chiefexecutive.net/how-emerging-technology-is-driving-job-creation-new-industries/ [https://perma.cc/7V7K-FFNU] (arguing that technology increases job opportunities).

190 *Id.*

191 *See, e.g.*, Harper Neidig, *Public Interest Groups Urge Officials to Protect Net Neutrality,* THE HILL (Mar. 7, 2017), http://thehill.com/policy/technology/322558-public-interest-groups-urge-officials-to-protect-net-neutrality [https://perma.cc/6DLK-MMHK] (describing the political pressure associated with encumbering the internet). *See also* KAN. STAT. ANN. § 21-5514 (Westlaw through 2018) (outlining penalties for those trafficking in child pornography online).

192 *See What We Can Learn from the History of Deregulation: US Telecommunications*, BOUNCE ENERGY, https://www.bounceenergy.com/articles/texas-electricity/history-of-deregulation-telecommunication [https://perma.cc/LQD4-Q56V] (describing the telecommunications achievements through a combination of deregulation and monopoly-ending practices).

193 *See* Pattman v. Mann et al., 701 S.E.2d 232, 236 (Ga. Ct. App. 2010) (explaining the standards of care anticipated of professionals versus members of the general public). *See also* Wal-Mart Stores, Inc. v. AIG Life Ins. Co., No. 19875, 2005 WL 5757652 (Del. Ch. Apr. 1, 2005) (defining the criteria to trigger the higher standard of care associated with professional negligence). *Compare* RESTATEMENT, *supra* note 111, § 402A (attaching special liability to professionals engaged in selling defective products), *with* RESTATEMENT, *supra* note 111, § 281 (stating the elements for negligence), *and* RESTATEMENT, *supra* note 111, § 282 (defining negligence), *and* RESTATEMENT, *supra* note 111, § 283 (elaborating on the standard of conduct of the reasonable person).

194 *See* Wal-Mart Stores, Inc. v. AIG Life Ins. Co., No. 19875, 2005 WL 5757652 (Del. Ch. Apr. 1, 2005) (discussing professional liability compared to ordinary individuals engaged in the same activities).

manufacturers such as Ford Motor Co. to be held to a higher standard for their products while avoiding placing too high of a burden on home hobbyists and smaller-scale innovators.[195]

Johnson defines a series of twelve tort policies that form foundational blocks to modern tort jurisprudence.[196] One of those policies is that accident victims who are not at fault should be fully compensated.[197] Also, those who engage in dangerous activities should bear the resultant risks.[198] Taken together, these policy considerations may form an exception that, while it is important not to stifle innovation or assign responsibility to a small-time seller or designer, perhaps those sellers should be held to a higher standard and commensurate risk exposure when the products they sell are inherently or foreseeably dangerous.[199] Additionally, Johnson opined that large manufacturers could more effectively spread the costs of accidents across a wide number of people to avoid the costs of an accident falling too harshly on a single individual.[200]

Balanced against these policies is a desire to spread the costs of accidents widely.[201] With small-time purveyors of goods or designs, those unbalanced costs may simply shift from one party to another.[202] Tipping the balance, then, is "notice." A framework of liability, to be effective, must be sufficiently straightforward that parties have notice of their potential liability, which serves Johnson's tort policy of fostering predictability of outcomes.[203] This notice should also serve the important public policy of deterring accidents.[204]

Finally, it is crucial to think of micro-manufacturers not in the traditional sense of the large manufacturing entities of the past but rather as personalized services.[205] Three-dimensional printing, while it can and has been adopted by large manufacturers, has a secondary use that is

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195 *See* Mearian, *supra* note 4 (illustrating the expansion of 3D printing into wider markets).

196 *See* JOHNSON, *supra* note 27, at 7–10 (defining twelve tort policies Johnson believes are central to understanding modern jurisprudence in tort law).

197 *Id.* at 9–10.

198 *Id.* at 8.

199 *Id.*

200 *See* id. at 7–8 (opining that deeper pockets of manufacturers might lead to better cost-spreading of accidents).

201 *Id.*

202 *See infra* note 224 and accompanying text (outlining the inequality in financial resources between individual households and large manufacturers).

203 *See* JOHNSON, *supra* note 27, at 8–9.

204 *Id.* at 7–8.

205 *See, e.g.*, Jamie D., *Mini Offers 3D Printing Personalization Services for its Cars,* 3D NATIVES (Jan. 10, 2018), https://www.3dnatives.com/en/3d-printing-mini-100120184/ [https://perma.cc/DPE3-TV8Y].

growing in adoption as well—as a personal service.[206] Innovators are now pushing the edge of this technology to solve basic needs such as making clothing on their home printer.[207] Enthusiasts liken this versatile technology for solving their needs to the fictitious *Star Trek* replicator, seeing a future in which products are created in their own homes as needed and traditional manufacturing is relegated to a much more limited role in their daily lives.[208] With an eye to this potential future, any liability framework must consider the possibility that there may be no traditional manufacturer to which to assign liability at all.[209]

C. Synthesizing the Issues

From this balancing of tort policies, a potential framework of liability begins to take shape. A framework of liability should consider the degree of notice of risk those actors have, whether they have been financially incentivized as professional manufacturers or designers, and the degree of attenuation between those actors and the actual injury. By assigning a duty of care to the actor based on these factors, a court will be able to assign liability in a predictable and flexible way that may accommodate the unique challenges of the three-dimensional printing industry. From the above analysis emerges a clearer picture of the parameters of the problem. The actors in three-dimensional printing may include: (1) hobbyist designers with no reasonable foreseeability as to the potential uses or harms from their products; (2) manufacturers who are also the end consumers so that no actual manufacturer is available under present product liability; (3) makers of printers that are merely the tools for producing the defective end product; (4) filament manufacturers who are arguably even more remote from the end consumer and potential harm than the printer manufacturers; and (5) the manufacturer who actually runs the printer but who may have little to no relationship with the end product being manufactured.[210] These actors all share two common threads: limited foreseeability and limited compensation for the part being produced.[211]

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206 *See, e.g.*, *id.*

207 *See, e.g.*, Kate Baggaley, *Soon You May Be Able to 3D Print Clothing in Your Own Home*, NBC NEWS (Feb. 20, 2018), https://www.nbcnews.com/mach/science/soon-you-may-be-able-3d-print-clothing-your-own-ncna848646 [https://perma.cc/J7ZX-G9ZM].

208 *See* David Gewirtz, *I've Seen the Future of 3D Printing (Think Star Trek Replicator)*, ZDNET (July 7, 2017), https://www.zdnet.com/article/ive-seen-the-future-of-3d-printing-think-star-trek-replicator/ [https://perma.cc/22KP-MSRU] (discussing the future of 3D technology).

209 *See id.* (giving an example of the author's plans to be the manufacturer for himself).

210 *See generally What Is 3D Printing?*, *supra* note 46.

211 *Id.*

Complicating matters further, there are inherently dangerous objects versus ordinary objects being created.[212] Objects that are inherently dangerous carry their own special risks and, by their nature, often carry easily foreseeable risks.[213] Standard product liability may not apply to them, however, because the question that must be asked in standard product liability is whether there was a manufacturing, design, or labeling defect.[214] A gun that fires correctly is, technically, not defective in that sense, and product liability would not attach.[215] However, the dangers incumbent upon the promulgation of three-dimensionally printed guns are different than those of ordinary gun manufacturers.[216] Guns are ordinarily subject to controls to ensure that only those who are licensed can purchase them.[217] These protections are not available with the current digital marketplaces for firearms.[218] As a result of these special risks, and the fact that a gun that works as designed might permit those involved in its digital promulgation to escape standard product liability, another thread emerges—that those involved in the sales, distribution, manufacture, or design of inherently dangerous objects have a unique duty within the paradigm of three-dimensional printing due to the uncontrolled nature of that distribution.[219] Therefore, a special duty of

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212 *See* Woollacott, *supra* note 172 (explaining the legal position of Defense Distributed, a purveyor of online gun designs for reproduction on 3D printers).

213 *See* JOHNSON, *supra* note 27, at 7–10 (listing the fundamental policies underlying tort theory according to Johnson).

214 *See Failure to Warn as a Basis of Liability under Doctrine of Strict Liability in Tort*, 53 A.L.R. 3d 239. *See e.g.*, Goins v. The Clorox Co., 926 F.2d 559, 561 (illustrating how a failure to warn can cause liability to arise in a case involving products liability). *See generally* JOHNSON, *supra* note 27, at 697–752 (elaborating on products liability). *See, e.g.*, Linden v. CNH Am., LLC, 673 F.3d 829 (8th Cir. 2012); Pannu v. Land Rover N. Am., Inc., 120 Cal. Rptr. 3d 605 (Ct. App. 2011); Richetta v. Stanley Fastening Sys., L.P., 661 F. Supp. 2d 500 (E.D. Pa. 2009).

215 *See* Danielle Kurtzleben, *FACT CHECK: Are Gun-Makers 'Totally Free of Liability for Their Behavior'?*, NPR (Oct. 6, 2015), https://www.npr.org/sections/itsallpolitics/2015/10/06/446348616/fact-check-are-gun-makers-totally-free-of-liability-for-their-behavior [https://perma.cc/4W6X-ECLQ] (outlining that guns that fire as intended do not attach liability to their manufacturers).

216 *See Are 3D-Printed Guns Legal?*, CRIM. DEF. LAW., https://www.criminaldefenselawyer.com/resources/are-3d-guns-legal.htm [https://perma.cc/ZGZ8-PMAT] (outlining some of the unique risks to 3D printed firearms and the attempts to curtail those risks).

217 *See, e.g.*, *Gun Laws by State: The Complete Guide–2018*, GUNS TO CARRY, https://www.gunstocarry.com/gun-laws-state/ [https://perma.cc/SM2H-DFHP] (defining gun regulations on a state-by-state basis). This is usually restricted to adult, non-felons, often with cooling periods prior to issuing a license to ensure that a gun is not purchased in the heat of passion for use in a crime. *Id.*

218 *See Are 3D-Printed Guns Legal?*, *supra* note 216 (explaining the current state of legalized gun manufacture via 3D printing).

219 *See infra* Part IV (offering a means for courts to shift liability based on duty of care and the inherent danger posed by the printed object).

care should attach to those actors with direct involvement in the sales, distribution, manufacture, or design of inherently dangerous objects.[220]

In addition, unlike standard manufacturing, three-dimensional printing involves hobbyists as well as professionals.[221] Due to the much lower cost of entry into the manufacturing marketplace for three-dimensional printing, home hobbyists and others are able to enter the marketplace who would be restricted from entering the far more expensive realm occupied by traditional manufacturers.[222] This prevents the cost-spreading benefit of applying strict liability to traditional manufacturers.[223] Also, a home hobbyist is unlikely to have the deep pockets necessary to indemnify an accident victim, defeating one of the key purposes of liability—to make an accident victim whole.[224] Further, the home hobbyist is far less likely to have access to the means to protect himself through the types of rigorous testing and legal counsel often

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[220] *Compare* JOHNSON, *supra* note 27, at 698–701 (discussing enterprise liability, which attaches liability to "those who profited by making and selling products" that cause injuries), *and* RESTATEMENT, *supra* note 111, § 402A ("One who sells any product in a defective condition unreasonably dangerous to the user or consumer . . . is subject to liability" if certain elements are met), *with* RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 20 (2010) (establishing the standard for abnormally dangerous activities), *and* JOHNSON, *supra* note 27, at 686–87 (providing a list of court cases in which courts applied the strict liability standard for "abnormally dangerous activities" and a list of activities to which courts applied a negligence standard, and noting that the analysis "does not turn primarily on levels of danger"). *But see* Gerald W. Boston, *Strict Liability for Abnormally Dangerous Activity: The Negligence Barrier*, 36 SAN DIEGO L. REV. 597, 599 (1999) (noting that plaintiffs have a difficult time succeeding on "abnormally dangerous activity" claims).

[221] *See* Tyler Koslow, *Sculpteo Details the Hobbyist Market in Their "State of 3D Printing" Industry Report*, 3DPRINT.COM (May 12, 2016), https://3dprint.com/133924/sculpteo-report-hobbyists/ [https://perma.cc/FA8U-JWE5] (describing broadly the wide number of home hobbyists enjoying the 3D printing market).

[222] *See, e.g.*, Lampton, *supra* note 65 (illustrating the expensive nature of traditional design processes).

[223] *See* JOHNSON, *supra* note 27, at 8 (stating that a key tort policy is the spreading of costs of accidents).

[224] *See id.* (discussing the deep pockets necessary to protect those injured in accidents). To put the dichotomy of net worth of large companies versus individual households into perspective, in 2018, the value of the S&P 500 cumulatively was placed at $20,967,117,500,000—over twenty trillion dollars. *See S&P 500 Historical Total Market Cap & Float Adjusted Cap*, SIBLIS RES. LTD, http://siblisresearch.com/dSata/total-market-cap-sp-500/ [https://perma.cc/EY5N-7VZW]. *Id.* By way of comparison, in June 2018, the median household income in the United States was just $62,175. *See June 2018 Median Household Income*, SEEKING ALPHA, https://seekingalpha.com/article/4193310-june-2018-median-household-income [https://perma.cc/GA4Z-T8QE]. Therefore, the average net worth of an S&P 500 company is more than 500,000 times the income of the median household.

retained by large, traditional manufacturers.[225] As a result, applying traditional product liability to home hobbyists may be too burdensome and impractical. Therefore, home hobbyists, those with limited compensation for their involvement, should also not carry the same duty of care as a professional designer or manufacturer.[226]

A final problem encountered with extending traditional product liability to the paradigm of three-dimensional printing is whether much of what is being done is even a "product" as defined by law.[227] Today, software, digital subscriptions, and services are often not treated as products and so product liability does not attach.[228] Therefore, relying upon a traditional product liability framework is likely to be insufficient to ensure protections for accident victims harmed by three-dimensionally printed products.

From this summary emerges an overall pattern—that liability in three-dimensional printing should not be based on traditional notions of product liability.[229] Traditional product liability presumes a large manufacturer with deep pockets and greater foreseeability for the uses of its products than is present in the normal context of three-dimensional printing.[230] Instead, courts should adopt a liability framework based upon the duty of care owed by each of the actors, tempered by whether the actor is a hobbyist or professional and enhanced if the actor is engaged in the manufacture of inherently dangerous objects. Courts have already

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225 *See* JOHNSON, *supra* note 27, at 7–10 (describing the tort policies that were developed during the era of larger manufacturers, many of which may be ineffective in practice, principle, or both, today).

226 A natural question to ask at this stage would be, "And how does one determine who is a hobbyist versus who is a professional?" While the separation of the two is a topic beyond the scope of this Note, some insight into how the Supreme Court has separated those who are merely amateurs from those who are in a business or trade can be gained by referring to *Commissioner v. Groetzinger*, 480 U.S. 23, 27–28 (1987).

227 *See, e.g.*, Engstrom, *supra* note 23, at 38 (stating that designs that are digital objects are uncertain to be held to be products).

228 Whether software is a product, whether it is governed by the *Uniform Commercial Code*, and the ways in which liability may emerge for software development is a broad and notoriously ephemeral concept in the courts. Currently, different jurisdictions have approached the problem in myriad ways. *See* Richard Raysman, *The UCC and Software Contracts: Recent Developments*, HOLLAND & KNIGHT (Feb. 18, 2011), https://www.hklaw.com/digitaltechblog/the-ucc-and-software-contracts-recent-developments-02-18-2011/ [https://perma.cc/9P3A-BPZ4].

229 *See* JOHNSON, *supra* note 27, at 700–01.

230 *See* Escola v. Coca Cola Bottling Co. of Fresno, 150 P.2d 436, 441 (Cal. 1944) (Traynor, J., concurring) (citing a manufacturer's ability to better manage the costs of injury as a reason for conferring absolute liability on manufacturers for defective products).

engaged in this duty of care analysis with bailments, and a similar theory applied to three-dimensional printing is a natural fit to the problem.[231]

IV. CONTRIBUTION

This Note proposes that courts adopt a framework of liability for cases involving three-dimensionally printed objects that deviates from current products liability. Specifically, this Note proposes that courts adopt a negligence theory of liability, tempered by a duty of care analysis based on three criteria: (1) whether the actor is a professional or an amateur; (2) whether the object involved was inherently dangerous; and (3) whether the actor was too attenuated from the injury.

A duty of care analysis should follow that actors who are professionals and are compensated as professionals for their work relating to three-dimensional printing owe a heightened duty of care for the products they design and manufacture. As a result, even slight negligence on the part of such an actor should result in a finding of liability.[232] Beneath this group, amateurs who are directly involved or in some way compensated for the distribution of their products to the consumer marketplace should owe a duty of ordinary care for the products they design and manufacture.[233] As a result, ordinary negligence principles should apply. Beneath this group, amateurs who are attenuated from the consumer marketplace and are uncompensated should be similar to a bailor who is performing the bailment on behalf of the bailee—only a slight duty of care should arise; therefore, only gross negligence will trigger liability.[234] Outside of this framework, courts should treat those involved in the sale, distribution, manufacture, and design of inherently dangerous objects as strictly liable for the harm caused by those products. In this way, those who are involved in the manufacture of those products

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231 *See* Hanes v. Shapiro & Smith, 84 S.E. 33, 35 (N.C. 1915) (showcasing alternative degrees of care owed based on the bailor-bailee relationship). *Cf.* United Farm Family Ins. v. Riverside Auto, 753 N.E.2d 681, 685 (Ind. Ct. App. 2001); Pitman v. Pitman, 717 N.E.2d 627, 631 (Ind. Ct. App. 1999); Norris Auto. Serv. v. Melton, 526 N.E.2d 1023, 1026 (Ind. Ct. App. 1988).

232 *Cf. United Farm Family Ins.*, 753 N.E.2d at 685; *Pitman*, 717 N.E.2d at 631; *Norris*, 526 N.E.2d at 1026. Again, this is similar to the same analysis that takes place in bailment in determining the degree of negligence permissible.

233 *See Hanes*, 84 S.E. at 36 (defining a duty of ordinary care in a bailment relationship of mutual benefit). *Cf. United Farm Family Ins.*, 753 N.E.2d at 685; *Pitman*, 717 N.E.2d at 631; *Norris*, 526 N.E.2d at 1026.

234 *See Hanes*, 84 S.E. at 35 (outlining how a duty of only slight care arises under a bailment, which is mostly to the advantage of the bailee). *Cf. United Farm Family Ins.*, 753 N.E.2d at 685; *Pitman*, 717 N.E.2d at 631; *Norris*, 526 N.E.2d at 1026.

are incentivized to tightly control the means by which they are distributed to ensure the safety of the public at large.

Additionally, those who are involved in the manufacture of inherently dangerous products should be assumed to have a duty of care akin to the slight negligence applied in bailments on behalf of the bailor.[235] This will have the market effect of forcing those involved in the manufacture of inherently dangerous objects to ensure that those objects are not recklessly placed into the stream of commerce without sufficient protections.

This solution, based not on the product but on the duty of care arising from how the actor is situated relative to the injured party, encourages the growth and exchange of ideas in this emergent technology while still permitting those injured by a three-dimensionally printed product an avenue to pursue compensation for those injuries. This framework of liability accommodates the wide-ranging and unpredictable ways in which three-dimensional printing may injure the public with sufficient flexibility to prevent narrow rules from creating a morass of local rules and exceptions to wade through. At the same time, by limiting liability to those with a foreseeable duty of care, the likelihood of suppressing innovation or ensnaring home enthusiasts and burdening them disproportionately is lessened. And a framework like this is needed. Three-dimensional printing is rapidly expanding its presence in our lives and courts will need to adapt to the unique challenges this technology brings with it.

V. CONCLUSION

Having settled on a potential solution of using bailment theory, the next question is whether or how liability would attach in the example of a three-dimensionally printed brake pad as above. In the case of the hobbyist designer, he is placing his design in the stream of ideas without compensation and therefore, using the metaphor of bailment logic, only gross negligence would leave the hobbyist designer liable.[236] In the case of manufacturers who are also the end consumers, the upstream distributors would still be liable if they failed to meet the dictates of ordinary negligence and if they were being compensated for the service of providing designs to the consumer.[237] The manufacturer of a printer

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[235] *Hanes*, 84 S.E. at 36 (explaining the duty of slight care present under this form of bailment).

[236] *Cf.* sources cited *supra* note 234 and accompanying text (establishing the duty of care analysis for bailment, and targeting the heightened duty of care).

[237] It is beyond the scope of this Note, but one approach that may be more effective than product liability in these circumstances would be to challenge the provider of 3D designs

would be liable under ordinary negligence if the printer was shown to be in some way defective when producing the brake pad. The filament manufacturer, who is a compensated professional, cannot claim attenuation alone as a shield but would have the same liability as a bailor who enjoys a mutual benefit from a bailment.[238] The manufacturer who actually runs the printer, but who may have little to no relationship with the end product being manufactured, would be liable if that manufacturer was negligent only if that manufacturer was compensated sufficiently to claim a mutual benefit; otherwise, this actor would only be liable if the actor was grossly negligent.[239]

William Pollard famously stated, "Learning and innovation go hand in hand. The arrogance of success is to think that what you did yesterday will be sufficient for tomorrow."[240] Similarly, a successful liability framework for three-dimensional printing will not rest in the standard product liability of the past but must embrace the realities and challenges of this new and increasingly ubiquitous technology.

The challenges in this new technology are readily apparent: determining who the manufacturer truly is, applying products liability to digital designs, navigating the risk of a proliferation of untraceable dangerous objects, and avoiding allowing large manufacturers to shift the burden to consumers or hobbyist designers—to name just a few. A framework for product liability involving three-dimensional printing must be sufficiently flexible to accommodate these challenges, and a framework based on duty of care will permit flexibility while still encouraging innovation and creativity.

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under warranty law. The designs should still be warranted to meet the purpose intended for that product, and if not, the promulgator of those designs could still be liable.

238 *See* Hanes v. Shapiro & Smith, 84 S.E. 33, 36 (N.C. 1915) (dictating that a duty of ordinary care is present when a bailment is for the mutual benefit of both the bailor and bailee).

239 *See id.* (categorizing the alternative duties of care under a bailment).

240 William Pollard, BRAINYQUOTE, https://www.brainyquote.com/quotes/william_pollard_163253 [https://perma.cc/XP7B-GKAB].

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