

WHEN CLASSICAL DOCTRINES OF PRODUCTS
LIABILITY ENCOUNTER 3D PRINTING: NEW
CHALLENGES IN THE NEW LANDSCAPE

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I. INTRODUCTION

Three-dimensional (“3D”) printing, also known as additive manufacturing or rapid prototyping, essentially enables 3D physical objects to be printed according to their digital equivalents or blueprints, which are often called Computer-Aided Design (“CAD”) files.¹ Put it another way, 3D printers use digital bits to print physical atoms layer-by-layer, which not only closely connects the digital and the physical worlds together,² but also results in less waste since it does not require removal of materials from a block.³ Since CAD files function as digital representations of their counterparts in the physical existence, 3D printing allows CAD files to be duplicated or modified nearly cost-free, and to be shared instantaneously with almost anybody in the world, without changing or moving 3D physical objects.⁴ Even President Obama has expressly declared in his recent State of the Union Address that “3-D printing has the potential to revolutionize the way we make almost everything.”⁵ To date, 3D printing technology has already demonstrated its capacity to print a remarkably wide variety of seamless objects, such as jewelry, human organs, and even guns.⁶ In short, 3D printing signals a new era of manufacturing, production, and commercial activities.⁷

However, new eras often bring about new challenges, and thereafter, new landscapes of rules and regulations. 3D printing is no exception.⁸ While it empowers individuals to create

1. Lucas S. Osborn, *Regulating Three-Dimensional Printing: the Converging Worlds of Bits and Atoms*, 51 *SAN DIEGO L. REV.* 553, 554–56 (2014) (introducing fundamental elements and applications of 3D printing).

2. *Id.* at 558–59.

3. Lucas S. Osborn, *Of PHDs, Pirates, and the Public: Three-Dimensional Printing Technology and the Arts*, 1 *TEX. A&M L. REV.* 811, 812 (2014).

4. Osborn, *supra* note 1, at 560-61 (explaining that the sender does not lose possession of a 3D object when she emails the CAD file to the receiver, which is a fundamental difference between sending 3D physically existing items and sending their digitally equivalent CAD files).

5. President Barack Obama, *State of the Union Address* (Feb. 12, 2013), <http://www.whitehouse.gov/the-press-office/2013/02/12/remarks-president-state-union-address>.

6. Julian J. Johnson, *Print, Lock, and Load: 3-D Printers, Creation of Guns, and the Potential Threat to Fourth Amendment Rights*, 2013 *U. ILL. J. L. TECH. & POL'Y* 337, 338 (2013).

7. See Nora Freeman Engstrom, *3-D Printing and Product Liability: Identifying the Obstacles*, 162 *U. PA. L. REV. ONLINE* 35, 36 (2013) (explaining that 3D printing may “transform the goods we buy, the products we use, and the world we inhabit.”).

8. *Id.* (explaining that legal scholars and policymakers must consider how our existing legal framework adapts to a significant technological breakthrough, such as 3D

inconceivably fascinating objects and unprecedentedly enables almost anyone to become a manufacturer overnight, the legal implications of the 3D printing technology are enormous, including products liability, environmental issues, firearm controls, and infringements of intellectual property.⁹ Among all of these new challenges, products liability actions pose substantial risks that are associated with the emergence of 3D printing because this young technology has the potential to completely change the interplay between manufacturers, retailers, and customers.¹⁰

Imagine, for example, one downloads a CAD file of a pair of shoes from the Internet, prints it at home, and then subsequently gets injured while wearing the printed shoes. Who can one sue under the current doctrines of products liability? It becomes quite difficult to provide a persuasive answer to such a concise question, because in this context, the manufacturer, the retailer, and the customer converges to one single person, something unimaginable in the current manufacturing industry. In addition, suppose, instead of printing the CAD file by herself at home, one orders the so called 3D printing services (“3DP services”) to print the shoes for her, and she subsequently gets injured while wearing them as well. Will the outcome be significantly different? Can she successfully bring claims of products liability against 3DP services? It remains equally challenging to answer this question because it is not crystal clear factually who the manufacturer, the CAD file designer or 3DP service who prints out the physical shoes, is even though the manufacturer, the retailer, and the customer are not centralized into one single person in this context.

Starting from such a hypothetical scenario, this article takes an in-depth look at almost every single aspect of the potential product liability issues raised by 3D printing technology, mainly under two distinct contexts: home printing and 3DP services. This article further elaborates on six possible targets against whom the injured party may bring product liability actions: (1) the occasional or hobbyist inventor who creates CAD files and uploads them online for non-commercial purposes; (2) the commercial inventor who designs the CAD file and sells it online for commercial purposes; (3) 3DP services that print out CAD files for customers; (4) the manufacturer of the 3D printer that

printing, which implicates numerous aspects of laws and poses profound challenges).

9. See Osborn, *supra* note 1, at 562.

10. See *id.* at 566 (explaining that 3D printing will “empower millions to design and manufacture products”).

prints the defective item; (5) the program designer who writes the computer code that instructs the 3D printer to print; and (6) “ink” providers who provide raw physical materials, or in other words, atoms.

Part II reviews the classical doctrine of product liability that, in the words of the Third Restatement of Torts, states “[o]ne engaged in the business of selling or otherwise distributing products who sells or distributes a defective product is subject to liability for harm to persons or property caused by the defect.”¹¹ Part II highlights three categories of defects that are prevalent in the current legal framework: manufacturing, design, and warning defects.¹² Breach of the implied warranty of merchantability becomes a possible claim if the seller can be treated as a merchant selling or distributing goods.¹³ In addition, this section reviews possible defenses that defendants may establish.

Part III addresses the first fundamental question when classical doctrines of products liability encounter 3D printing—which items in the context of 3D printing could be categorized as a “product” under the Third Restatement.¹⁴ Part III shows that both CAD files and 3D printed items can be categorized as products, provided that they are “distributed commercially for use or consumption.”¹⁵ Thus, as a consequence, those CAD files designed by hobbyist inventors and distributed online for free cannot be treated as products.

Part IV examines a wide range of possible defendants in an era of 3D printing. Part IV highlights different levels of difficulty for the injured plaintiff to prevail over different groups of defendants. This section shows that it becomes relatively more difficult for the injured party to prevail in the home printing environment than in the 3DP services context. This is because in the home printing environment customers assume risks of improper ink or defective 3D printers, whereas in the latter environment 3DP services, as a third party, assume those risks. Moreover, Part IV addresses possibilities of future regulations tailored for each scenario.

This paper contributes in several aspects. First, the paper

11. RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 1 (AM. LAW INST. 1998).

12. *Id.* § 2.

13. See J. David Prince, *Defective Products and Product Warranty Claims in Minnesota*, 31 WM. MITCHELL L. REV. 1677, 1690–91 (2005).

14. RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 19 (AM. LAW INST. 1998) (defining a product to be “tangible personal property distributed commercially for use or consumption”).

15. *Id.*

enlarges the scope of discussions from home printing only, as covered by Professor Engstrom,¹⁶ to 3DP services, and shows that these two distinct contexts yield significantly distinct landscapes of product liability litigation. Second, this paper considers not only strict liability actions, but also negligence claims, and thus, provides a thorough examination on three primary categories of product defectiveness: manufacturing, design, and warning defects.¹⁷ Third, the paper addresses potential regulations on new frontiers.

II. AN OVERVIEW OF THE CLASSICAL DOCTRINAL FRAMEWORK OF PRODUCTS LIABILITY

It is important to highlight that the current framework of product liability law only applies to commercial sellers, those “engaged in the business of selling or otherwise distributing products,”¹⁸ and recognizes three categories of product defects: manufacturing, design, and warning defects.¹⁹ The doctrine of strict liability governs most litigation arising from manufacturing defects when “the product departs from its intended design even though all possible care was exercised in the preparation and marketing of the product.”²⁰ In most jurisdictions and under the current Restatement, design and warning defects are governed by the standard of negligence.²¹ A design defect exists when “the foreseeable risks of harm posed by the product could have been reduced or avoided by the adoption of a reasonable alternative design,” and “the omission of the alternative design renders the product not reasonably safe.”²² A warning defect exists when “the foreseeable risks of harm posed by the product could have been reduced or avoided by the provision of reasonable instructions or warnings,” and “the omission of the instructions or warnings renders the product not reasonably safe.”²³ In addition, a number of possible defenses exist in product liability claims. For example, (1) a defendant may show that the product is state-of-the-art, as state-of-the-art products may undercut negligence elements in designing a

16. See Engstrom, *supra* note 7, at 36 n.7.

17. RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 2 (AM. LAW INST. 1998).

18. *Id.* § 1.

19. *Id.* § 2.

20. VICTOR E. SCHWARTZ ET AL., PROSSER, WADE AND SCHWARTZ'S TORTS CASES AND MATERIALS 768-71 (12th ed. 2010); RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 2 (AM. LAW INST. 1998).

21. SCHWARTZ ET AL., *supra* note 20, at 771-94.

22. RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 2 (AM. LAW INST. 1998).

23. *Id.*

product;²⁴ (2) a defendant that only occasionally sells a product is not strictly liable for a product defect;²⁵ (3) a service provider that uses a product is not liable for the underlying product defects unless the product serves a predominant purpose in the service;²⁶ and (4) a manufacturer is not liable for an unforeseeable abnormal use of the product.²⁷

Applying to 3D printing the existing doctrines of products liability summarized in a nutshell above, there are a number of challenging questions to be answered and fundamental issues to be resolved.

III. WHAT CONSTITUTES A “PRODUCT” IN 3D PRINTING?

It would be groundless to discuss product liability if there was no “product” involved in 3D printing. According to the Third Restatement, a “product” is defined as “tangible personal property distributed commercially for use or consumption.”²⁸ The Third Restatement also treats some intangible property, such as electricity, to be products “when the context of their distribution and use is sufficiently analogous to the distribution and use of tangible personal property.”²⁹ The Third Restatement emphasizes that pure services are not products, even when provided for commercial purpose.³⁰

First, the defining element of a “product” is that it must be distributed for “commercial” purposes, which implies that if there are no minimum commercial activities involved, personal property should fail to be treated as a “product,” let alone giving rise to product liability actions.³¹ For example, many unsophisticated individuals nowadays create their own smart phone apps and upload them on the Internet to give away for free.³² In this situation, because those app creators do not make any profit by giving away their inventions, those created apps are

24. SCHWARTZ ET AL., *supra* note 20, at 784.

25. See RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 1 (AM. LAW INST. 1998).

26. See *Hector v. Cedars-Sinai Med. Ctr.*, 225 Cal. Rptr. 595 (Cal. Ct. App. 1986) (holding that hospitals are not subject to strict liability for a defective product provided to a patient during treatment because the hospital is a provider of services rather than a seller of products).

27. See *Ford Motor Co. v. Matthews*, 291 So. 2d 169, 169 (Miss. 1974) (holding that Ford Motor Co. was not liable for the death of Matthews when Matthews was dragged under a tractor and killed when he started the tractor while standing next to it, because Matthews had an unforeseeable abnormal use of the tractor).

28. RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 19 (AM. LAW INST. 1998).

29. *Id.*

30. *Id.*

31. *Id.*

32. See *Osborn*, *supra* note 1, at 568–69.

treated as gifts, rather than products, under the current doctrines of product liability.³³ Similarly, in the context of 3D printing, a CAD file given away for free on the Internet may not be treated as a “product” because the CAD file designer does not intend to distribute it for commercial purposes.³⁴ Therefore, non-commercial CAD files are not products, which immediately suggests that it is almost impossible for one to recover from the CAD file designer if she gets hurt by an item printed out of a non-commercial CAD file.³⁵

Second, the question remains whether commercial CAD files should be treated as products. Professor Osborn made two analogies in his article.³⁶ On one hand, similar to electricity, CAD files can be produced and distributed in the stream of commerce, and thus, should be treated as a product.³⁷ On the other hand, CAD files are per se more directly analogous to computer software due to their intangible digital features.³⁸ Because the criteria of applying product liability doctrines to software hinges on the predominant purpose of that software—either a greater service aspect or a greater commercial product aspect—the same criteria should also apply to CAD files.³⁹ If CAD files are mass-marketed or distributed for commercial purposes, they should be categorized as products.⁴⁰ Otherwise, if they mainly provide services, such as 3D printed arts, they do not give rise to products liability actions.⁴¹

However, one of the strongest counterargument refers to the leading case of *Winter v. G.P. Putnam's Sons*, in which the plaintiff became severely ill after relying on the inaccurate information contained in the encyclopedia to harvest certain poisonous mushrooms, and then brought a product liability action against the encyclopedia.⁴² The Ninth Circuit dismissed the plaintiff's claim, holding that because the content of a book is intangible, the inaccurate content itself could not be categorized as a product, and thus, failed to give rise to product liability

33. *Id.* at 569.

34. *Id.*

35. *Id.* at 570.

36. *Id.* at 567.

37. *Id.*

38. *Id.*

39. *Id.* at 568.

40. *Id.*

41. Osborn, *supra* note 3, at 811.

42. See Engstrom, *supra* note 7, at 38 (citing *Winter v. G.P. Putnam's Sons*, 938 F.2d 1033, 1033–34 (9th Cir. 1991)).

actions, even though the book might be treated as a product.⁴³ As for 3D printing, one might argue that a CAD file is analogous to the encyclopedia, and the content of a CAD file is similar to the content of a book. Like the plaintiff in *Winter* who became severely ill after relying on the content of the book, one might get injured after using the rendered content of a CAD file. Thus, it is the manifestation of the content of a CAD file, rather than the content of the CAD file itself, that causes the injury. Put it in another way, while commercial CAD files, like commercial books, may be treated as products, the intangibly defective content of CAD files gives no rise to product liability actions.

Such a counterargument opens ample room for further clarification. Courts might hold that if CAD files could not be treated as products for this reason, then any computer software could not be treated as products either, which is contrary to our common sense in a digital world because, after all, the content of any computer software is inherently intangible. Thus, most likely, courts may analogize commercial CAD files to existing commercial computer software and consequently treat them as products.

Third, it is straightforward to conceive that physical objects printed out of CAD files for commercial use could be categorized as products. There is no significant difference between a 3D printed object and a classical object sold on a market, except the former is manufactured via a cutting-edge 3D printing process, while the latter is manufactured by a conventional factory. In addition, when the 3D object is already printed out, the tangible-intangible dichotomy is no longer a barrier to treating the printed objects as products.

In sum, both CAD files and 3D printed items could be categorized as products, provided that they are “distributed commercially for use or consumption.”⁴⁴ Because 3D printing is a state-of-the-art technology, courts need closely and carefully examine real 3D printing practices.⁴⁵

IV. WHO IS POSSIBLY SUBJECT TO PRODUCTS LIABILITY IN 3D PRINTING?

Due to the diversity of actors in the 3D printing industry, it is crucial to examine whom the plaintiff will likely sue after she is injured by a 3D printed item. In other words, who are the

43. *Id.* (citing *Winter*, 938 F.2d at 1034-36).

44. RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 19 (AM. LAW INST. 1998).

45. Osborn, *supra* note 1, at 569.

possible defendants subject to a product liability claim? Here, we list six categories: (1) the occasional or hobbyist inventors who design CAD files and then give them away for free on the Internet; (2) the commercial seller who sells CAD files online, like Amazon; (3) 3DP services which print out CAD files for customers; (4) the manufacturer of 3D printers; (5) the computer programmer who writes the code that instructs the 3D printer to print; (6) the “ink” provider that provides raw materials for 3D printers to print.

A. *Occasional or Hobbyist Inventors of CAD Files*

The limitation that products liability only applies to those “engaged in the business of selling or otherwise distributing products” makes it almost impossible for an injured party to prevail against hobbyist inventors who give away CAD files for free or sell their designs online occasionally.⁴⁶ Because the strict product liability doctrine targets business entities, and occasional or hobbyist inventors are not in “business,” this category of designers manifestly falls outside the scope of our current legal framework.⁴⁷ In addition, Professor Engstrom lists several factors to determine which side of the “commercial-occasional” dichotomy hobbyist inventors will fall; those factors being: (1) the relationship between the defective products and the hobbyist’s general business; (2) the frequency and the volume of similar sales; and (3) the existence and the scale of mass marketing.⁴⁸ For example, if hobbyist inventors only give their CAD files for free, occasionally sell their designs, or have a low volume of sales, the prerequisite of “engaged in the business” that gives rise to product liability claims is not satisfied.⁴⁹ Put it another way, the doctrines of products liability are inapplicable to him.⁵⁰

Then such inapplicability raises a series of questions: Is it necessary to regulate those occasional or hobbyist inventors? If so, how, and to what extent? To answer them, we have to take into account the full spectrum of 3D printing and look ahead in the future of this fascinating technology.

First, CAD files are treated as speech under the First

46. RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 1 (AM. LAW INST. 1998).

47. *See id.*

48. Engstrom, *supra* note 7, at 37 (citing Donald M. Zupanec, *When Is Person “Engaged in the Business” for Purposes of Doctrine of Strict Tort Liability*, 99 A.L.R.3d 671, 673 (1980); *Agurto v. Guhr*, 887 A.2d 159, 163 (N.J. Super. Ct. App. Div. 2005)).

49. Engstrom, *supra* note 7, at 37.

50. *Id.*

Amendment,⁵¹ and thus, are entitled to the freedom of speech protection because they contain sufficient elements of communication.⁵² CAD files move beyond traditionally recognized forms of speech, combining both expressive and functional conducts together.⁵³ The salient test for whether regulations or restrictions of CAD files result in violations of the First Amendment should align with the well-known test of *Brandenburg v. Ohio*.⁵⁴ Under *Brandenburg*, governmental regulations of protected speech, like distributing CAD files, should be prohibited except “where such advocacy is directed to inciting or producing imminent lawless action and is likely to incite or produce such action.”⁵⁵ Except for certain sensitive 3D printed items that may trigger constitutional scrutiny under the *Brandenburg* test, such as 3D printed guns, distributing most CAD files online is protected by the First Amendment.⁵⁶ Therefore, occasional or hobbyist inventors have the constitutional right to freely upload their invented CAD files on the Internet, even if printing out those files may result in defective 3D items.

Second, the more 3D printing technology is ubiquitous, the more individuals will share their CAD files online. The defining feature of 3D printing is that it signals an unprecedented era of “individual empowerment and creativity,” which completely reshapes the classical landscape of manufacturing.⁵⁷ The prosperity of today’s smart phone apps predates the thriving of tomorrow’s CAD files.

Traditional factories will be superseded by home or public-accessible 3D printers. The prototypes of 3D items, namely, CAD files, will be shared widely and instantaneously by any individual in the world.⁵⁸ In this upcoming era, after one hobbyist uploads his invented CAD file, it is highly possible that the file will be

51. U.S. CONST. amend. I.

52. See Barton Lee, *Where Gutenberg Meets Guns: The Liberator, 3D-Printed Weapons, and the First Amendment*, 92 N.C.L. REV. 1393, 1401 (2014) (explaining that because CAD files contain all the elements of communication they should be considered as speech and warrant First Amendment protection).

53. See Julia Cosans, *Between Firearm Regulation and Information Censorship: Analyzing First Amendment Concerns Facing the World’s First 3-D Printed Plastic Gun*, 22 AM. U.J. GENDER SOC. POL’Y & L. 915, 931 (2014) (explaining that “a CAD file is both expressive in its ability to convey a plethora of complex ideas and functional for its critical role in the performance of certain tasks”).

54. *Brandenburg v. Ohio*, 395 U.S. 444 (1969).

55. *Id.* at 447.

56. Josh Blackman, *The 1st Amendment, 2nd Amendment, and 3D Printed Guns*, 81 TENN. L. REV. 479, 507 (2014).

57. See Osborn, *supra* note 1, at 560.

58. *Id.* at 560–61.

printed many times worldwide.⁵⁹ If many people are injured by the printed items, is it justifiable that the hobbyist inventor cannot be sued under the current legal framework of products liability? If not, what new regulatory framework should be added to account for the new situation?

Third, because CAD files are able to be distributed worldwide instantaneously, jurisdiction becomes a complicated issue.⁶⁰ Imagine a hobbyist inventor in the United States uploads his CAD file on the Internet. Immediately another Japanese hobbyist downloads it, modifies, and then re-uploads the new CAD file online. Eventually, a French consumer downloads the Japanese-modified CAD file, prints it out, and gets injured while using it. Such hypothetical facts implicate complex issues of transnational jurisdiction, forum non conveniens, and choice of law rules.⁶¹

Fourth, even if the injured party is able to bring negligence claims against occasional or hobbyist inventors, these CAD file designers may establish strong defenses, claiming themselves to be state-of-the-art digital architects, and thus shield away from products liability.⁶²

Last but not least, directly imposing the strict products liability on occasional or hobbyist inventors will not only impede millions of inventive minds,⁶³ but also may infringe fundamental rights protected by the First Amendment.⁶⁴ The overarching principle of possible regulations should be flexibility, which is narrowly tailored instead of generally targeted, while at the same time encourage this young and dynamic technology rather than inhibit it.⁶⁵

In sum, under current doctrines of products liability, no occasional or hobbyist inventor will be held strictly liable to injuries caused by 3D items printed out of their designed CAD files. In the near future, when 3D printing is prevalent, courts may adopt new regulations tailored for newly encountered

59. *Id.*

60. *See id.* at 563 (explaining that 3D printing may raise complex jurisdiction questions).

61. *Id.*

62. Engstrom, *supra* note 7, at 39 (citing *City of Mounds View v. Walijarvi*, 263 N.W.2d 420, 423–25 (Minn. 1978); *Chubb Grp. of Ins. Cos. V. C.F. Murphy & Assocs. Inc.*, 656 S.W.2d 766, 779–81 (Mo. Ct. App. 1983)).

63. Osborn, *supra* note 1, at 602 (explaining that strict products liability may have a “chilling effect” on millions of CAD file designers).

64. RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 19 cmt. d (AM. LAW INST. 1998).

65. *See Osborn, supra* note 1, at 608–09.

circumstances.⁶⁶

B. *Commercial Sellers of CAD Files*

For those “engaged in the business of selling or otherwise distributing” CAD files, for example, similar to Microsoft “engaged in the business of selling” its flagship commercial software package, say Windows, the current doctrines of products liability apply, which have recognized three categories of product defectiveness: manufacturing, design, and warning defects.⁶⁷ Significantly distinct from occasional or hobbyist inventors who are to some extent more like architects, business inventors intend to make a profit by selling their designed CAD files online.⁶⁸ In addition, an injured plaintiff may also bring an action against commercial CAD file merchants for breach of the implied warranty of merchantability, under established doctrines found in the Uniform Commercial Code.⁶⁹

Customers can either directly purchase the CAD file and then print it out by themselves at home, or place an order requesting the business seller ship the printed items to them.⁷⁰ There is another possibility, customers can resort to the third party service provider, namely 3DP services, to print out their ordered CAD files.⁷¹ The next subsection will investigate in detail the issues arising from the intervention of third party service providers. The focal point of this subsection is the direct interaction between customers and business CAD file sellers, without involving third parties.

1. Manufacturing defects

Pursuant to the Third Restatement of Torts, a product contains a manufacturing defect “when the product departs from its intended design even though all possible care was exercised in the preparation and marketing of the product.”⁷²

To prevail, the injured plaintiff must prove that the product deviated from the business seller’s design or from the seller’s other products of the same design, not what specific conduct of the manufacturer led to that defect.⁷³

66. *Id.*

67. RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 2 (AM. LAW INST. 1998).

68. Osborn, *supra* note 1, at 569–70.

69. U.C.C. § 2-314 (AM. LAW INST. & UNIF. LAW COMM’N 1977).

70. Osborn, *supra* note 1, at 566.

71. *Id.* at 570.

72. RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 2 (AM. LAW INST. 1998).

73. SCHWARTZ ET AL., *supra* note 20, at 770.

If the seller ships the 3D printed items to customers, those physically existing items become final products “off the assembly line.”⁷⁴ Put it another way, the original design pattern, the CAD file, is only part of the final product in this situation.⁷⁵ If the printed item has a material defect that causes a personal injury, strict liability will usually apply.⁷⁶ This situation resembles classical manufacturing regimes and results in a lower bar for the injured plaintiff to prevail, because the business seller assumes the risks of uncertainty, such as the malfunctioning of the 3D printer, the inappropriateness of the “ink,” or the defectiveness of the printing process.⁷⁷ The 3D printed products reach customers in as familiar a manner as products that traditionally leave factories and are subsequently shipped to customers, the difference being 3D printers supersede the role of classical factories.⁷⁸ In addition, a multitude of factors are involved in the printing process, such as the choice of “ink” or the inherent quality of 3D printers. These factors may cause printed items to deviate from their intended design, even if “all possible care was exercised.”⁷⁹ Therefore, under such circumstances, it is relatively more straightforward for an injured customer to establish the elements of a manufacturing defect and prevail against the inventors of business CAD files.

However, the landscape will be substantially different if CAD files are the only final products and customers print the physical good at home. In this situation, the party assuming the printing risk shifts from CAD file inventors to customers, which is advantageous for CAD file sellers to establish a strong defense.⁸⁰ For example, in *Rix v. General Motors Corp.*, the plaintiff was injured when his truck was hit from behind by a vehicle equipped with a water tank that was installed by someone other than the manufacturer.⁸¹ The injured plaintiff brought a strict product liability claim against the manufacturer for the defectiveness of the braking system.⁸² The Supreme Court

74. “Assembly line” is a terminology of classical manufacturing. Here, it is used to analogize 3D printing with traditional manufacturing industry, treating 3D printed items as products off the manufacturer’s assembly line.

75. See Engstrom, *supra* note 7, at 39-40.

76. SCHWARTZ ET AL., *supra* note 20, at 770.

77. See Engstrom, *supra* note 7, at 37 (explaining that an injured plaintiff may sue the manufacturer of the 3D printer or the digital designer who wrote the code instructing the printing process).

78. Classical factories manufacture products. Here 3D printers print products.

79. See RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 2 (AM. LAW INST. 1998).

80. Engstrom, *supra* note 7, at 41.

81. *Rix v. Gen. Motors Corp.*, 723 P.2d 195, 197 (Mont. 1986).

82. *Id.* at 198.

of Montana dismissed the claim because the vehicle was altered after leaving the assembly line, and thus, the liability could not be traced back to the manufacturer.⁸³ Similarly, business sellers may argue that the CAD file, as a product, is altered after leaving the assembly line by the customers who download the CAD file and print out the final product, and thus, liability may not be traced back to the CAD file designer. To support such an argument, sellers may be able to establish numerous defenses, such as that most customers printing out the same CAD file are not injured, or that the specific defectiveness of the printed item can be attributed to the customer's improper printing process.⁸⁴

Further, to prevail under the Second Restatement, the injured plaintiff must show that the product "is expected to and does reach the user or consumer without substantial change in the condition in which it is sold."⁸⁵ However, the business inventor's product, namely the CAD file, cannot be eventually used by the customer without undergoing substantial changes through the printing process.⁸⁶ Judge Jose Cabranes considered this point determinative in a similar case, because the design of CAD files can be used by the plaintiff only after its "transformation via reconstruction."⁸⁷ Thus, under any circumstance, there is an indispensable printing step between the CAD file products and usage by customers. This unique extra step is exactly what makes application of the product liability doctrines to 3D printing more complex and intriguing. In addition, this indispensable printing step by itself is complex and involves state-of-the-art technology, such as the choice of ink and techniques gluing atoms together.⁸⁸ If the seller assumes the risk of printing, it is advantageous to the plaintiff, as discussed previously. If the customer assumes the risk of printing, however, the seller is more likely to prevail against a products liability claim.

Unfortunately, in the near future when 3D printing is ubiquitous, most commercial CAD file inventors will not offer printing services in order to circumvent strict product liability, which means that customers will either print the purchased CAD file at home or a third party, like 3DP services, will print for

83. *See id.*

84. *See Ford Motor Co. v. Matthews*, 291 So. 2d at 169, 172 (Miss. 1974).

85. RESTATEMENT (SECOND) OF TORTS § 402A(1)(b) (AM. LAW INST. 1998).

86. Engstrom, *supra* note 7, at 40.

87. *Id.* (citing *K-Mart Corp. v. Midcon Realty Grp. of Conn. Ltd.*, 489 F. Supp. 813 (D. Conn. 1980)).

88. Johnson, *supra* note 6, at 222–23.

their customers.⁸⁹ In other words, two major printing environments will emerge, namely, in-home printing and 3DP services.⁹⁰ The doctrinal contours of product liability associated with these two contexts are substantially distinct and novel.⁹¹ Moreover, to further shield the potential products liability, commercial CAD designers may require prospective customers to sign a warranty disclaimer online before placing orders, which makes it even harder for customers to prevail.⁹²

2. Design Defects

Pursuant to the Third Restatement of Torts, a product is defective in design “when the foreseeable risks of harm posed by the product could have been reduced or avoided by the adoption of a reasonable alternative design,” and “the omission of the alternative design renders the product not reasonably safe.”⁹³ There are four approaches used to determine the meaning of “defect” in design defect cases.⁹⁴ The first, as established by Dean Wade, adopts a negligence risk-utility analysis, focusing upon “whether the manufacturer would be judged negligent if it had known of the product’s dangerous condition at the time it was marketed.”⁹⁵ The second compares the risk and utility of the product at the time of trial, as established by Dean Keeton.⁹⁶ The third focuses on consumer expectations.⁹⁷ The fourth combines risk-utility and consumer expectation tests.⁹⁸

Most jurisdictions adopt some form of risk-utility analysis for design defect cases.⁹⁹ Factors relevant in risk-utility analysis are: (a) the usefulness and desirability of the product; (b) the safety aspect of the product; (c) the availability of a substitute product; (d) the manufacturer’s ability to eliminate the unsafe character of the product; (e) the user’s ability to avoid danger; (f) the user’s anticipated awareness of the dangers inherent in the

89. Osborn, *supra* note 1, at 560, 570.

90. *Id.* at 561.

91. *See id.* at 569 (discussing the application of strict products liability to only those selling or distributing CAD files).

92. *See* John R. Trentacosta, *Article 2—Warranties and Warranty Disclaimers*, 70 MICH. B.J. 278, 280 (1991) (discussing the creation of express and implied warranties, the disclaimer of warranties, and methods of defeating warranty disclaimers).

93. RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 2 (AM. LAW INST. 1998).

94. *Prentis v. Yale Mfg. Co.*, 365 N.W.2d 176, 183 (Mich. 1984).

95. *Id.*

96. *Id.*

97. *Id.*

98. *Id.*

99. *See* John Wade, *On Product “Design Defects” and Their Actionability*, 33 VAND. L. REV. 551, 563 (1980).

product; (g) the feasibility of spreading the loss; and (h) the state-of-the-art of the product.¹⁰⁰

The assessment of the utility of a design also takes into consideration other relevant alternatives.¹⁰¹ Now, if no other alternatives are available, the defendant will have a strong defense by sticking to a specific design, even if the design is proved to be defective.¹⁰² Because most CAD files of 3D printing are state-of-the-art designs, it becomes significantly difficult for the injured plaintiff to show the existence of an available alternative that is safer and equally efficacious.¹⁰³

For example, present-day 3D printers already possess capabilities to create a wide range of complex objects, such as prosthetic hands,¹⁰⁴ human organs,¹⁰⁵ bones, or splints.¹⁰⁶ With respect to human organs, however, existing technological expertise and scientific knowledge cannot create alternative designs of human organs or human tissues; rather, such human tissue CAD files are scanned from the physical human organs.¹⁰⁷

As another example, designers Gernot Oberfell, Jan Wertel, and Matthias Bar recently created a complex and aesthetic 3D-printed coffee table called Fractal-T, using a series of mathematical equations.¹⁰⁸ Its base consists of several columns of mathematical patterns, and its top is created when all columns merge together in a seamless manner.¹⁰⁹ Such an exotic, unique, and complex structure would never be rendered without the advent of 3D printing.¹¹⁰

Imagine a plaintiff injured by a Fractal-T table bringing a product liability action against the designers; the designers

100. O'Brien v. Muskin Corp., 463 A.2d 298, 304–05 (N.J. 1983).

101. *Id.* at 305.

102. *Id.*

103. *See id.* (discussing the state-of-the-art factor and its relationship with the available alternative requirement). *See also* Osborn, *supra* note 1, at 562 (discussing the uniqueness of the CAD file).

104. Johnson, *supra* note 6, at 338 (citing Sean GallagherGallagher, *Robohand: How Cheap 3D Printers Built a Replacement Hand for a Five-year Old Boy*, ARS Technica (Feb. 1, 2013, 3:51 PM), <http://arstechnica.com/information-technology/2013/02/robohand-how-cheap-3d-printers-built-a-replacement-hand-for-a-five-year-old-boy>).

105. *See* Sarah Swanson, *3D Printing: A Lesson in History: How to Mold the World of Copyright*, 43 SW. L. REV. 483, 507 (2014) (explaining that current 3D printing technology can print lifesaving organs for transplant surgeries).

106. *Id.* (citing *3D-Printed Sugar Network to Help Grow Artificial Liver*, BBC NEWS (July 2, 2012, 1:33 PM), <http://www.bbc.com/news/technology-18677627>).

107. Osborn, *supra* note 3, at 814.

108. *Id.* at 816 (citing HOD LIPSON & MELBA KURMAN, *FABRICATED: THE NEW WORLD OF 3D PRINTING* 177 (2013)).

109. *Id.*

110. *Id.*

would argue that there is no available substitute for Fractal-T because it is created out of specific and precise set of mathematical equations that are programmed on a computer. The underlying mathematical equations would need to be replaced if there existed a substitute of design, which would result in a completely different product.¹¹¹

The assessment of the risk of a design considers the inherent safety aspects of the product, and the manufacturer's ability to eliminate or mitigate the unsafe feature.¹¹² A typical example is the gun control of 3D-printed guns.¹¹³ 3D printing technology gives the general public the ability to create untraceable and undocumented do-it-yourself guns.¹¹⁴ A commercial seller distributing CAD files of guns online for business may cause tremendous troubles in today's regulatory framework.¹¹⁵ First, the inherent character of a gun, either 3D-printed or not, is unsafe.¹¹⁶ In other words, there is a substantial likelihood that 3D printed guns may cause severe injuries.¹¹⁷ Second, it is hardly possible to eliminate or mitigate the inherent danger of a 3D printed gun from the designer's point of view, because it is, after all, a gun.¹¹⁸ Third, it is equally difficult for a user to avoid danger even with the exercise of care.¹¹⁹ A 3D printed gun may function exactly the same way as a real gun does.¹²⁰ Therefore, an injured plaintiff may possibly prevail against commercial sellers of CAD files of 3D printed guns, via risk-utility analysis. But under most circumstances, it becomes quite hard for the plaintiff to prevail due to the inability to show available alternative designs.

3. Warning Defects

Pursuant to the Third Restatement of Torts, a product is defective because of inadequate warnings "when the foreseeable risks of harm posed by the product could have been reduced or avoided by the provision of reasonable instructions or warnings,"

111. Osborn, *supra* note 3, at 816–17.

112. Wade, *supra* note 107, at 553.

113. See Osborn, *supra* note 1, at 577.

114. Caitlyn R. McCutcheon, *Deeper Than a Paper Cut: Is It Possible to Regulate Three-Dimensionally Printed Weapons or Will Federal Gun Laws Be Obsolete Before The Ink Has Dried?* U. ILL. J.L. TECH. & POLY 219, 221 (2014).

115. *Id.* at 232.

116. *Id.*

117. *Id.* at 226–27.

118. *Id.* at 236.

119. See *id.*

120. See, e.g., *id.* at 227–28 (stating that Defense Distributed has made several successful 3D printed firearms).

and “the omission of the instruction or warnings renders the product not reasonably safe.”¹²¹ In warning defect cases, most courts still apply a negligence standard, requiring the plaintiff to show that the manufacturer knew or should have known of risks that injured the plaintiff.¹²² For instance, in the example of the Fractal-T table, it is always beneficial for the designers of the state-of-the-art products to add instructions or warnings, or even disclaimers before releasing the CAD file.¹²³ In the example of 3D printed guns, however, even if the commercial CAD file producers provide adequate instructions or warnings, they could still be held strictly liable because guns are inherently dangerous items.¹²⁴

Therefore, compared to manufacturing and design defects, it is relatively straightforward to resolve warning defect issues arising from 3D printing. To provide instructions and warnings is quite simple because 3D printers take care of the entire printing process without any human intervention.¹²⁵ The only type of instructions and warnings that need to be provided is how to use the 3D-printed objects properly. Thus, it falls into the scope of the classical negligence theory of product liability arising from warning defects.¹²⁶

4. Implied Warranty of Merchantability

Warranty law is an important branch of rules that supplement the tort principles of products liability arising from defective products.¹²⁷ Although today warranty law is widely regarded as an essential part of contract law, it originates from tort law.¹²⁸ The warranty that most often arises from the context of the sale of products is the implied warranty of merchantability because a product that is defective is automatically not merchantable.¹²⁹ Thus, in addition to product liability claims, an

121. RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 2 (AM. LAW INST. 1998).

122. See *Vassallo v. Baxter Healthcare Corp.*, 696 N.E.2d 909, 923 (Mass. 1998) (holding that a manufacturer will not be held liable under an implied warranty of merchantability for failure to warn or provide instructions about risks that were not reasonably foreseeable at the time of sale or could not have been discovered by way of reasonable testing prior to marketing the product).

123. See RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 2 (AM. LAW INST. 1998).

124. See *Osborn*, *supra* note 1, at 567.

125. See *Johnson*, *supra* note 6, at 340.

126. See *Anderson v. Owens-Corning Fiberglas Corp.*, 810 P.2d 549, 558 (Cal. 1991).

127. *Prince*, *supra* note 13, at 1679.

128. *Id.* (citing William L. Prosser, *Assault on the Citadel (Strict Liability to the Consumer)*, 69 YALE L.J. 1099, 1103-10, 1124-27 (1960); William L. Prosser, *The Implied Warranty of Merchantability Quality*, 27 MINN. L. REV. 117, 118-22 (1943)).

129. *Id.* at 1690 (citing *Peterson v. Bendix Home Sys. Inc.*, 318 N.W.2d 50, 53 (Minn. 1982) (explaining that “this warranty is breached when the product is defective to a

injured plaintiff may bring an action for breach of implied warranty of merchantability against commercial CAD file sellers, based on two assumptions: (1) CAD files are goods, and (2) commercial CAD file sellers are merchants.¹³⁰

First, the implied provisions of UCC only apply to sales of goods, not to the sale of services.¹³¹ Similar to the situation in products liability, the treatment of CAD files is analogous to the treatment of computer software, which has aspect of both goods and services.¹³²

Many courts adopt a predominant purpose test, under which courts tend to treat mass-marketed software as a good, but custom-built software as a service.¹³³ Likewise, if the commercial seller of the CAD file widely promotes the file, courts may treat the promoted file as a good.¹³⁴ In contrast, if the seller creates a complex CAD file tailored for a specific customer, then the aspect of service will dominate.¹³⁵

Second, the seller of a good generally must be “a merchant with respect to goods of that kind” before the transaction gives rise to the implied warranty of merchantability.¹³⁶ Being a merchant matters because the UCC applies special rules to merchants who deal in specific goods on a regular basis.¹³⁷ In practice, individuals who repeatedly sell a variety of CAD files should be categorized as merchants, which implies that occasional or hobbyist sellers are not merchants.¹³⁸ This is consistent with the “engaged in business” requirement stated in the Third Restatement of Torts.¹³⁹

In sum, an injured plaintiff may bring an action against commercial CAD file merchants for breach of the implied warranty of merchantability, in addition to the product liability claims. For the best protection of consumers, in practice, there may be certain situations in which the breach of an implied warranty of merchantability claim will prevail while the tort claim of products liability may not.¹⁴⁰ Thus, it improves the

normal buyer making ordinary use of the product.”)).

130. See Osborn, *supra* note 1, at 571–73.

131. Prince, *supra* note 13, at 1692.

132. Osborn, *supra* note 1, at 571–72.

133. *Id.* at 572.

134. *Id.*

135. *Id.*

136. *Id.* at 574.

137. *Id.* at 573.

138. *Id.* at 574.

139. RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 2 (AM. LAW INST. 1998).

140. See Osborn, *supra* note 1, at 573.

chance of prevailing for the injured party.

C. 3DP Services

Up to this point, we have examined product liability claims directly between only two parties, namely the injured plaintiff and the CAD file designers that are either occasional inventors or commercial sellers. The emergence of the so-called 3DP services—a third party service provider situated between the user and the seller—substantially reshapes the landscape of products liability. In the age of 3D printing, customers may place an order of the purchased CAD file online, and then order the 3DP services to print the CAD file for them.¹⁴¹ The salient question to ask is whether 3DP services are manufacturers or pure service providers.¹⁴²

First, the basic function of 3DP services is to provide printing services.¹⁴³ The transaction between the CAD file designer and the customer has already been completed before the customer approaches the 3DP service.¹⁴⁴ The 3DP service only charges a fee for printing the ordered CAD file, in a manner that is extremely similar to a FedEx Office.¹⁴⁵ According to the Third Restatement of Torts, “services, even when provided commercially, are not products.”¹⁴⁶

Secondly, however, the unique feature of the 3D printing technology makes the 3DP service more like a modern manufacturer, rather than a pure service provider, simply because the complex 3D printing process is by its nature a manufacturing process.¹⁴⁷ One major reason a customer approaches a 3DP service is to gain access to higher quality 3D printers, in an analogy, higher quality “modern factories.”¹⁴⁸ In addition, 3DP services are capable of providing the most important and decisive elements, the ink and the diversity of the ink, which are hardly possible for customers to sufficiently provide for themselves.¹⁴⁹ Thus, evidently, 3DP services own a

141. *Id.* at 570–71.

142. *Id.*

143. *Id.*

144. *Id.* at 570.

145. *Id.*

146. RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. § 19 (AM. LAW INST. 1998).

147. *See* Osborn, *supra* note 1, at 587. 3D printers print CAD files in a similar manner as traditional assembly line manufactures products according to blueprints. *Id.*

148. Because 3DP services print tens of thousands of CAD files for many customers, they likely possess higher quality 3D printers and ink, as compared to individuals. *Id.* at 570 n.106.

149. *See id.* at 561.

suite of indispensable manufacturing components: a “modern factory” consisting of high quality 3D printers, a raw material supply that is essentially the ink or seas of “atoms,” and a modern workflow instructing the “assembly line” to function upon raw materials. The only missing item is the blueprint, which is the CAD file ordered by the customer.¹⁵⁰ Once a blueprint is ordered by a customer, 3DP services function in almost exactly the same way as traditional manufacturers, following the virtual blueprint to produce 3D physically items that satisfy the customer’s needs.¹⁵¹ In short, 3DP services can be treated as manufacturers in the modern era of 3D printing technology.¹⁵²

Third, there is a significant difference between classical manufacturers and modern manufacturers of 3DP services. Classical manufacturers know almost every detail of their products, simply because they are also the designers of the blueprints. However, in the context of 3D printing, virtual blueprint designers and manufacturers of final products may be completely separate entities. Thus, it is most likely 3DP services have absolutely no idea what they are printing or manufacturing, and therefore, have no opportunity or expectation to consider the safety aspect of products.¹⁵³

Last but not least, returning to the theme of products liability, most likely the injured plaintiff would bring claims of defective products against 3DP services instead of the CAD file designer, because after all, it is the 3DP service that delivers the final product to the plaintiff.¹⁵⁴ Subsequently, it is the duty of 3DP services to impute the asserted liability to either the CAD file designer, or 3D printer manufacturer. Things become much less complicated when the CAD file designer is “engaged in business.”¹⁵⁵ However, when CAD file sellers are occasional or hobbyist inventors, 3DP services may assume all risks of uncertainty because the current framework of products liability does not apply to occasional sellers.¹⁵⁶ Imagine a hobbyist

150. Rachel Ehrenberg, *The 3-D Printing Revolution: Dreams Made Real, One Layer at a Time*, 183 SCIENCE NEWS NO. 5, 21 (Mar. 9, 2013).

151. *Id.*

152. Matt Tudball, *3D printing revolution*, ICIS CHEMICAL BUS., July 29, 2013, at 12–13.

153. Osborn, *supra* note 1, at 570 (citing Lisa L. Kirchner, *Who’s Liable for Crimes Committed with a 3D Printed Gun?*, TECHNEWS DAILY (May 10, 2013), <http://www.technewsdaily.com/18019-3d-printing-liability.html>).

154. *See id.* at 570–71.

155. *Id.* At least, CAD file designers are in the chain of business when they are “engaged in business.” *Id.*

156. *Id.* at 570.

inventor uploads his recent CAD file design online. A user downloads it, and then orders the 3DP service to print it out. The user gets injured and then sues the 3DP service. Is it justifiable for the 3DP service to assume all the liabilities without ever knowing any detail of the blueprint? Courts should be very cautious in deciding those cases in the near future.

In sum, 3DP services may have both aspects of a service provider and a modern manufacturer, which makes it more complex to apply the current legal framework of products liability, and thus, may call for new regulations.¹⁵⁷

D. *Manufacturers of 3D Printers*

Because the physical item printed from the CAD file, rather than by the CAD file itself, injures the plaintiff, manufacturers of 3D printers substantially contribute to creating the final product that gives rise to a product liability claim.¹⁵⁸ However, it may be insurmountable for the plaintiff to prevail over the manufacturer of 3D printers because the plaintiff not only has to show that the printer is defective when printing the item that caused injury, but also that the printer was defective when it left the printer manufacturer's possession and control.¹⁵⁹

In practice, unless a certain 3D printer continues printing defective items—which may bring about examinations into the defectiveness of the printer—it is hard to prevail over the printer manufacturer for only a few defective printed items.

E. *Programmers Who Write the Code to Run 3D Printers*

Another possible category of defendants is the computer programmer who wrote the code instructing the machine (the 3D printer) to manufacture (the printing process) the products according to the virtual blueprints (the CAD files) of the final products. Put differently, such programmers play a central role connecting together the world of bits and the world of atoms, because they instruct the printing machine to put physical atoms at the locations precisely designated by digital bits.¹⁶⁰ However,

157. See *id.* at 570–71.

158. *Id.*

159. Engstrom, *supra* note 7, at 38 (citing RESTATEMENT (THIRD) OF TORTS: PRODS. LIAB. § 2 (AM. LAW INST. 1998)).

160. See Osborn, *supra* note 1, at 568 (citing Michael D. Scott, *Tort Liability for Vendors of Insecure Software: Has the Time Finally Come?*, 67 MD. L. REV. 425, 434 (2008); Frances E. Zollers et al., *No More Soft Landings for Software: Liability for Defects in an Industry that Has Come of Age*, 21 SANTA CLARA COMPUT. & HUGH TECH. L.J. 745, 745 n.1, 75–56 nn.57–58 (2005)).

the requirement that products have to be “tangible personal property” is the main obstacle for the plaintiff to prevail against these programmers.¹⁶¹

F. “Ink” Providers

The most unique category of defendants in the context of 3D printing are the “ink” providers. The same CAD file printed with different inks, which are deposited physical materials ranging from plastic, iron atoms, to even human cells, may result in distinct quality and durability.¹⁶² Thus, using inappropriate ink, by either the customer or 3DP services, may be a strong defense for commercial CAD file sellers because they can always raise an argument that the defectiveness of the item would have disappeared, or at least been substantially mitigated, if a proper ink was used. In addition, after ruling out other possible roots of the defectiveness, actions against ink providers fall squarely within the scope of classical doctrines of products liability.

V. CONCLUSION

The era of 3D printing is not coming—it has arrived. To cope with the advance of this young technology, lawmakers need to reshape the doctrinal contours of products liability. In particular, lawmakers must devise regulation for occasional or hobbyist inventors who distribute their CAD files online for free. Such regulation must also address the unique uncertainties associated with 3D printing that may complicate litigation, including possible defectiveness of a 3D printer itself, improperness of the printing ink, or flawed CAD file, because it would be challenging to single out the root of the defectiveness when those roots—the printer, the ink, and the CAD file—are so intertwined. Finally, the general public policy behind regulating 3D printing must be specific to prevent a chilling effect and to embrace this emerging technology.

Shen Wang

161. See Engstrom, *supra* note 7, at 38 (citing *Winter v. G.P. Putnam’s Sons*, 938 F.2d 1033 (9th Cir. 1991)).

162. Osborn, *supra* note 1, at 559.