TORT VS. TECHNOLOGY: Accommodating Disruptive Innovation

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INTRODUCTION

Given that the American legal system supports markets that make technological advancement economically feasible and thus attractive to investors, it may be said that our law generally encourages the development of innovative, albeit sometimes unavoidably dangerous, technology. Specific examples abound. Thus, the rule of limited shareholder liability encourages innovative risk-taking.[1] And some specialized areas appear even more self-consciously to promote innovation; in this regard, intellectual property law deserves high marks for making the effort, whatever may be said for its bottom-line results.[2] By contrast tort law, whether or not its central objective is deterrence,[3] carries the potential for discouraging creative technological innovation.[4] Indeed, observers have criticized the American system of

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1. The general rule is that shareholders are not personally responsible for the obligations of the corporation. *See* MODEL BUS. CORP. ACT § 6.22 (AM. BAR ASS'N 1984) (amended 2002). It is believed that the rule is necessary to attract relatively wealthy individuals to invest in corporations engaged in risky albeit socially beneficial operations. *See* Henry G. Manne, *Our Two Corporation Systems: Law and Economics*, 53 VA. L. REV. 259, 262 (1967) (the seminal article). For a review of various rationales for limiting liability of shareholders, see generally Frank H. Easterbrook & Daniel R. Fischel, *Limited Liability and the Corporation*, 52 U. CHI. L. REV. 89 (1985).

2. Patents give their holders rights to exclude others for a limited time from the use and enjoyment of inventions in order to encourage inventors to develop new technology. *See* JOHN G. MILLS III ET AL., PATENT LAW FUNDAMENTALS §§ 1:2–3 (2d ed. 2014). Critics argue that current patent law grants too broad a monopoly and overly discourages others from innovating on their own. *See, e.g.*, ALEXANDER TABARROK, LAUNCHING THE INNOVATION RENAISSANCE: A NEW PATH TO BRING SMART IDEAS TO THE MARKET FAST 38–48 (2011) (arguing that our patent system is on the right track generally, but that reforms are necessary to optimally encourage innovation in various industries).

3. For a summary of the possible objectives of tort, see generally JAMES A. HENDERSON, JR. ET AL., THE TORTS PROCESS 35–40 (8th ed. 2012). For a discussion of the objectives of products liability, see generally JAMES A. HENDERSON, JR. & AARON D. TWERSKI, PRODUCTS LIABILITY: PROBLEMS AND PROCESS 24–28 (7th ed. 2011).

4. As will be made clear, the modifier "disruptive" connotes that a particular innovation presents a creative breakthrough rather than merely a marginal improvement. *See infra* notes 35–37 and accompanying text. For a discussion of how strict tort liability operates to decrease levels of activity—i.e., to marginally discourage engagement in the activity regardless of how careful the actor is to avoid causing harm—see HENDERSON ET AL., *supra* note 3, at 473. Although in

products liability on precisely that basis and have argued that it contributes significantly to placing our business firms at a disadvantage in global competition.[5] This Article takes issue with such criticisms. Properly understood, American tort law contains a number of features that are accommodative of, rather than pointedly antagonistic toward, disruptive technological innovation. Thus, our liability rules allow innovating firms to avoid exposure to potentially existential liability for latent, unknowable risks associated with new technology, thereby comparing favorably with the relevant portions of foreign liability law.[6] It follows that no compelling reasons exist to believe that our tort system significantly disadvantages American firms in their efforts to compete globally.[7]

Tort law's accommodation of innovation may be viewed as part of a broader set of circumstances in which tort embraces risk-taking in order to promote individual and social values that the system considers appropriate. Most fundamentally, retention of negligence as the ubiquitous liability standard[8] reflects a willingness to allow actors to make reasonable risk-benefit trade-offs that harm others without necessarily incurring tort liability.[9] Within the negligence system, the stubborn persistence of the quasi-contractual concept of assumption-of-the-risk (in spite of efforts to merge it into the concept of contributory negligence/comparative fault[10]) reflects a

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theory negligence law aims at optimizing levels of care, as a practical matter the uncertainty of its application causes it to operate, to some extent, as a strict liability rule.

5. *See generally* PETER W. HUBER, LIABILITY: THE LEGAL REVOLUTION AND ITS CONSEQUENCES 1–3 (1988); Alfred W. Cortese, Jr. & Kathleen L. Blaner, *The Anti-Competitive Impact of U.S. Product Liability Laws: Are Foreign Businesses Beating Us at Our Own Game?*, 9 J.L. & COM. 167 (1989); Randolph J. Stayin, *The U.S. Product Liability System: A Competitive Advantage to Foreign Manufacturers*, 14 CAN.-U.S. L.J. 193 (1988).

6. *See infra* Part II.

7. *See infra* Part III.D.

8. *See* James A. Henderson, Jr., *Why Negligence Dominates Tort*, 50 UCLA L. REV. 377, 379 (2002).

9. *See* HENDERSON ET AL., *supra* note 3, at 184 ("[T]he net effect of the negligence rule is to force plaintiffs to bear the accident costs of a defendant's harm-causing activity as long as the defendant struck a reasonable balance between accident costs and the costs of precautions.").

10. The older rule was that assumption of the risk—agreement by the plaintiff to accept a risk of harm arising from the defendant's negligent conduct—was a total bar to liability. *See* RESTATEMENT (SECOND) OF TORTS §§ 496B–E (AM. LAW INST. 1965). Fairly early on, courts began to merge assumption of risk into contributory negligence, see, for example, Meistrich v. Casino Arena Attractions, Inc., 155 A.2d 90, 93 (N.J. 1959), and then into comparative fault, see RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM, § 25, cmt. (e) (AM. LAW INST. 2010). But assumption of the risk as a defense separate from contributory fault persists and appears to have a life of its own. *See, e.g.*, Knight v. Jewett, 834 P.2d 696, 707–08 (Cal. 1992) (under comparative fault, the jury was entitled to take into consideration a plaintiff's voluntary action in choosing to engage in an unusually risky sport); *see also* Kenneth W. Simons, *Reflections on Assumption of Risk*, 50 UCLA L. REV. 481, 528 (2002) ("Despite calls

willingness to allow competent actors to take responsibility for choosing to run substantial risks of harm to achieve their individual objectives.[11] And even within the American tort system's bastion of consumer protection—our system of products liability—the no-duty rule denying claims that attack entire categories of products for being defectively designed[12] reflects the normative judgment that the products liability system should allow individuals to use and consume even highly risky product categories—e.g., trampolines[13] and tobacco[14]—if those products are properly marketed and reflect consumers' considered preferences.[15] Thus, although the focus in this Article is on tort law's apparent willingness to allow substantial breathing room for technological innovation, the analysis has relevance to the broader subject of tort law's responses to other forms of beneficial risk-taking.

This Article's methodology is essentially descriptive rather than normative. Instead of arguing on allocative-efficiency or fairness grounds that our tort system should encourage technological innovation, the Article observes analytically that American tort law, including products liability, contains a number of features that reveal the system generally to be conducive to the introduction and promotion of disruptively creative, albeit dangerous, new technology. Whether or not the innovations accommodated by tort are socially beneficial or morally acceptable is a normative question that this Article does not pursue.[16] Thus, when the analysis suggests that a particular

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for [its] abolition . . . the doctrine survives in some jurisdictions, and its spirit endures in most, if not all.").

11. *See* Stelluti v. Casapenn Enter., 1 A.3d 678, 694–95 (N.J. 2010) (the Court gave effect to a waiver and release from liability regarding an exercise program in a private fitness center, stressing the value of allowing vigorous participation in athletic activities involving inherent and expected physical contact and high levels of emotional intensity).

12. *See infra* notes 154–56 and accompanying text.

13. *See, e.g.*, Parish v. Jumpking, Inc., 719 N.W.2d 540, 543–47 (Iowa 2006).

14. *See, e.g.*, Adamo v. Brown & Williamson Tobacco Corp., 900 N.E.2d 966, 968–69 (N.Y. 2008).

15. Most often, categorical risks are obvious and warnings are not necessary. On the subject of category liability, see generally James A. Henderson, Jr. & Aaron D. Twerski, *Closing the American Products Liability Frontier: The Rejection of Liability Without Defect*, 66 N.Y.U. L. REV. 1263 (1991).

16. Although one might assume that technological innovation is socially beneficial from an overall perspective, some observers, such as committed environmentalists or pacifists, might disagree. *See, e.g.*, STEVEN JOHNSON, HOW WE GOT TO NOW: SIX INNOVATIONS THAT MADE THE MODERN WORLD 7–9 (2014). But whatever one's normative views regarding the various ends served by innovation, this Article views innovation as an instrumental means of achieving those ends. Thus, examining how innovation works and how tort law affects innovation is useful, whatever the ends being served. *See generally* Ernest J. Weinrib, *Deterrence and Corrective Justice*, 50 UCLA L. REV. 621, 630–31 (2002) (instrumental means are conceptually compatible with noninstrumental ends as long as means and ends are logically sequenced so that the former give way when the two come into conflict).

tort doctrine may increase the quality of innovation by making it more useful, or may increase the quantity of innovation by lowering its costs, the analysis leaves open the question of whether or not such increases serve a good purpose. Moreover, whether or not American tort law handicaps American firms trying to compete internationally is an empirical question that this Article does not attempt to answer rigorously.[17] As with the normative issues latent within an assessment of the relationship between tort law and technological innovation, the analysis that follows is satisfied to show, applying common sense to outward appearances, that our tort law is designed to allow innovators to avoid crushing liability and, in ways most relevant to this analysis, compares favorably with foreign law.

The Article is comprised of three parts. Part I provides necessary background by examining the nature and sources of technological innovation, identifying work environments that foster, and others that inhibit, efforts to develop new technology. Recent years have witnessed a burgeoning literature on the subject.[18] Part I brings that literature to bear. Part II describes the ways in which tort law generally, apart from products liability, allows the distributors of innovative technology to avoid what might otherwise prove to be existential liability for the sorts of hard-to-foresee risks that strongly correlate with disruptive innovation. Most significantly, non-products tort law shields innovative technology from exposure to strict liability[19] and refuses to rely on time-of-trial hindsight in applying the negligence standard.[20] Part III shifts focus to the uniquely American aspect of tort—our products liability system—showing how mainstream rules governing liability for defective product designs protect and encourage marginal, sustaining

17. The emphasis here should be on "rigorously." Quantifying and factoring in the numerous variables in addition to tort liability that affect American firms' competitiveness in global markets—trade barriers; governmental involvement in, and regulation of, industrial activity; consumer demand; stability of financial markets; insurance markets; and so on; would be nearly impossible. But this Article's assessment of American tort and products liability law, although empirically nonrigorous, describes a major variable in helping to determine the quality and quantity of innovation that occurs in this country. If this Article's assessment is mostly accurate, it points fairly strongly in the direction of concluding that our liability system probably does not contribute to suppressing innovation or handicapping our firms in global competition.

18. *See, e.g.*, PAUL ALLEN, IDEA MAN (2011); CLAYTON M. CHRISTENSEN, THE INNOVATOR'S DILEMMA (1997); ERNEST FREEBERG, THE AGE OF EDISON (2013); JON GERTNER, THE IDEA FACTORY (2012); WALTER ISAACSON, THE INNOVATORS (2014); JOHNSON, *supra* note 16; TOM KELLEY, THE ART OF INNOVATION (2001); THOMAS S. KUHN, THE STRUCTURE OF SCIENTIFIC REVOLUTIONS (2d ed. 1970); MARK PAYNE, HOW TO KILL A UNICORN (2014); ERIC SCHMIDT & JONATHAN ROSENBERG, HOW GOOGLE WORKS (2014); PETER SKARZYNSKI & DAVID CROSSWHITE, THE INNOVATOR'S FIELD GUIDE (2014); PETER THIEL, ZERO TO ONE (2014).

19. *See infra* notes 94–99 and accompanying text.

20. *See infra* notes 100–06 and accompanying text.

innovation.[21] More importantly, this discussion also explains how the rule against liability for generic risks presented by entire product categories similarly protects and encourages breakthrough, disruptive innovation.[22] Part III concludes that no credible evidence supports the claim that our products liability system disadvantages American firms competing in global markets. To be sure, the American system imposes greater process costs than do other systems. But that circumstance does not differentially penalize American firms.

I. THE NATURE AND SOURCES OF, AND INFLUENCES ON, TECHNOLOGICAL INNOVATION

A. The Nature and Sources of Innovation

Technological innovation consists of new and sometimes dramatically disruptive ways of engaging in the practical arts and applied sciences.[23] It is inherently instrumental, seeking to develop more effective means of achieving human ends.[24] Thus, innovation does not consist of developments in pure scientific theory which, as with the fine arts famously pursued for their own sake,[25] involve the pursuit of conceptual breakthroughs as ends-in-

21. *See infra* notes 40–41 and accompanying text.

22. *See infra* notes 37–39 and accompanying text.

23. *See* WEBSTER'S NEW WORLD COLLEGE DICTIONARY, http://www.yourdictionary.com/innovation#websters (last visited January 23, 2016) (defining innovation as "something newly introduced; new method, custom, device, etc."). A popular how-to book defines innovation as "an idea, successfully commercialized." *See* SKARZYNSKI & CROSSWHITE, *supra* note 18, at 75.

24. Once again the phrase "develop more effective" reflects no judgment regarding the normative ends sought to be achieved. *See supra* note 16 and accompanying text.

25. Certainly artists do create art in order to achieve external goals relating to morality, politics, and utility. But many believe that a preoccupation with these instrumental, problem-solving objectives is inimical to the essence of artistic expression. *See, e.g.*, EDGAR ALLAN POE, THE POETIC PRINCIPLE (1850), *reprinted in* EDGAR ALLAN POE: CRITICAL THEORY 182 (Stuart Levine & Susan F. Levine eds., 2009) ("[T]he simple fact is, that, would we but permit ourselves to look into our own souls, we should immediately there discover that under the sun there neither exists nor *can* exist any work more thoroughly dignified—more supremely noble than this very poem—this poem *per se*—this poem which is a poem and nothing more—this poem written solely for the poem's sake.").

themselves.[26] Once issues of theory are settled upon,[27] innovation consists of applying the relevant theory in novel, instrumentally-effective ways. This author has elsewhere characterized the major components of the American legal system, including contract and tort, as essentially problem-solving enterprises.[28] Problem solving is a broader concept than innovation because it includes solutions that, although not initially obvious to the problem-solver, are not necessarily novel from a wider social perspective.[29] If one thinks of the development of substantive law and legal processes as constituting the applied sciences of social, moral, and political theory,[30] the author's previous analyses of law as problem solving closely parallel, with a difference in emphasis, this Article's analysis of technological innovation. Thus, the problems that legal innovations seek to solve involve coordinating social behavior,[31] whereas the problems that technological innovations seek to solve mainly involve coordinating elements of the physical environments in which

26. KUHN, *supra* note 18, at 38 ("The scientific enterprise as a whole does from time to time prove useful, open up new territory, [and] display order . . . . Nevertheless, *the individual* engaged on a normal research problem *is almost never doing any one of these things.* Once engaged, his motivation is of a rather different sort. What then challenges him is the conviction that, if only he is skillful enough, he will succeed in solving a puzzle that no one before has solved or solved so well. Many of the greatest scientific minds have devoted all of their professional attention to demanding puzzles of this sort. On most occasions any particular field of specialization offers nothing else to do, a fact that makes it no less fascinating to the proper sort of addict."); *see also* SCHMIDT & ROSENBERG, *supra* note 18, at 240 ("It may sound corny, but the reward [from working creatively] comes from the work itself. Several studies have shown that extrinsic rewards don't encourage creativity, and in fact hinder it, by turning an inherently rewarding endeavor into a money-earning chore.").

27. In most instances of sustaining innovation—making existing technology marginally better—the underlying scientific theory is not questioned. *See infra* notes 40–41 and accompanying text. By contrast, disruptive innovation—categorically challenging the status quo—comes close to challenging the underlying theory itself. *See infra* notes 37–39, 57–67 and accompanying text. The point is that, in any event, the teams of engineers that often work out innovative applications, see *infra* notes 52–55 and accompanying text, must get the underlying theory straight before proceeding.

28. *See* James A. Henderson, Jr., *Contract's Constitutive Core: Solving Problems by Making Deals*, 2012 U. ILL. L. REV. 89 (2012) [hereinafter Henderson, *Contract's Core*]; James A. Henderson, Jr., *The Constitutive Dimensions of Tort: Promoting Private Solutions to Risk-Management Problems*, 40 FLA. ST. U. L. REV. 221 (2013) [hereinafter Henderson, *Constitutive Tort*].

29. *See* Henderson, *Contract's Core*, *supra* note 28, at 99–100.

30. *See generally id.* at 90–99.

31. *See id.* at 98, n.37 and accompanying text; Henderson, *Constitutive Tort*, *supra* note 28, at 221.

social behavior takes place.[32] However, the methodologies involved in problem solving and technological innovation are functionally identical.[33]

From this Article's perspective the most useful insight regarding technological innovation, propounded by Clayton Christensen two decades ago, is the distinction between disruptive innovation and sustaining innovation.[34] Disruptive innovation consists of fundamental changes in direction,[35] sometimes resembling paradigm-shifts in scientific theory, that reflect a rethinking of the basic premises of important areas of mainstream technology.[36] These changes are deemed disruptive because they aim to replace the status quo.[37] By contrast, sustaining innovation supports the status quo by incrementally improving areas of mainstream technology.[38] Sustaining innovation does not challenge, but rather extends, the premises underlying existing technology, making that technology less vulnerable to

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32. *See supra* notes 23–26 and text accompanying.

33. *Cf.* Henderson, *Contract's Core*, *supra* note 28, at 108–10 (explaining the methodologies of problem solving); *infra* notes 51–56 and accompanying text (explaining the methodologies of technological innovation).

34. *See* CHRISTENSEN, *supra* note 18, at xviii–xix.

35. As Christensen makes clear, the new technology may not be superior to existing technology in terms of performances, but functionally it may deliver its inferior performance by means of a vehicle that better serves a significant portion of the market. *See* CHRISTENSEN, *supra* note 18, at 116. He employs the example of how the ink-jet printer came to replace the laser-jet printer for a large number of relatively unsophisticated users. *Id.* ("The ink-jet printer isn't as good as the laser jet and may never be. But the critical question is whether the ink jet could ever be as good a printer as the personal desktop computing *market* demands. The answer appears to be yes. The resolution and speed of ink-jet printers, while still inferior to those of laser jets, are now clearly good enough for many students, professionals, and other un-networked users of desktop computers."). Sustaining innovation would have focused on making the laser-jet even better. *See id.* By moving to a basically different technology, the disruptive innovators delivered a new product that better served the less-demanding needs of customers for whom a more expensive laser-jet printer represented "printer overkill." *See id.* at 116–17.

36. Thomas Kuhn describes why and how a new candidate for a new scientific paradigm comes to replace the old one in KUHN, *supra* note 18, at 144–59. Essentially, the new paradigm, like the ink-jet printer, *supra* note 35, gradually comes to be accepted as a better way of meeting the needs of the scientific community—explaining observable reality and predicting realities that become observable in the future. KUHN, *supra* note 18, at 159 ("At the start a new candidate for paradigm may have few supporters . . . . Nevertheless, if they are competent, they will improve it, explore its possibilities, and show what it would be like to belong to the community guided by it. And as that goes on, if the paradigm is one destined to win its fight, the number and strength of the persuasive arguments to its favor will increase. More scientists will then be converted, and the exploration of the new paradigm will go on. Gradually the number of experiments, instruments, articles, and books based upon the paradigm will multiply. Still more [scientists,] convinced of the new view's fruitfulness, will adopt the new mode of practicing normal science, until at last only a few elderly hold-outs remain.").

37. *See* SCHMIDT & ROSENBERG, *supra* note 18, at 207 ("We aren't trying to improve on an existing way of doing something, rather we want to start over.").

38. *See* CHRISTENSEN, *supra* note 18, at xviii.

challenge by competitors.[39] It is rarely in the interests of firms relying on established technology to undermine their investments by developing disruptive alternatives.[40] Some established firms, especially those involved in information technology (IT), do perform as innovative disrupters.[41] But that task appears mostly to fall to upstart firms[42] seeking to assume the role of smaller Davids slaying larger Goliaths that are held captive, as it were, by their ongoing commitment to sustain existing technological paradigms.[43] If one imagines a large number of upstart "Goliath-slayers" competing to be the first to develop a patentable disruptive technology capable of attracting significant numbers of customers from the established firms that have been captured by existing paradigms,[44] what determines which upstart competitor will prevail? Intuitively, one might imagine the appropriate answer to be "the upstart that develops the best new technology." In actuality, a better answer is "the upstart that develops new technology that, even if only barely good enough,[45] is the first, often largely as a function of random chance, to gain

39. *See id.* at 13 ("[The] pattern of technology leadership among established and entrant firms offering products based on new sustaining technologies . . . is stunningly consistent. Whether the technology was radical or incremental, expensive or cheap, software or hardware, component or architecture, competence-enhancing or competence-destroying, the pattern was the same. When faced with sustaining technology change that gave existing customers something more and better in what they wanted, the leading practitioners of the prior technology led the industry in the development and adoption of the new.").

40. *See* CHRISTENSEN, *supra* note 18, at 199. For Christensen's recommendations for the appropriate response by an established firm facing the likelihood of disruptive technology from would-be competitors—create an independent upstart of its own, see *id.* at 199–202.

41. *See* SCHMIDT & ROSENBERG, *supra* note 18, at 207–08.

42. *See* CHRISTENSEN, *supra* note 18, at 24 ("[T]he firms that led the industry in every instance of developing and adopting disruptive technologies were entrants to the industry, not its incumbent leaders."); *see also* SCHMIDT & ROSENBERG, *supra* note 18, at 211.

43. *See* CHRISTENSEN, *supra* note 18, at 18–19 ("Held Captive by Their Customers.").

44. For an anecdotal description of this phenomenon from a Davidean perspective, see ALLEN, *supra* note 18 (the patent-holder on the first personal computer, who had been approached by many software upstarts, resolved to give a software contract to "first person to walk through his door . . . with a working [software] system"). One intriguing aspect is the idea that many upstarts, working simultaneously and independently, are more likely in the aggregate to come up with successful disruptive technology that would any one of them working alone. This may be one of the reasons (overlooked until now) why established firms are less likely to develop such innovations. *See* CHRISTENSEN, *supra* note 18, at 24. They cannot afford to replicate dozens of upstarts working independently, so their odds of success are smaller than those of the upstarts in the aggregate. Interestingly, Christensen recommends that an established firm spin off its own independent upstart. *See id.* at 199–202. But an established firm can hardly afford to create a dozen, or a hundred, such firms.

45. *See* CHRISTENSEN, *supra* note 18, at 116 (arguing that ink-jet printers are technically inferior but market-wise superior to laser-jet printers); *see also* FREEBERG, *supra* note 18, at 1–2 (Edison's first workable light bulb filament did not function long enough (fourteen hours) to be commercially practicable, but lasted long enough to show that his system worked and to get a patent and attract investors).

market traction sufficient to fend off its rivals."[46] From that point the cycle tends to repeat itself, with successful upstarts developing into larger firms that thereafter rely on sustaining innovation and patents to protect the advantages initially obtained by marketing a disruptive innovation.[47] And, of course, no sooner has the new, larger firm begun to sustain its profitable commitment to what has become patent-protected mainstream technology than a new wave of upstarts begins to try to develop disruptive innovation aimed at replacing the newly-established technology.[48]

B. Work Environments That Facilitate (or Threaten) the Different Types of Technological Innovation

Each type of innovation—sustaining and disruptive—flourishes in a different type of work environment. Sustaining innovation, aimed at protecting and marginally extending successful core technology,[49] is typically and most advantageously carried on by teams of engineers,[50] often guided and

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46. For a fascinating explanation of how chance plays an important, but largely hidden, role in life and in markets, see generally NASSIM NICHOLAS TALEB, FOOLED BY RANDOMNESS (2d ed. 2004). The role of chance is hidden for a number of reasons mostly rooted in psychological biases, including a strong tendency to explain outcomes that are largely the product of chance as being the product of skill, or intelligence, or lack thereof. *See id.* at 1–5. Thus, when one upstart out of dozens, or hundreds, or thousands, develops barely adequate disruptive technology, subsequent story tellers tend to attribute it to skill, or genius, rather than largely to luck. *See id.* Most of the books cited, *supra* note 18, conform to this tendency. Indeed, one of the authors is so sensitive on the subject that he devotes an entire chapter denying the possibility that luck is the dominant factor. *See* THIEL, *supra* note 18, at 59–81 ("You Are Not a Lottery Ticket"). For a recent work tilted somewhat in the opposite direction, see MALCOLM GLADWELL, OUTLIERS 175–76 (2008) ("[S]uccess arises out of the steady accumulation of [randomly bestowed] advantages: when and where you are born, what your parents did for a living, and the circumstances of your upbringing . . . .").

47. *See, e.g.*, ALLEN, *supra* note 18, at 176–79; CHRISTENSEN, *supra* note 18, at 10 ("[A] given firm would be considered an entrant at one specific point . . . [y]et the same firm would be considered an established firm [at a later point]."); *see also* FREEBERG, *supra* note 18, at 260, 264.

48. *See* Gary Hamel, *Bringing Silicon Valley Inside*, HARV. BUS. REV., Sept.–Oct. 1999, at 70, 72 ("Face it: Out there in some garage, an entrepreneur is forging a bullet with your company's name on it."). For the story of how a series of successive disruptive innovations shook the hard disk drive industry in the 1970s and 80s, see CHRISTENSEN, *supra* note 18, at 14–25; *see also* ALLEN, *supra* note 18, at 181, 185 (referring to the upstarts as "hell-hounds," the author observes: "Now we're moving to a new age, and the same pattern keeps recurring. A company [like Microsoft] jumps out to a big lead and then is late diving into the latest innovation. Before you know it, an adversary has staked its claim and is crowned as the market and technology leader.").

49. *See supra* notes 34, 38–39 and accompanying text.

50. *See* KELLEY, *supra* note 18, at 70 ("[G]reat projects and products are often the result of great teams."); ISAACSON, *supra* note 18, at 85 ("[I]nnovation is usually a group effort, involving collaboration between visionaries and engineers . . . ."). For a summary of the decision processes

inspired by an imaginative project leader who may (but need not) have been involved in first discovering and developing the core technology.[51] While smaller subteams may focus on particular components of the larger team's development project,[52] the firm explicitly encourages team and subteam members to collaborate with one another rather than to strike out on tangents of their own.[53] Because the focus of such collaborative efforts is more practical than theoretical—marginally improving the benefit-cost ratios of proven technologies—the firm supports them by supplying the resources necessary for building and testing components, prototypes, and the like.[54]

The working environments that best facilitate disruptive innovation are different from those just described. Because coming up with innovations sufficiently different to displace established core technologies typically requires greater emphasis on theory, the initial breakthrough insights are almost always accomplished by one, and almost never by more than two, creative intellects.[55] Disruptive, paradigm-breaking departures are invariably followed by collaborations among teams of problem-solving engineers who apply the novel concepts in working out the practical implications of the emergent new technologies.[56] These follow-up processes resemble those

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of groups created by firms to solve problems, see generally Henderson, *Contract's Core*, *supra* note 28, at 109–10.

51. For a description of the classic instance of the inspired leader turning projects over to teams of engineers, see FREEBERG, *supra* note 18, at 32 ("Edison invented a new style of invention, a coordinated program of scientific research and product development that amplified the speed and range of his individual genius by channeling it through the talents and insights of dozens of assistants."); ISAACSON, *supra* note 18, at 92 ("Most of the great innovations of the digital age sprang from an interplay of creative individuals . . . with teams that knew how to implement their ideas.").

52. *See* KELLEY, *supra* note 18, at 10 (describing a project aimed at improving the design of the common shopping cart, the author observes: "[w]e split [the design team] into four smaller groups . . . each team focusing on a separate concern . . . .").

53. *See* GERTNER, *supra* note 18, at 133 (describing a department at Bell Labs "that thrived on its collective intelligence—where members of the staff were encouraged to work on papers together rather than alone . . . ."). Resident geniuses, by contrast, when engaged in disruptive technology, require freedom to think independently. *See infra* notes 65–66 and accompanying text.

54. *See* GERTNER, *supra* note 18, 153–54 ("[Bell Labs] needed to give [their teams of engineers] all the tools they needed."); *see also* KELLEY, *supra* note 18, at 7.

55. *See* GERTNER, *supra* note 18, at 134 ("It is in the mind of a single person that creative ideas and concepts are born.") (quoting JOHN R. PIERCE, MERVIN JOE KELLY: 1894–1971 202 (NAT'L ACADS. OF SCIS. 1975)); ISAACSON, *supra* note 18, at 326 (describing how Bill Gates and Paul Allen collaborated to produce BASIC); *see also* Henderson, *Contract's Core*, *supra* note 28, at 108.

56. *See* GERTNER, *supra* note 18, at 134–35 ("It was the individual from which all ideas originated, and the group . . . to which the ideas, and eventually the innovation responsibilities, were transferred.").

described in connection with sustaining innovation.[57] As for the breakthroughs themselves, most often they are not "eureka" moments in which the insights arrive all-at-once, in a flash.[58] Instead, innovators build on them over time, pulling together strands from many sources.[59] Moreover, the innovators who accomplish disruptive breakthroughs tend to be relatively young[60] and are often, perhaps partly as a function of their youth, relative newcomers to the relevant field of technical endeavor.[61] In any event, disruptive innovators almost always focus on novel ideas as ends in themselves, much as would a theoretical scientist or an *avant garde* artist.[62]

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57. *See supra* notes 34, 38–39 and accompanying text.

58. *See* FREEBERG, *supra* note 18, at 2–3 ("We associate [Edison's discovery of] the [light] bulb with a 'eureka' moment . . . . [H]istorians of technology have long shown the limitations of this view, which is in fact more hero worship than history."); *see also* ISAACSON, *supra* note 18, at 85 ("Only in storybooks do inventions come like a thunderbolt, or a lightbulb popping out of the head of a lone individual in a basement or garret or garage.").

59. *See* ALLEN, *supra* note 18, at 75 ("In building our homegrown BASIC, we borrowed bits and pieces of our design from previous versions . . . . [W]e all stand on others' shoulders."); FREEBERG, *supra* note 18, at 3 ("Edison's success with a carbon filament on that October evening in 1879 was an important step, but only one of many needed to turn the incandescent light from an idea into a viable technology. . . . [H]e drew on the successes and instructive failures of many other inventors, working over decades and on both sides of the Atlantic . . . .").

60. *See* Benjamin F. Jones & Bruce A. Weinberg, *Age Dynamics in Scientific Creativity*, PROC. OF THE NAT'L ACAD. OF SCI., Nov. 22, 2011, at 18910, 18910–14 (In a study based on 525 Nobel prize winners in physics, chemistry, and physiology or medicine between 1901 and 2008, authors found that empirical innovators, who would likely produce sustaining innovation, work inductively and peak in their mid-fifty's, while theoretical innovators, who would likely produce disruptive innovation, work deductively and do their best work around the age of twenty-five); Benjamin F. Jones, *Age and Great Invention*, REV. OF ECON. & STAT., Feb. 2010, at 1, 1 (refining the premise that most acknowledged "great inventors" peak in their mid 30's); Ezekiel J. Emanuel, *Why I Hope to Die at 75*, ATLANTIC MAGAZINE, Oct. 2014, at 77 (stating that most creative people make their best contribution before age forty).

61. *See* KUHN, *supra* note 18, at 1–3. Discussing a new way of approaching the history of science, Kuhn expresses doubt that the traditional development-by-accommodation concept—that scientific understanding grows incrementally over time—is an adequate hypothesis. Instead, he suggests that, from time to time, a scientific researcher will introduce a new paradigm—a new way of organizing and explaining a field of science—that does not add incrementally to, but fundamentally challenges and destroys, the old paradigm. In the context of applied science, this way of thinking runs parallel to Christensen's distinction between disruptive and sustaining innovation. *See supra* notes 34–39 and accompanying text. At one point, Kuhn introduces the possibility that someone "who is ignorant of [the field about to be revolutionized] but who knows what it is to be scientific" might be the one to question the existing theoretical paradigm and thereby threaten to destroy it. *See* KUHN, *supra* note 18, at 4. In the context of this instant inquiry into technological innovation, this quality of relative naivete fits with the qualities of relative youth, *supra* note 60, and risk-tolerance, *infra* note 64.

62. *See supra* note 25 and accompanying text. *See also* GERTNER, *supra* note 18, at 350 ("You were in [the innovative venture] for the adventure . . . 'I was motivated . . . by curiosity.'") (quoting an interview by Claude E. Shannon with Robert Price, in New Brunswick, N.J. (July 28, 1982)); *see also* KUHN, *supra* note 18, at 38 ("What then challenges [the scientist-researcher] is

Much like fine artists, these innovators are most likely to thrive when they are free to follow their instincts and intuitions.[63] By contrast to more practical-minded engineers in big firms, innovators in start-ups tend to harbor little concern for risk[64] or respect for authority.[65] When disruptive innovators work within large firms, their employers try to provide work environments that are functionally similar to those just described—ones that afford them the freedom to think on their own, without formal constraints,[66] including the freedom to fail without suffering reprisals.[67]

C. Coping Mechanisms by Which Innovative Firms Can Reduce the Negative Effects of Tort

The threat of tort liability is a feature of the work environment that has the potential not only to distract the innovators, thus reducing the quality of innovation, but also to raise the cost of innovation, thus reducing the quantity.[68] Later discussions will consider whether and to what extent our tort system adjusts the liability rules and relevant procedures to reduce such negative effects.[69] Here, the question is whether and to what extent the basic types of innovation—sustaining and disruptive—are inherently susceptible to being discouraged by exposure to liability even if one assumes for the sake of argument that tort law makes no particular effort to embrace liability-reducing adjustments. Is either type of innovation likely to be inhibited by credible threats of tort liability? Regarding sustaining innovation carried on by established firms, the team members who collaborate to develop marginal product improvements are not, at least as a practical matter, individually

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the conviction that, if only he is skillful enough, he will succeed in solving a puzzle that no one before has solved or solved so well.").

63. *See* GERTNER, *supra* note 18, at 152 ("In technology, the odds of making something truly new and popular have always tilted toward failure. That is why [a legendary leader at Bell Labs] let many members of his research department roam free, sometimes without concrete goals, for years on end."); *see also* SCHMIDT & ROSENBERG, *supra* note 18, at 210 ("All companies that want to be innovative . . . need to start by creating an environment where the different components of creation are given free rein . . . and then give [them] . . . the time and freedom to evolve and live, or—much more often—stagnate and die.").

64. *See* SCHMIDT & ROSENBERG, *supra* note 18, at 211 ("People who join start-ups crave risk; it's part of what attracts them to the venture.").

65. *See* ISAACSON, *supra* note 18, at 338 ("Gates was also a rebel with little respect for authority, another trait of innovators.").

66. *See supra* note 63 and accompanying text.

67. *See* SCHMIDT & ROSENBERG, *supra* note 18, at 238–39 ("[D]on't stigmatize the team that failed: Make sure they land good internal jobs. The next innovators will be watching to see if the failed team is punished.").

68. *See supra* note 4 and accompanying text.

69. *See infra* Parts II and III.

liable in tort for the harm-causing choices they make;[70] but of course the firm that employs them is exposed to liability,[71] and that may distract innovators. In light of the team's immunity and the firm's exposure, one may reasonably assume that: (1) the firm will make efforts to insulate its teams from being distracted in their creative endeavors by the firm's liability concerns;[72] (2) to some extent, perhaps by adjustments in the firm's formal structure, the firm will reduce its own exposures to liability-related losers flowing from innovative technology even if the liability rules, themselves, make no discernable effort to reduce the firm's exposures;[73] and (3) in any event, investors such as shareholders and venture capitalists are not personally responsible for the firm's residual tort liabilities[74] for which liabilities the firm will obtain appropriate insurance coverage.[75] Because the second and third of these responses by the firm do not directly shelter the innovative process, they may not increase the quality of innovation measured by its creativeness and instrumental effectiveness; but they may very likely increase the quantity of innovation by reducing its costs.[76]

Do these same considerations apply regarding disruptive innovation? When disruptive innovation takes place within large business firms,[77] the same circumstances will presumably obtain regarding the firm's attempting to shelter its innovators and reduce its own, and its investors, exposures to liability-related financial losses.[78] One difference might be that the innovative, disruptive geniuses working within firms may be more aware of the firm's exposures to liability than may the engineers working on sustaining innovation and, given the aspirational nature of disruptive innovation, may

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70. *See* Reinier H. Kraakman, *Corporate Liability Strategies and the Costs of Legal Controls*, 93 YALE L.J. 857, 858 (1984) ("The iron law of tort . . . liability for corporate delicts is this: Liability risks, if [not shifted by contract] ordinarily attach to the legal entity (the corporation) rather than to its officers, employees, or agents.").

71. The premise here is that the innovators' bad choices cause the firm's products to be defective. A firm is liable in tort for harm caused by defective products it distributes commercially. *See infra* note 126 and accompanying text.

72. These efforts would include assuring team members that they are not personally liable and that, in any event, the firm will hold them harmless, and managing their teamwork so that the firm's liability is not part of their conscious considerations. *See* Kraakman, *supra* note 70, at 859 ("Subsidized insurance, routine indemnification, and the preferences of . . . aggrieved plaintiffs combine to assure that the enterprise's culpable agents bear little direct legal risk[s] . . . .").

73. *See* HENDERSON & TWERSKI, *supra* note 3, at 701–04.

74. *See supra* note 1 and accompanying text.

75. Insurance reduces the firm's liability costs, even if it does not decrease the liabilities themselves. For a discussion of the value of insurance, see generally ROBERT H. JERRY II, UNDERSTANDING INSURANCE LAW (5th ed. 2012).

76. *Cf. supra* note 68 and accompanying text.

77. *See supra* notes 40–41 and accompanying text.

78. *See supra* notes 72–74 and accompanying text.

be relatively more affected by threats to the firm notwithstanding the firm's efforts to minimize the negative effects.[79] In any event, what of the lion's share of disruptive innovation that takes place outside of established firms—in the iconic home garage or college dorm room?[80] With the exposure-reducing advantages associated with the corporate form presumably lacking,[81] are exposures to liability likely to have chilling effects on typically unemployed, uninsured innovators? Regarding individuals who work to accomplish innovative breakthroughs, several factors combine to suggest that exposures to liability will not significantly affect the creative process. As noted earlier, these individuals are likely to view their disruptive-innovation projects as ends in themselves, much as might a scientist working on pure theory or a fine artist.[82] Thus, they are probably either ignorant of their exposures to tort or indifferent toward them.[83] And the venture capitalists deciding whether to invest in start-ups that have achieved breakthrough technology are presumably in a position to take advantage of the corporate form to reduce their exposures in the ways outlined above.[84]

The foregoing is not intended to suggest that firms that promote innovative technology are able to manipulate their environments so as to shelter their innovators completely or to escape their own exposures to tort altogether or even nearly so. Structural adjustments designed to avoid liability are limited and costly, and insurance lowers, but does not eliminate, liability costs.[85] Thus, it remains for Parts II and III to consider whether and how American tort law generally, and products liability law in particular, accommodate innovation and allow it to flourish. These inquiries are especially interesting because a number of ostensibly rational observers have insisted that our tort liability system discourages innovation to the point of seriously

79. For the aspirational dimensions of disruptive innovation, see *supra* notes 55 and 62 and accompanying text.

80. *See* ISAACSON, *supra* note 18, at 85; *see also id.* at 344–54 (describing the homespun beginnings of Apple); *id.* at 313–40 (discussing the homespun beginnings of Mircosoft).

81. All of the best-known start-ups described in Isaacson's chronicle experienced their breakthrough insights before evolving into large, sophisticated corporations. *See supra* note 80. Bell Labs is a stand-out exception to the pattern. *See* GERTNER, *supra* note 18, at 1–3.

82. *See supra* notes 25–26 and accompanying text.

83. For starters, they are likely to be judgment-proof. Because the levels of liability for a defectively designed and widely distributed new product are likely to be significant, and the entrepreneurial innovators working out of garages or dorm rooms are unlikely to possess significant personal wealth or be covered by adequate insurance, as a practical matter, injured plaintiffs who win judgments against the garage dwellers are unlikely to end up with enough to cover the costs of bringing the tort actions.

84. *See supra* notes 72–74 and accompanying text.

85. *See supra* note 75.

disadvantaging American firms engaged in global competition.[86] What follows sheds new light on these assertions.

II. HOW THE AMERICAN TORT SYSTEM IN GENERAL, APART FROM PRODUCTS LIABILITY, ACCOMMODATES TECHNOLOGICAL INNOVATION

The author has argued elsewhere that tort law cannot actively force actors to aspire to innovate.[87] Moreover, in connection with passively allowing such innovation to take place, the American tort system nowhere embraces a broad rule that distributors of innovative technology are, as such, immune from tort. But our tort system does include a number of doctrines that, while they reduce the exposures to liability of all distributors of technology, do so in ways that are especially important to technological innovators. To the extent that these doctrines avoid discouraging innovation and thereby help make it possible for innovation to flourish, this analysis concludes that the American tort system accommodates technological innovation.

Aside from considerations of products liability, American tort law accommodates technological innovation in two basic ways: first, by refusing to impose strict liability on distributors of technology, including innovative technology;[88] and second, by avoiding hindsight-based "gotcha liability" when applying the general negligence standard.[89] These two features of our tort law combine to protect distributors of technology from strict liability for harm caused by latent risks, unknown and unknowable at time of distribution, that surface only after new technology has been widely distributed. Because such latent risks are more likely to accompany new, rather than established, technology and have the potential of imposing crushing liability, removing such risks from the innovator's concerns represents a significant accommodation.[90]

Regarding the first doctrinal adjustment—avoidance of strict liability—courts have not only refused to embrace a general regime of strict enterprise liability under which all commercial enterprises, including distributors of

86. *See supra* notes 3–5 and accompanying text.

87. *See* James A. Henderson, Jr. & Richard N. Pearson, *Implementing Federal Environmental Policies: The Limits of Aspirational Commands*, 78 COLUM. L. REV. 1429, 1431–32 (1978).

88. *See infra* notes 91–95 and accompanying text.

89. *See infra* notes 96–102 and accompanying text.

90. Without this accommodation, the risks presented by tort claims would be uninsurable. *See generally* Patricia M. Danzon, *Tort Reform and the Role of Government in Private Insurance Markets*, 13 J. LEGAL STUD. 517 (1984); Alan Schwartz, *Products Liability, Corporate Structure and Bankruptcy: Toxic Substances and the Remote Risk Relationship*, 14 J. LEGAL STUD. 689 (1985).

new technology, are held liable without fault for causing accidental harms;[91] but they also have excluded the distribution of innovative technology from the categories of extra-hazardous activities that trigger non-products-liability-based strict liability.[92] Regarding hazardous-activity-based strict liability, courts have not included the distribution of products and services within the activities covered by the doctrine.[93] Given that the modern trend in the cases and commentary is against expanding the application of strict liability,[94] in part out of apparent concern that such liability might inhibit industrial development and economic growth,[95] one may conclude that hazardous-activity-based strict tort does not now, and will not in the future, apply to the distribution of disruptive technological innovation, as such.

One might classify our courts' refusals to use time-of-trial hindsight to impose negligence-based liability for previously-unforeseeable harmful outcomes[96] as simply another means of avoiding strict liability,[97] thereby including such refusals as part of the "rejection of enterprise liability" position identified earlier.[98] However, the two positions are better dealt with as separate phenomena. The first type of strict liability does not rest on a case-by-case reasonableness analysis,[99] whereas the second type does.[100] In any event, on the assumption that courts will not allow negligence claims based on allegations that the defendant should have known of the latent risks to undermine the rule against relying on hindsight,[101] tort law's refusal to base

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91. *See generally* Henderson, *supra* note 8.

92. For an enumeration of the activities included within the strict liability rule, see HENDERSON ET AL., *supra* note 3, at 464–65.

93. *See id.* at 465 ("In general, courts have been reluctant to classify the marketing of products as ultrahazardous . . . .").

94. *See id.* at 474 ("[T]he wide-scale adoption of strict liability has not occurred.").

95. *See id.* ("[Writers] contend . . . that the reasons for the slowing of enthusiasm for strict liability in American jurisprudence arise from political and cultural factors, such as the desire to promote industrialization . . . .").

96. *See* RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 3 (AM. LAW INST. 2010).

97. Liability for risks that were not reasonably foreseeable when the defendant acted would be liability without fault.

98. *See supra* notes 91–95 and accompanying text.

99. Courts may employ a "societal cost-benefit" test in deciding which enterprises are to be held strictly liable. *Cf.* RESTATEMENT (THIRD) OF TORTS: LIABILITY FOR PHYSICAL AND EMOTIONAL HARM § 20(b)(1) (AM. LAW INST. 2010) ("the activity creates a foreseeable and highly significant risk of physical harm . . . ."). But once included in a covered category, the individual defendant is liable whether or not he exercised reasonable care. *Id.* § 20(a).

100. After attributing time-of-trial knowledge to the individual defendant for then-unforeseeable risks, the test is one of negligence.

101. Negligence is determined, after all, in part by whether a reasonable person would have foreseen the risk. *See supra* note 96 and accompanying text. If courts were to give this issue to

negligence liability on time-of-trial hindsight accommodates innovative non-manufacturers by relieving them of legal responsibility for previously-unknowable risks, one of the greatest exposures of innovating firms to potentially devastating liability.[102]

To these basic ways that our negligence-based tort system accommodates disruptive technological innovation may be added others of somewhat lesser significance. A few of them will be taken up in Part III's treatment of products liability, where they have greater practical impact in helping innovators avoid potentially existential exposures to liability. It will be useful to consider several examples here, in order to suggest the extent to which courts have variously adjusted tort law to accommodate disruptive technological innovation. The first of these accommodations is the traditional refusal of our courts to let industry custom set the standard of care by which industry participants are judged under the negligence rule.[103] The opposite rule—recognizing conformance to industry custom as a total bar—would create an incentive for firms to remain committed to the status quo.[104] In this regard, coauthors have recently argued that, even under the traditional rule disallowing conformance to custom as a bar to liability, the admissibility of evidence that a defendant deviated from industry custom tends to persuade juries that the innovative defendant has acted negligently, thereby discouraging firms from innovating. They conclude, therefore, that evidence of industry custom should be inadmissible.[105] Reasons exist for questioning these coauthors' conclusions.[106] In any event, the general rule that industry custom does not set the standard of reasonable care, especially when compared with a rule that would equate conformance to custom with due care, represents an important accommodation of disruptive innovation. Moreover, a widely-recognized exception for medical procedures, according to which custom in the profession does set the standard of care,[107] reflects the view that

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the jury in almost every instance, it would very much reduce (but not eliminate) the utility to defendants of the "no hindsight" rule.

102. *See supra* note 90 and accompanying text.

103. *See, e.g.*, The T.J. Hooper, 60 F.2d 737 (2d Cir. 1932).

104. When whether or not to innovate is a close question, and not innovating reduces exposure to liability, some firms will choose not to innovate.

105. *See* Gideon Parchomovsky & Alex Stein, *Torts and Innovation*, 107 MICH. L. REV. 285, 310 (2008).

106. For example, their proposed remedy of refusing to admit evidence of industry custom seems myopic. Defendants legitimately may want to show that their innovative approach is significantly safer than industrial custom, and plaintiffs may legitimately want to use industry custom as their best proof that the untaken safeguard they propose, reflecting industry custom, was technologically feasible. *See id.* at 286–87.

107. *See* HENDERSON ET AL., *supra* note 3, at 213. ("For most courts in medical malpractice cases, professional custom is not just evidence of the standard of care, it *is* the standard of care.").

medical providers should be discouraged from attempting to innovate technologically on their own, individual initiatives.[108]

Another example of how tort law has accommodated disruptive innovation relates to the time-honored rule that purely consequential economic losses—losses that do not flow derivatively and parasitically from physical harm or properly damage—are not recoverable in tort.[109] The rule is important to this Article's analysis because a significant share of disruptive, breakthrough innovation in recent decades has directly or indirectly involved information technology (IT),[110] and in most instances, the losses caused when IT fails to perform as expected are purely economic in nature.[111] This analysis defers to Part III issues relating to whether IT breakthroughs are products within our products liability system. The point here is that, however our courts eventually answer such questions for products liability purposes, the general rule against tort recovery for purely economic losses largely renders those answers moot. To be sure, failures of IT are capable of causing the sorts of physical harms for which tort law traditionally allows recovery.[112] As subsequent discussions in Part III will reveal,[113] however, our products

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108. Consistent with usage throughout this Article, technological innovation does not include defensive medicine in the form of providers ordering redundant, unnecessary medical tests, or referring patients for third and fourth opinions. Concerned with the potential wastefulness of such practices, a scholar has criticized the profession-standards rule for encouraging ever-increasing redundancy of treatments through a ratcheting process based on "doctrinal feedback"—as physicians invoke more and more wasteful treatments, the standard moves to embrace them and further redundancy is necessary to provide the desired cushion from exposure to liability. *See* James Gibson, *Doctrinal Feedback and (Un)reasonable Care*, 94 VA. L. REV. 1641, 1641 (2008). However, even if the author's thesis holds true for defensive medicine, it misses the mark regarding what might be termed "offensive medicine"—technologically innovative, improved methods of performing risky, complex medical procedures. In the latter context, which is this Article's focus, society is arguably better off leaving the development of experimental improvements not to individual providers but to leaders in the profession working in major medical centers. Thus, the tort law rule deferring the setting of standards to the medical profession may generate wasteful defensive medicine, but it helps to avoid potentially disastrous examples of offensive medicine by individual providers conducting radically innovative experimentation at the local, or individual, level.

109. *See, e.g.*, E. River S.S. Corp. v. Transamerica Delaval, Inc., 476 U.S. 858, 874–75 (1986); *see generally* HENDERSON & TWERSKI, *supra* note 3, at 619.

110. *Cf.* authorities cited *supra* note 18. Of the twelve books on innovation listed, seven focus significantly or entirely on the development of IT.

111. Software failures, including inadequate security, typically lead to accounting errors, identify theft, and the like. *See, e.g.*, Juliet M. Moringiello, *Warranting Data Security*, 5 BROOK. J. CORP. FIN. & COM. L. 63 (2010).

112. The sorts of cases are not hard to fathom. Every time that software is incorporated into aircraft, motor vehicles, medical equipment, or the like, errors in the software may lead to accidents causing physical harm.

113. *See infra* notes 135–38 and accompanying text.

liability system affords commercial distributors of IT significant protection from liability even when plaintiffs suffer physical injury.[114]

III. HOW THE AMERICAN PRODUCTS LIABILITY SYSTEM ACCOMMODATES DISRUPTIVE TECHNOLOGICAL INNOVATION

A. Products Liability is the Innovator's Major Tort Concern

Reflecting their inherently instrumental character,[115] successful technological breakthroughs invariably evolve into commercially-distributed products and services,[116] the safety-based review of which generally falls to courts in our products liability system.[117] Whether or not entirely deserved, American products liability law's historical emphasis on strict liability[118] has generated an intimidating reputation in the minds of many observers and would-be reformers.[119] That the American Law Institute in the early 1990s chose products liability as the first subject to be covered in its ambitious

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114. *See infra* note 137 and accompanying text.

115. *See supra* text accompanying notes 23–24.

116. *See* GERTNER, *supra* note 18, at 107 ("[A]n innovation [refers to] the lengthy and wholesale transformation of an idea into a technological product (or process) meant for widespread practical use."); *cf. supra* note 23 and accompanying text.

117. Federal administrative agencies play an important role in some areas, including prescription products, and can have a significant impact on innovation. *See generally* JOSEPH V. GULFO, INNOVATION BREAKDOWN: HOW THE FDA AND WALL STREET CRIPPLE MEDICAL ADVANCES (Post Hill Press ed., 2014). For a discussion of why judicial review is indispensable, see HENDERSON & TWERSKI, *supra* note 3, at 184–86.

118. Section 402A of the Restatement (Second) of Torts, adopted in 1965, imposed liability on commercial sellers of products for harm caused by time-of-sale defects and included, in subsection (2), the language: "The [liability] rule . . . applies although (a) the seller has exercised all possible care in the preparation and sale of his product . . . ." RESTATEMENT (SECOND) OF TORTS § 402A (AM. LAW INST. 1965). This led some courts and commentators to insist that the strict liability rule applied to design-related generic risks as well as risks created by manufacturing defects. *See generally* James A. Henderson, Jr., *Judicial Review of Manufacturers' Conscious Design Choices: The Limits of Adjudication*, 73 COLUM. L. REV. 1531, 1554 (1973). By the time the Restatement (Third) of Torts on Products Liability Sections 1 and 2 were adopted in 1998, a large majority of courts had adopted a risk-utility test for generic defects. *See* RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY § 2 cmt. a, d–f (AM. LAW INST. 1998). But, the historical roots of our products liability system are to be found in Section 402A's commitment to strict liability. *See* RESTATEMENT (SECOND) OF TORTS, *supra*.

119. *See, e.g.*, W. Kip Viscusi & Michael J. Moore, *Rationalizing the Relationship Between Liability and Innovation*, *in* TORT LAW AND THE PUBLIC INTEREST: COMPETITION, INNOVATION, AND CONSUMER WELFARE 105–06 (Peter H. Schuck ed., 1991) ("[One of the main topics in] the product liability reform debate has been the product liability-innovation linkage. . . . The most prominent view in the literature on product liability reform is that product liability imposes costs that hit new products particularly hard . . . .").

Restatement (Third) of Torts project[120] suggests that the products area was important and required clarification.[121] Why should distributors of innovative technology, which one may assume provides more effective methods of accomplishing a variety of human objectives, be particularly concerned with their exposures to tort, even if the products liability system has become a formidable foe for distributors of established, less remarkably beneficial technology? The answer, of course, lies in the reality that new technology, while it often confers enormous benefits, sometimes carries generic risks for which the commercial distributors may be held massively liable. As the preceding Part II explains, apart from products liability, our tort system generally avoids imposing either strict or negligence-based liability for originally-unknowable risks based on time-of-trial hindsight.[122] But, products liability has traditionally prided itself for embracing strict liability.[123] The analysis in this Part III sorts all of this out, concluding that our products liability system, although it continues to cling to a "strict liability" mantra,[124] accommodates innovative technology in a host of different ways, including avoiding design-based liability for unknowable generic risks.[125]

B. How the Substantive Law of Products Liability Accommodates Disruptively Innovative Technology

1. Identifying the Building-Block Elements of American Products Liability

The basic rule of our products liability system is set forth in the Products Liability Restatement: "One engaged in the business of selling or otherwise

120. *See generally* RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY (AM. LAW INST. 1998). The author served with Aaron D. Twerski as co-reporter on the project.

121. *See id.* at xvi. ("Professor Max Radin once famously analogized the development of common-law rules to the twisting and sometimes misdirected course of a runaway calf. . . . The law of products liability certainly was such. This Restatement puts this body of law much straighter.").

122. *See supra* text accompanying note 96.

123. *See supra* note 118 and accompanying text.

124. *See, e.g.*, Potter v. Chi. Pneumatic Tool Co., 694 A.2d 1319, 1332 (Conn. 1997) ("[I]n some instances, a product may be in a defective condition unreasonably dangerous to the user even though no feasible alternative design is available. In such instances, the manufacturers may be strictly liable for a design . . . .").

125. Both Sections 2(b) and 2(c) of the Restatement (Third) of Torts on Products Liability, dealing with design and warning defects, require the relevant risks to be foreseeable at the time of distribution by the defendant. RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY § 2(b)–(c) (AM. LAW INST. 1998).

distributing products who sells or distributes a defective product is subject to liability for harm to persons or property caused by the defect."[126] The discussions that follow describe how the meanings courts have given to the basic concepts of products liability limit the exposures to liability of commercial distributors of innovative technology. Products, in most instances, are tangible personal property.[127] Products may include other items, including intangibles, where the context surrounding their distribution is sufficiently analogous to the distribution of tangible personal property to make it appropriate to include them.[128] Products do not include services, even when provided commercially.[129] One otherwise distributes a product when, in a commercial transaction other than a sale, one provides the product for immediate or eventual use or consumption.[130] And finally, a product is defective when, at the time of commercial sale or distribution, it contains a manufacturing defect (an inadvertent departure from the product's intended design),[131] is defective in design (the design is unreasonably dangerous),[132] or is distributed without reasonably adequate instructions or warnings[133]. This bare-bones summary will suffice to allow sense to be made of how our courts have accommodated innovative technology and avoided exposing commercial distributors to potentially crushing, existential liability.

2. Defining "Products" to Exclude Areas of Technology that Would Be Especially Problematic for Innovators

It will be recalled that one commercial area that has produced a dramatic explosion of innovation in recent years is information technology (IT), and that the rule against tort recovery for purely consequential economic loss has protected distributors in that area from significant exposures to tort liability.[134] In parallel with these developments under general tort principles, courts have also excluded commercial distribution of IT from the reach of our products liability system.[135] Notwithstanding these developments in

126. *Id.*§ 1.

127. *See id.* § 19(a) ("A product is tangible personal property distributed commercially for use or consumption.").

128. *See id.*

129. *See id.* § 19(b).

130. *See id.* § 20(b).

131. *See id.* § 2(a).

132. *See id.* § 2(b).

133. *See id.* § 2(c).

134. *See supra* note 111 and accompanying text.

135. Although the caselaw is sparse and confusing, coauthors recently observed: "Strict products liability cases are a significant branch of traditional tort law. In contrast, no cybertorts-plaintiff [advancing an IT-related tort claim] has received either an equitable or legal remedy

connection with economic losses, one might reasonably have assumed that commercial providers are liable for physical harm to persons and property caused by allegedly defective informational elements of IT.[136] But even when alleged software defects cause physical harm, courts have denied recovery on the ground that the informational elements of IT are not products.[137] The picture that emerges from an extensive review of the relevant case law is one of a tangled web of doctrinal constraints that, taken together, significantly limit, if not eliminate, the exposure to liability of distributors of IT. Such limits on recovery are quite significant, given the extent to which IT has dominated the innovation scene in the past several decades. Moreover, even if IT commerce were to be included within products liability, the validity of claims of defective design and failure to warn would be determined not on the basis of strict liability but rather on the basis of negligence.[138]

This pattern of courts excluding from products liability coverage potentially problematic areas by restricting what constitute products repeats itself in other contexts of special relevance to innovators, including the non-electronic distribution of information and ideas. Books and other physical vehicles for delivering information are products;[139] but the ideas and information contained in them are not.[140] Thus, if an innovator sells or

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based upon any theory of strict liability. . . . Courts have yet to extend products liability theories to bad software, computer viruses, or web sites with inadequate security or defective design." Michael L. Rustad & Thomas H. Koenig, *Cybertorts and Legal Lag: An Empirical Analysis*, 13 S. CAL. INTERDISC. L.J. 77, 135 (2003). Although products liability claims based on defective IT have not gained traction, the same coauthors indicate that a variety of intentional torts, including business torts, trespass to chattels, and defamation, have made headway. *See id.* at 92–93. Another group of coauthors, after a presumably diligent search for authority supporting their proposal that courts should include software in the products liability system, conclude: "To date, there have been no reported cases holding a software manufacturer strictly liable for defects in the software." *See* 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 COMPUTER & HIGH TECH. L.J. 745, 766 (2005).

136. For a description of typical cases, see *supra* note 112. As a general rule, courts allow recovery in products liability cases for physical harm. RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY § 1 (AM. LAW INST. 1998). Indeed, when software causes a motor vehicle to crash the motor vehicle manufacturer will be liable for physical harms caused by the crash. *See, e.g.*, *In re* Toyota Motor Corp. Unintended Acceleration Mktg., Sales Practices, & Prods. Liab. Litig., 978 F. Supp. 2d 1053 (C.D. Cal. 2013)

137. *See, e.g.*, James v. Meow Media, Inc., 300 F.3d 683, 700–01 (6th Cir. 2002) (holding that parents of school shooting victim failed to state a strict liability claim against game software makers and parties maintaining websites because those parties did not deal in "products").

138. *See infra* notes 147–48 and accompanying text.

139. *See* RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY § 19 cmt. d (AM. LAW INST. 1998) ("[A] tangible medium such as a book [is] itself clearly a product . . . ."). In parallel fashion, a unit of computer hardware would seem clearly to be a product.

140. *See, e.g.*, Winter v. G.P. Putnam's Sons, 938 F.2d 1033, 1037 (9th Cir. 1991); *see also* RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY § 19 cmt. d (AM. LAW INST. 1998) ("[T]he plaintiff's grievance in . . . cases [against book publishers] is with the information, not with the

licenses a new design to others who manufacture and distribute product units based on that design, the seller or licensor of the design is not strictly liable for harm caused by the units distributed by the licensees even if the designs of those units are defective.[141] Another example of courts excluding commercially-distributed intangibles from the definition of products in a context relevant to this inquiry concerns the generation and delivery of electrical power. A few courts have excluded electricity from the products liability system altogether.[142] Some have suggested that electricity becomes a product after it has passed through a customer's meter.[143] Thus, so long as examples of innovative technology relate to the generation and wholesale distribution of electrical power, they are not within the reach of strict products liability.

3. Defining "Defectiveness" to Reduce the Exposures to Liability of Product Innovators

It is indisputably true that commercial distributors of products, whether innovative or not, that contain manufacturing defects—inadvertent departures from the intended design—are strictly liable in tort for harm caused by the defect.[144] But, distributors of innovative technology are no more concerned with liability for manufacturing defects than are the distributors of established technology.[145] Instead, what keeps innovators awake at night is

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tangible medium. Most courts . . . have, appropriately, refused to impose strict products liability in these cases."). Several courts have held that aeronautical charts are products. *See, e.g.*, Saloomey v. Jeppesen & Co., 707 F.2d 671, 677 (2d Cir. 1983).

141. The Restatement (Third) of Torts on Products Liability explicitly exempts trademark licensors from liability on doctrinal grounds that would seem to apply equally well to licensors of product designs. *See* RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY § 14 cmt. d (AM. LAW INST. 1998) ("[T]he licensor, who does not sell or otherwise distribute products, is not liable under . . . this Restatement."). This approach would appear to exempt consulting firms specializing in innovating (but not manufacturing) on behalf of others. For descriptions of such firms, see generally KELLEY, *supra* note 18; PAYNE, *supra* note 18. Of course, the sellers and licensors of innovative designs may be exposed to liability outside of the products liability system for harm proximately caused by their negligence.

142. *See, e.g.*, Curtiss v. Ne. Utils, No. CV92-0511572-S, 1994 WL 702690 at *3 (Conn. Super. Ct. 1994) (finding that electricity is natural and not manufactured).

143. *See, e.g.*, Otte v. Dayton Power & Light Co., 523 N.E.2d 835, 840 (Ohio 1988).

144. *See* RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY §§ 1, 2(a) (AM. LAW INST. 1998).

145. Manufacturing defects occur in a very small percentage of most product production runs. *See* HENDERSON ET AL., *supra* note 3, at 479. No plausible reasons exist for believing that generic innovations, as such, are more likely to cause manufacturing defects, or that the harm such defects cause are likely to be more severe. Moreover, even on worst-case assumptions, manufacturing defects occur so infrequently, and are so insurable, that they should not cause innovators to lose sleep.

the prospect of being strictly liable for harm caused by the generic risks associated with innovative technology, especially if those risks are unknown and unknowable at the time of distribution.[146] Here is where the definitions of design and warning defects help to allay such fears. Most American jurisdictions apply a reasonableness standard for judging the design and marketing safety of products;[147] from the manufacturer's standpoint, the operative test for defectiveness is negligence.[148] That the standard for generic defects is fault-based carries several significant implications. First, generic risks presented by products are judged as of the time of original distribution, not time of trial, eliminating distributors' liability for risks that were unknown and scientifically unknowable at the time of original distribution.[149] Of course, the issue of knowability in many cases will be for the trier of fact. Moreover, plaintiffs may also argue that even if the risks that materialized in their harms were generally unknown at the time of original distribution, the defendant should have discovered them sooner and issued post-sale warnings in time to prevent plaintiff's injuries.[150] Given that the burden of proof in both time-of-marketing and post-marketing contexts is substantial and is on the plaintiffs, defendants should prevail as a matter of law in a majority of such instances.[151]

The most interesting question in predicting the likely impact of products liability law on innovative technology is whether our courts will attempt to judge the reasonableness of the unique set of risks associated with the design features that render some product innovations disruptive. For example, if an innovator were to propose that the traditional bicycle be replaced by a propeller-driven seat suspended from the ground on cushions of downward-

146. *See* HENDERSON & TWERSKI, *supra* note 3, at 179 ("Unlike manufacturing defects, if you condemn one unit as generically defective, you condemn them all . . . . [A] manufacturer can wake up one morning and find itself confronted with the real possibility that all the products it has sold for the last 20 years (all 450 billion of them) are legally defective.").

147. *See* RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY § 2 cmt. d (AM. LAW INST. 1998) ("Subsection (b) [defining design defects] adopts a reasonableness ('risk-utility balancing') test. . . ."); *see also id.* § 2 cmt. i ("Commercial product sellers must provide reasonable instructions and warnings about risks of injury posed by products.").

148. *See id.* § 2 cmt. d ("[The] approach [most courts use in assessing the adequacy of product design] is also used in administering the traditional reasonableness standard in negligence.").

149. *See id.* § 2 cmt. m ("[H]arms that result from unforeseeable risks—for example, in the human body's reaction to a new drug, medical device, or chemical—are not a basis of liability.").

150. *See id.* § 10.

151. Regarding post-sale warnings, see *id.* cmt. a ("[A]n unbounded post-sale duty to warn would impose unacceptable burdens on product sellers . . . . [A]s product designs are developed and improved over time, many risks are reduced or avoided by subsequent design changes. If every post-sale improvement in a product design were to give rise to a duty to warn users of the risks of continuing to use the existing design, the burden on product sellers would be unacceptably great.").

forced air—an "airbike," if you will—would courts allow a plaintiff to attack the core idea of the new design as unreasonable without being required to show how the defendant's core idea could be retained by using a marginally safer variation of the "airbike?" Attempting such categorical judgments would challenge the traditional limits of adjudication by requiring courts to assess the social acceptability of fundamentally new and different technological paradigms.[152] And negative judicial assessments regarding the very foundations of disruptive technological innovations, by condemning whole product categories, would almost certainly be existential in their magnitude.[153] However, products liability law once again rescues both courts and technological innovators from such dire straits with a rule denying the imposition of liability based on what observers refer to as categorical design risks—unavoidable risks that by definition inhere in the conceptual category of which the innovative product that harmed the plaintiff is one, but not the only, example.[154] Thus, under our products liability law, one may plausibly attack a bicycle design for being unreasonably unstable because its handlebars are several inches too short;[155] but one may not plausibly attack a bicycle design for being unstable because it has two, instead of three, wheels.[156] The first of these claims proffers a marginal improvement of what clearly remains a bicycle; the second constitutes a categorical attack on the very concept of the bicycle as a two-wheeled, pedal-driven means of transportation. The first may present a viable design claim; the second does not. Our courts reject categorical attacks on product designs for a

152. Deciding whether the hypothetical "airbike" in the preceding note were reasonably safe in light of all the social costs and benefits would be more difficult than would be deciding, for example, whether the handle-bars of the traditional bicycle should be two inches longer, for added stability. *See* Henderson & Twerski, *supra* note 15, at 1298–1300; *cf. infra* note 155 and accompanying text.

153. In the airbike hypothetical, *supra* notes 151–52 and accompanying text, if the plaintiff were to succeed in condemning the very idea of a one-person, air-suspended vehicle, then a start-up firm based on that innovative concept would likely have no further reason to exist. Presumably, most firms can survive successful non-categorical, marginal attacks on their product designs; but successful categorical attacks would likely to be fatal.

154. *See* RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY § 2 cmt. d (AM. LAW INST. 1998) ("[C]ourts have not imposed liability for categories of products that are generally available and widely used and consumed, even if they pose substantial risks of harm."). The only exception to this rule is for categories that are "manifestly unreasonable"—i.e., have very low social utility and very high levels of risk. *See id.* cmt. e.

155. For a discussion of this hypothetical, see Henderson & Twerski, *supra* note 15, at 1298–1300. For the general rule requiring plaintiff to prove the availability to defendant of a marginal, reasonable alternate design, see RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY § 2(b) (AM. LAW INST. 1998).

156. A three-wheel cycle is not a variation of a bicycle; it is a tricycle, a different product category.

combination of reasons including the belief that basic, categorical product-design choices—for example, whether to prefer cycles over airbikes, or bicycles over tricycles—are best left to consumers in the marketplace, constrained only by legislative and administrative, rather than judicial, regulation.[157]

It follows that American products liability law does not generally countenance second-guessing regarding the trade-offs embedded in the disruptiveness, as such, of disruptive innovation. Although courts may occasionally make exceptions where the embedded trade-offs reflect extremely bad judgment,[158] the plaintiff's burden in such instances should prove difficult to carry.[159] Of course, a tort plaintiff may attack disruptive new technology marginally by tacitly accepting the disruptive aspects but arguing that the product design before the court could have been made safer without rejecting the innovative new category of which it is an example.[160] But, distributors of products based on disruptive innovation have nothing more—one could plausibly argue they have less—to fear regarding the possibility that their products will be found to be defectively designed than do distributors of products based on established, time-tested technology.[161]

4. Overriding the Dictates of Doctrine in Discrete Product Areas in Order to Shelter Innovative Technology from Liability

If the products liability system's accommodations of innovative technology described in the preceding discussions could be said to be doctrinally derived, the accommodations to be considered here reflect policy-based overrides of products liability doctrine and thus could be said to be

157. *See* RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY § 2 cmt. d (AM. LAW INST. 1998) ("Courts have not imposed liability for categories of products that are generally available and widely used and consumed, even if they pose substantial risks of harm.").

158. *See id.* § 2 cmt. e.

159. *See* James A. Henderson, Jr., *A Discussion and a Defense of the Restatement (Third) of Torts: Products Liability*, 8 KAN. J.L. & PUB. POL'Y 18, 22 (1998) (Very few claims based on the exception should succeed).

160. *See* RESTATMENT (THIRD) OF TORTS: PRODUCTS LIABILITY § 2(b) (AM. LAW INST. 1998) (requiring that a plaintiff prove that a reasonable, safer alternative design was available at the time of original sale or other distribution.) A pair of authors suggest that such lower-level, marginal attacks actually encourages what this Article refers to as sustaining innovation. *See* Viscusi & Moore, *supra* note 119, at 122–23.

161. Plaintiffs attacking the design of a disruptively innovative new product may have a more difficult time establishing a reasonable alternative design than would plaintiffs attacking an established product design that has been on the market long enough to have been subjected to extended study and second-guessing.

nakedly policy-driven.[162] The first of these overrides relates to prescription products, including drugs and medical devices. Under the law generally applicable to product designs, one might have expected that courts would judge the reasonableness of the designs of prescription products as they would the reasonableness of the design of other commercially-distributed products,[163] such as the bicycle designs earlier considered.[164] However, for important reasons of policy that the author explores at greater length elsewhere,[165] American courts have traditionally refused to review the reasonableness of prescription product designs, listening only to claims for generic hazards based on failures to warn.[166] This fact is especially significant in the context of this Article because the prescription-drug and medical-device industries are among the most disruptively innovative on the planet.[167] Thus, the traditional no-design-liability rule for prescription products constitutes an important accommodation of technological innovation. Although the trend in some jurisdictions in recent years has been for courts to engage in prescription product design review,[168] the legal bases for such review are sufficiently limited that significant accommodations of the prescription products industries will almost certainly persist into the future.[169]

Another policy-driven override of traditional products liability doctrine that has important implications for distributors of innovative technology involves the government contractor defense.[170] When a manufacturer designs a product for the federal government and the government approves the design specifications, unless the manufacturer has failed to warn of important risks

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162. Of course, the first category of accommodations also reflect policy considerations (as do all functional elements of a legal system); the policy considerations supporting accommodations in this second category simply have a bolder profile.

163. For an argument to this effect, see George W. Conk, *Is There a Design Defect in the Restatement (Third) of Torts: Products Liability?*, 109 YALE L.J. 1087, 1118 (2000) (prescription drug design should be handled in the same fashion as product designs generally).

164. *See supra* notes 155–57 and accompanying text.

165. *See generally* James A Henderson, Jr. & Aaron D. Twerski, *Drug Designs are Different*, 111 YALE L.J. 151 (2001).

166. *See, e.g.*, Brown v. Superior Court, 751 P.2d 470, 475–77 (Cal. 1988).

167. The prescription drug and medical devices industries are among the most innovative industries in our economy. *See The World's Most Innovative Companies*, FORBES (Aug. 19, 2015), http://www.forbes.com/innovative-companies/list/#tab:rank (Four out of the top ten companies are pharmaceuticals. Three of those four are American companies).

168. *See* Brown, 751 P.2d at 477–78; RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY § 6(c) (AM. LAW INST. 1998); Henderson & Twerski, *supra* note 165, at 174.

169. To date, no court has gone to the extreme of treating allegedly defective prescription product designs the same as other products. *See generally* James A. Henderson, Jr. & Aaron D. Twerski, *Drug Design Liability: Farewell to Comment K*, BAYLOR L. REV (forthcoming 2015), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2600601##.

170. *See, e.g.*, Boyle v. United Techs. Corp., 487 U.S. 500, 510 (1988); *see generally* HENDERSON & TWERSKI, *supra* note 3, at 531–33.

it will not be liable in tort for harm caused by alleged defects in the design.[171] Because many of the products sold to the government—products such as state-of-the-art military aircraft and armored vehicles—are likely to incorporate highly innovative technology, sheltering civilian contractors from design-based liability represents a significant accommodation of innovation of the sort explored in this Article. As with the shelter enjoyed by the pharmaceutical industry,[172] one of the avowed purposes of the government contractor defense shields innovators and their firms from pressures that might otherwise distort their efforts to be creative in meeting the special technological requirements of governmental agencies.[173]

Yet another significant accommodation of disruptive technological innovation finds its source not in products liability doctrine or policy, which are mostly creatures of state law, but in the constitutional principle of federal supremacy. Whenever the imposition of tort liability under state law would significantly conflict or otherwise interfere with a regulation issued, or a regulatory scheme commenced, by Congress or by a federal administrative agency, courts deem the federal regulation or regulatory scheme to have preempted the relevant state tort law, rendering the latter null and void.[174] Federal preemption comes in several different flavors: express and implied, with two variations of implied.[175] Although preemption law can be frustratingly muddled,[176] this much is clear: because the areas into which Congress is apt to send non-judicial federal safety regulators are likely to be ones in which technological innovation is common and recurrent;[177] and because federal safety regulations in those areas are likely to impose performance rather than design standards, leaving firms relatively free to innovate;[178] it follows that federal preemption represents a significant means of accommodating disruptive innovation in our products liability system.

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171. *See* HENDERSON & TWERSKI, *supra* note 3, at 531–32 ("When a manufacturer has designed a product for the military in accordance with federal government specifications, the government contractor defense may shield it from liability.") (citing Boyle v. United Techs. Corp., 478 U.S. 500, 512 (1988)).

172. *See supra* notes 165–69 and accompanying text.

173. *See Boyle*, 487 U.S. at 512–13 ("We adopt [the government contractor defense] . . . to protect discretionary functions . . . .").

174. *See generally* HENDERSON & TWERSKI, *supra* note 3, at 444–61.

175. *See id.* at 441.

176. *See id.* at 441–42.

177. Two high-profile product areas in which preemption issues arise are prescription drugs and devices and motor vehicles, both of which have traditionally involved high levels of disruptive innovation. *See, e.g.*, PLIVA, Inc. v. Mensing, 131 S. Ct. 2567, 2582 (2011) (generic drug manufacturers shielded from liability); Geier v. Am. Honda Motor Co., 529 U.S. 861, 874–76 (2000) (automobile airbags).

178. The FDA leaves pharmaceutical companies free to direct their research efforts as they choose, reviewing new drugs and medical devices for their efficacy and risk, only after the fact

C. Procedural and Evidentiary Aspects of the American Products Liability System That Help to Accommodate Innovative Technology

The aspects about to be considered constitute what might be characterized as the "process dimensions" of our products liability system. While they ameliorate the rigors of the torts process, they are less central to this Article because they are less pointedly aimed at, or related to, product innovation. Before proceeding to consider specific examples it should be understood that as a practical matter these process dimensions, together with higher damages awards for similar injuries, present a much sharper contrast with foreign liability systems than do substantive liability doctrines. If one thinks of these costs as a form of litigation tax, the tax is much higher in our courts than in foreign courts.[179] However, as will be explained in the next section, the tax is borne not only by American firms but also by foreign firms that sell products in this country and thus become defendants in tort actions brought in American courts. Thus, the relatively higher litigation taxes in this country do not appear to burden American firms, any more than foreign firms, to an extent that is disproportional to the amount of business they do in this country.

On the procedural side, the class action is part of the broader methodology of "mass tort" that threatens to increase the exposure to liability of distributors of allegedly defectively designed and mass-marketed products.[180] Disruptive technological innovation, when it turns out badly and

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of development. 21 U.S.C. § 355 (West 2013); *see generally What is the Approval Process for a New Prescription Drug?*, U.S. FOOD & DRUG ASS'N (Oct. 19, 2015), http://www.fda.gov/AboutFDA/Transparency/Basics/ucm194949.htm. The National Highway Traffic Safety Administration tends to promulgate motor vehicle safety standards in terms of minimum performance levels, leaving manufacturers free to decide how best to design their vehicles to achieve those levels. 49 U.S.C. § 30101 (2012); *see generally Who We Are and What We Do*, U.S. NAT'L HIGHWAY TRAFFIC SAFETY ADMIN. (2015), http://www.nhtsa.gov/About+NHTSA/Who+We+Are+and+What+We+Do. An excellent example of a performance standard is found in *BIC Pen Corp. v. Carter*, 251 S.W.3d 500, 503 (Tex. 2008).

179. *See* Stephen B. Presser, *How Should the Law of Products Liability be Harmonized? What Americans Can Learn from Europeans*, 2 GLOB. LIAB. ISSUES 1, 13 (2002), http://www.manhattan-institute.org/pdf/gli_2.pdf (Dow Chemical Corporation estimates it spends 100 times on litigation costs per unit of sales compared with similar costs in Europe).

180. *See generally* PRINCIPLES OF THE LAW OF AGGREGATE LITIGATION § 3.10 (AM. LAW INST. 2010); HENDERSON & TWERSKI, *supra* note 3, at 719 ("The scope of . . . mass tort actions is breathtaking [in that] one court might dispose of thousands of cases arising from 50-plus jurisdictions in one fell swoop . . . ."); Roger C. Cramton, *Individualized Justice, Mass Torts, and "Settlement Class Actions": An Introduction*, 80 CORNELL L. REV. 811, 812–13 (1995); William H. Rehnquist, *Welcoming Remarks: National Mass Tort Conference*, TEX. L. REV. 1523, 1524 (1995).

dangerously, may be especially vulnerable in this regard.[181] However, in all federal, and some state, jurisdictions, courts hesitate to certify classes based on tort claims, including products liability claims.[182] Moreover, a federal statute provides that any class action commenced in state court that allows class actions may be removed to the appropriate federal district court, thereby allowing the defendant to invoke federal law in urging the court to decline certification.[183] To these important procedural accommodations may be added the Supreme Court's commitment to due-process-based review of the procedures by which state and federal courts assess punitive damages in the types of tort actions plaintiffs are likely to bring against distributors of innovative technology.[184] Once again, this constitutional constraint on punitive damages[185] applies broadly; but the distributors of new technology are arguably among its more significant potential beneficiaries.[186]

In addition to the just-described procedural accommodations, our products liability system includes several adjustments of the rules of evidence that combine to lower the exposures to liability of distributors of new technology. Certainly the most important of these adjustments is the Supreme Court's interpretation of the Federal Rules of Evidence to require federal courts to review expert testimony to make sure that it reflects and is supported by respectable scientific methodology.[187] Once again, this rule constraining expert testimony applies generally and is not limited to actions involving innovative technology. But given that such actions are especially likely to

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181. Mass tort litigation involving new prescription drugs and medical devices are good examples. *See, e.g.*, Klein v. O'Neal, Inc., 222 F.R.D. 564, 566 (N.D. Tex. 2004) (certifying class for infant plaintiffs who were administered the drug E-Ferol); Davis v. Am. Home Prods. Corp., 844 So. 2d 242, 246–47 (La. Ct. App. 2003) (certifying class in strict liability action against the manufacturer of Norplant contraceptive device).

182. *See, e.g.*, *In re* Fibreboard Corp., 893 F.2d 706, 712 (5th Cir. 1990) ("[T]oo many disparities [exist] among the various plaintiffs for their common concerns to predominate . . . . To create the requisite commonality for trial, the discrete components of the class members' claims and the asbestos manufacturers' defenses must be submerged.").

183. *See* Class Action Fairness Act of 2005, Pub. L. No. 109-2, 119 Stat. 4 (West 2005); *see generally* HENDERSON & TWERSKI, *supra* note 3, at 722.

184. *See* Philip Morris USA v. Williams, 549 U.S. 346, 346–47 (2007); State Farm Mut. Auto. Ins. Co. v. Campbell, 538 U.S. 408, 409 (2003); *see generally* Thomas B. Colby, *Clearing the Smoke From* Philip Morris v. Williams*: The Past, Present, and Future of Punitive Damages*, 118 YALE L.J. 392, 392 (2008); Dan Markel, *How Should Punitive Damages Work?*, 157 U. PA. L. REV. 1383, 1392 (2009).

185. The constraint clearly runs to the amounts of the awards as well as to the related procedures. *See* HENDERSON & TWERSKI, *supra* note 3, at 686.

186. Especially to the extent that distributors of new technology are likely to be targets in mass tort proceedings of the sort discussed earlier, see *supra* notes 180–83, and given that juries may be inclined to be suspicious of new products that end up harming multitudes of victims, innovators would benefit somewhat more than others from federal limits on punitive damages.

187. *See* Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 579–80 (1993).

rely on expert scientific testimony on both sides, innovators are likely to be disproportionally benefited by evidentiary rules aimed at excluding spurious experts who rely on what is commonly referred to as "junk science." In any event, the traditional rule that this new evidentiary approach replaces—that, to be admissible, expert testimony must conform to the prevailing consensus in the relevant scientific community[188]—is arguably anti-innovation in much the same way as would total deference to industry custom.[189] Under the new approach, if the trial court determines after a separate hearing that the expert testimony represents bad science, the court excludes the evidence and, if it is proffered by the plaintiff and is vital to the plaintiff's claim, the court grants defendant's motion for judgment as a matter of law.[190] Judicial review of the technical legitimacy of the plaintiff's expert's testimony is particularly important to distributors of innovative technology who find themselves defending products liability actions-based on the allegedly defective design and marketing of their products.[191] The Supreme Court decision mandating review of expert testimony, being based on federal evidentiary rules, is binding only in federal courts.[192] Nevertheless, a number of states have chosen to follow the federal lead.[193] Because distributors of innovative technology are likely to attract tort claims based on questionable expert testimony,[194] this regime of judicial screening of expert testimony is an important evidentiary accommodation of innovative technology.

Another evidentiary rule, aimed more pointedly at the products liability exposures of distributors of new technology, concerns the admissibility in a design or warnings case of evidence that the defendant manufacturer adopted an improved design—which improvement often takes the form of sustaining or disruptive innovation—after distribution of the product unit that harmed

188. *See* Frye v. United States, 293 F. 1013, 1014 (D.C. Cir. 1923).

189. *See supra* notes 103–08 and accompanying text. Assuming that consensus in the scientific community is functionally equivalent to industry custom, and assuming that a rule allowing defendant's adherence to custom as a complete bar to plaintiff's claim for generic product risks would be anti-innovative; then an evidentiary rule disallowing expert opinions that were not part of a scientific consensus might well discourage firms from venturing into innovations where some, at least, of the relevant science had yet not reached consensus. Stated somewhat differently, the *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923) rule, *supra* note 188 and accompanying text, might discourage *new* science even if such science were not necessarily *bad* science.

190. That was the procedural outcome on remand to the federal court of appeals in *Daubert*, 509 U.S. at 597–98. *See* Daubert v. Merrell Dow Pharm., Inc., 43 F.3d 1311, 1322 (9th Cir. 1995).

191. Especially when the relevant technology is new, plaintiff may find it more difficult to find experts with which to establish the crucial elements of defectiveness and causation based on good science. *Cf. supra* note 161 and accompanying text.

192. *See* HENDERSON & TWERSKI, *supra* note 3, at 131.

193. *See id.* at 132.

194. *See supra* note 191.

the plaintiff. Such evidence is especially damaging to defendants because it may be assumed that triers of fact will construe it to be a confession of fault—an admission that the harm-causing product distributed prior to the subsequent improvement was unreasonably dangerous and therefore legally defective.[195] Were such evidence freely admissible, firms might hesitate to market marginal design improvements. However, given the likelihood that triers of fact will misuse the evidence in this prejudicial manner, courts in most American jurisdictions limit the admissibility of such evidence to the issue of the whether the design or marketing alternatives advanced by the plaintiff were technologically feasible when the harm-causing product was originally distributed.[196] Because most defendants in such circumstances readily admit technical feasibility, thus rendering the evidence of post-sale modification irrelevant, the evidentiary rule of limited admissibility functions in most cases to exclude the evidence altogether.[197] Thus, the evidentiary rule eliminates a possible disincentive for firms to engage in product innovation.

D. Little Remains to Support the Hypothesis that Our Products Liability System Handicaps American Firms in Global Markets

As noted at the outset, some critics assert that the American products liability system is excessively burdensome to manufacturers, especially those that produce and distribute disruptively innovative technology.[198] Critics also have argued that the system handicaps our firms in global competition.[199] A number of observers disagree with these pessimistic assessments, including writers who rely on empirical data.[200] Beyond this ongoing debate, which this

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195. The product improvement is not, legally, an admission of fault. But jurors are likely to see it as exactly that: "they improved the product because they must have known that something was dangerously wrong with it."

196. In federal courts, the rule limiting admissibility is codified in the Federal Rules of Evidence, Rule 407. FED. R. EVID. 407. Many states have their own versions of Rule 407, and some have separate statutes. *See generally* HENDERSON & TWERSKI, *supra* note 3, at 222–24.

197. *See, e.g.*, Ahlberg v. Chrysler Corp., 481 F.3d 630, 633 (8th Cir. 2007).

198. The most vocal, high-profile critic has been Peter Huber. *See* HUBER, *supra* note 5, at 157 ("[J]urors are not experts about technology . . . , and intuition here is a terrible guide . . . . Age, familiarity, and ubiquity are the most powerful legitimizing forces known to the layperson. The inexpert juror is predisposed at every turn to identify technologies that are novel, exotic, unfamiliar, or adventuresome as unwelcome and fraught with danger—in short, defective."); *see also* Deborah J. La Fetra, *Freedom, Responsibility, and Risk: Fundamental Principles Supporting Tort Reform*, 36 IND. L. REV. 645, 647–48 (2003).

199. *See, e.g.*, Cortese & Blaner, *supra* note 5, at 168–69; Stayin, *supra* note 5, at 193.

200. *See, e.g.*, PETER REUTER, THE ECONOMIC CONSEQUENCES OF EXPANDED CORPORATE LIABILITY: AN EXPLORATORY STUDY 36–40 (1988); Benjamin H. Barton, *Tort Reform, Innovation, and Playground Design*, 58 FLA. L. REV. 265, 302 (2006); Frank B. Cross, *Tort Law and the American Economy*, 96 MINN. L. REV. 28, 86–87 (2011).

author believes tilts toward those who voice skepticism regarding the "competitive disadvantage" hypothesis,[201] simple logic supports a skeptical outlook. Thus, even if the American products liability system imposes liability and litigation costs that are greater than the costs imposed by foreign liability systems, so long as one assumes that all firms play by substantive and procedural rules that provide no firms with comparative advantages in any given jurisdiction,[202] they must be competing in every jurisdiction on a level playing field.[203]

One can imagine situations in which the costs imposed by the American products liability systems are comparatively high and the playing field of global competition is not level—situations in which American firms are excessively exposed to the relative costliness of American products liability law out of proportion to the quantity of business they end up doing in this country. Two examples come to mind. First, if foreign plaintiffs were allowed to bring tort actions against American firms in American courts applying American law to accidents occurring abroad resulting from products distributed by American firms in foreign markets;[204] and if foreign firms that sell their products abroad were not similarly exposed to tort actions in

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201. Those who believe our firms are disadvantaged tend to have broad-based tort-reform agendas that give the author to question their motivations. See authorities cited *supra* in notes 198 and 200. For a critique of some of these agendas, see Cross, *supra* note 200, at 44–45; *infra* note 204.

202. Trade tariffs and other trade barriers raise the costs of firms entering any given market from the outside. *See generally* T. De Scitovszky, *A Reconsideration of the Theory of Tariffs*, 9 REV. ECON. STUD. 89, 89 (1942) (Free trade is beneficial in the world as a whole, but may not be best for a single country.). But here, the reasonable assumption is that foreign tort liability systems, like systems of nonjudicial safely regulation, apply on the same terms to all competitors operating in the same jurisdictions. Viewed on this assumption, liability systems do not function as barriers to trade. For a brief description of how American law tries to assure that foreign-based distributors will be open to being sued in our courts for products distributed in this country, see HENDERSON & TWERSKI, *supra* note 3, at 757. ("[M]ost foreign-country defendants who engage in business in the United States can be hauled into American courts").

203. This will be true regardless of whether tort systems vary in their relative harshness to product distributors, or whether any given form does more business in one jurisdiction or the other. Firms will, of course, present different facts that lead to different levels of liability. But all firms will presumably adjust their product designs to maximize their abilities to compete, in light of the applicable liability rules, in the different jurisdictions in which they do business.

204. At the extreme, if all plaintiffs harmed by allegedly defective American products wherever purchased were allowed to, and did, bring tort actions against our firms in American courts, American firms would never be able to benefit, as do foreign firms, from the more lenient and less costly liability systems in foreign venues. On the subject of the attractiveness to foreign plaintiffs of bringing actions in American courts, see generally Russell J. Weintraub, *The United States as a Magnet Forum and What, if Anything, to Do About it*, *in* INTERNATIONAL DISPUTE RESOLUTION: THE REGULATION OF FORUM SELECTION 215 (Jack L. Goldsmith ed., 1996); John R. Wilson, *Coming to America to File Suit: Foreign Plaintiffs and the Forum Non Conveniens Barrier in Transnational Litigation*, 65 OHIO ST. L.J. 659, 668 (2004).

American courts;[205] then foreign firms distributing abroad would enjoy lower liability and litigation costs than would American firms distributing abroad, thereby giving foreign firms a competitive advantage in both domestic and foreign markets. And second, if for reasons not directly related to liability firms had little real choice but to test-market innovative new products in their home jurisdictions;[206] then the relatively higher liability and litigation costs imposed on American firms during periods of home-based test marketing would represent costs disproportionally borne by American firms competing here and abroad with foreign firms that enjoy the benefits of test-marketing their new products in their own less costly and more lenient legal environments.[207]

Regarding the first of these scenarios, our courts have applied the doctrine of forum non conveniens to reduce, if not entirely eliminate, this possibility. The leading decision in the Supreme Court of the United States invoked the non conveniens doctrine to dismiss a foreign plaintiff's claim in this country based on an aircraft manufactured by the American firm and purchased in Scotland by British citizen who subsequently suffered injury in a crash in Scotland.[208] The Court rested its decision to disallow the claim in part on the need to prevent foreign plaintiffs from taking advantage of more favorable (to plaintiffs) tort law.[209] One critic argues that the rationale of avoiding inconvenience is a thinly-veiled excuse for exercising unfair prejudice against foreigners, and has urged that courts should give very little weight to that consideration.[210] Notwithstanding this argument, the trend appears to be in the direction of placing stronger restrictions on foreign plaintiffs attempting to bring actions against American firms in American courts based on transactions abroad that cause injury there.[211] For the foreseeable future all

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205. The argument here is that American firms should be vulnerable to actions in American courts because they are based in this country, but that foreign firms do not have that connection.

206. These nonliability costs would include higher costs generated by specially-formatted foreign distributions of smaller production runs.

207. In addition to litigation costs, see *supra* note 179 and accompanying text, liability costs would include American firms being overly cautious regarding innovations. This Article's main argument, of course, is that this is unlikely because our liability rules (vs. litigation rules) are not harsher on manufacturers than are the rules in foreign jurisdictions.

208. *See* Piper Aircraft Co. v. Reyno, 454 U.S. 235, 238 (1981).

209. *See id.* at 249 n.15; *see generally* Wilson, *supra* note 204, at 677–84.

210. *See* Wilson, *supra* note 204, at 693 ("[J]urisdiction is to be declined [only] in 'exceptional circumstances' when it is 'clearly inappropriate' to adjudicate . . . . Non-nationals should not be disdained as forum shoppers and dismissed for that reason alone . . . .").

211. *See generally* Richard D. Bernstein et al., *Business Law: Stronger Restrictions on Foreign Plaintiffs in U.S. Courts*, 30 GP SOLO No. 2, Mar.–Apr. 2013, at 64, http://www.americanbar.org/content/dam/aba/publications/gp_solo_magazine/march_april_2013/full_issue_2013_march_april_30_2.authcheckdam.pdf.

firms doing business here will bear the costs of being subject to our liability system only in proportion to the quantity of business they do here.

Regarding the second scenario—the one based on the test-market-at-home hypothesis—the underlying factual assumptions are quite implausible. Firms test-market new products mainly to gauge consumer response and to test proposed methods of product marketing and distribution.[212] For these reasons they choose to test-market products in venues where the products are likely to be marketed, not necessarily where the liability systems are most lenient.[213] Not only do many firms in this country choose to test-market new products abroad;[214] but as this Article demonstrates, American rules of liability are not, in any event, significantly harsher on defendants than are the liability rules in major foreign jurisdictions.[215] And even if one were to assume for the sake of argument that American products liability law is harsher on product innovation, our firms can employ a number of defensive structural responses that mitigate the practical effects of such harshness.[216] Admittedly, American procedures and processes are relatively more complex and costly.[217] But even assuming that those litigation costs are to some extent borne disproportionally by American firms, apparently those litigation costs are not so much greater than the aggregate costs of test-marketing abroad as to cause very many American firms to move their test-marketing operations entirely overseas.[218]

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212. *See* Jay E. Klompmaker et al., *Test Marketing in New Product Development*, 54 HARV. BUS. REV. 128, 134–35 (1976) (arguing in-house testing should eliminate operational problems and risks, and test marketing should confirm the appropriate marketing approach), https://hbr.org/1976/05/test-marketing-in-new-product-development; Alvin J. Silk & Glen L. Urban, *Pre-Test-Market Evaluation of New Packaged Goods: A Model and Measurement Methodology*, 15 J. MKTG. RES. 171, 171 (1978).

213. The author has completed an extensive Google search for references to material published within the last decade suggesting that liability law is a factor in choosing where to test-market and has found none. Liability does not appear to be an important factor.

214. *See generally* SAK ONKVISIT & JOHN J. SHAW, INTERNATIONAL MARKETING: STRATEGY AND THEORY 260 (5th ed. 2009) (Tokyo has emerged as a prime venue for test-marketing by American firms).

215. *See* Mathias Reimann, *Liability for Defective Products at the Beginning of the Twenty-First Century: Emergence of a Worldwide Standard?*, 51 AM. J. COMP. L. 751, 802 (2003) ("[T]he United States is no longer the only country with tough product liability rules. Almost all industrialized nations have them today.").

216. *See supra* note 73 and accompanying text.

217. *See supra* note 179 and accompanying text.

218. *See supra* note 212, in which both cited sources base their analyses on the assumption that American firms will do much of their test-marketing in this country. For most American firms the question is which states, if any, to test-market in, not whether to test-market abroad.

CONCLUSION

Although firm conclusions must await further empirical research, this Article shows that the hypothesis that America's liability system discourages technological innovation and places our firms at a competitive disadvantage in global markets lacks support. The more persuasive voices in the academic debates express skepticism. The underlying logic seems, in an IT-oriented world of increasingly global markets, to compel rejection of the anti-innovation/noncompetitive hypotheses. So long as all firms operate on a level playing field in every jurisdiction in which they do business, all will incur liability and litigation costs roughly proportional to the amount of such business. Moreover, an examination of the American tort and products liability systems demonstrates that, in a number of ways, the liability rules in those systems accommodate technological innovation. This Article's most significant contributions in this regard have been to show how marginal judicial review of product designs based on proofs that reasonable alternative designs were available resonates with the concept of sustaining innovation, and how the rule against product category liability resonates with the concept of disruptive innovation based on paradigm shifts. At the least, this Article shows that American tort law's antagonism toward product innovation is, like the rumors of Huckleberry's demise, greatly exaggerated. To that extent it casts further doubt on claims that our products liability system places our firms at a competitive disadvantage in global markets.