

The Coming Connected-Products Liability Revolution

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Technological innovation begets legal revolution. And tort law, as a creature of the common law, makes the most profound doctrinal leaps and does so more rapidly than any other area of law when technology changes our everyday lives to create new wrongs and demand remedies. History demonstrates tort's unique ability to respond to the newest technologies, as it did with the appearance of railroads and later automobiles.

Today, once again, we are living in an age of great technological change, ushered in by ubiquitous smart devices. Computers, connected to other computers through the Internet, populate a wide variety of everyday items. Projections estimate that a trillion connected computers will span the globe by 2035, linking everyday products, homes and buildings, and even human bodies. Even today, computer connections revolutionized government services, interpersonal communications, modern education, healthcare delivery, and business relations. And, as with every previous major societal change, the law struggles to keep up. Nowhere is that more evident than in the areas where duties and liability attach. Some of that is a function of old concepts and doctrines continuing to hold sway, given the tradition-bound and precedent-oriented nature of law. Yet, as with other liability-inhibiting doctrines, certain existing liability rules that may have once made sense will require reexamination and, perhaps, abandonment, as continued adherence to them becomes less a matter of considered choice than blind allegiance to a world that no longer exists.

This Article argues that products liability will undergo revolutionary changes to address liability and responsibility. It suggests that over-the-air updates, hidden technological capabilities, and susceptibility to hacking will require new standards that require manufacturer accountability that track reasonable consumer expectations. As a result, the Article predicts that the relatively new emphasis on a risk-utility approach that imposes proof of a reasonable alternative design will have a short shelf life because of the insensibility of imposing on a plaintiff the need to examine and improve upon millions of lines of computer code. It also suggests that what justice demands as a measurement of proximate cause will also shift away from rigid standards to what a manufacturer knew or should have known,

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what it should have done, and when it should have done it. Moreover, personal jurisdiction will require reexamination when the product through its connectivity with the manufacturer for updates and real-time monitoring, as well as proprietary software it continues to own, never actually leaves its maker's remote but ever-present hands.

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INTRODUCTION

Technological innovation begets legal revolution. And tort law, perhaps more than any other area of law, makes the most profound doctrinal leaps when technology changes our everyday lives. There is no mystery to tort's essential importance as the law seeks to conform itself to modern realities. Tort, a creature of the common law, addresses wrongs and remedies that people most typically face. As those wrongs change, tort law requires constant adjustment and retooling to address new conditions and ideas about justice and often does so through law-making authority that resides largely in the courts, even when informed by new statutes.¹

Although the concept of tort, embodied in writs of trespass, dates back to the thirteenth century²—and even medical malpractice had its origins in the fourteenth century³—its development and growth proceeded at less than a snail's pace. By the time the twentieth century began, torts existed only as a “twig on the great tree of law,” dismissively described as “totally insignificant.”⁴

Still, tort law was far from non-existent. Railroads, the advanced technology that created a new era in the mid-nineteenth century,⁵ signaled an importance to tort that only slowly revealed itself. Trains were “wild beasts” that traversed the nation.⁶ For all that railroads contributed positively to economic development, their powerful sweep across the landscape also killed livestock, caused devastating fires, injured passengers, and destroyed much in their path, including other trains.⁷ It is no hyperbole to say that “[r]ailroad law and tort law grew up together” and were essentially one and the same.⁸

The Industrial Revolution further changed tort law from a sleepy backwater of the law, even if it boasted some well-established doctrines and impressive treatises,⁹ into a growing powerhouse needed to address the “marvelous

1. For a discussion of the common law of tort influencing the application of tort-oriented statutes, see generally Mark A. Geistfeld, *Tort Law in the Age of Statutes*, 99 IOWA L. REV. 957 (2014).

2. Elizabeth Jean Dix, *The Origins of the Action of Trespass on the Case*, 46 YALE L.J. 1142, 1143 (1937).

3. See *Weidrick v. Arnold*, 835 S.W.2d 843, 846 (Ark. 1992) (citing WILLIAM PROSSER, *LAW OF TORTS* 161 n.32 (4th ed. 1971), to recognize that medical malpractice “had its origins at common law” and that the first recorded case occurred in 1374); see also Allan McCoid, *The Care Required of Medical Practitioners*, 12 VAND. L. REV. 549, 550 (1959) (identifying the same 1374 case).

4. LAWRENCE M. FRIEDMAN, *A HISTORY OF AMERICAN LAW* 467 (2d ed. 1985).

5. See Donald G. Gifford, *Technological Triggers to Tort Revolutions: Steam Locomotives, Autonomous Vehicles, and Accident Compensation*, 11 J. TORT L. 71, 87 (2018).

6. FRIEDMAN, *supra* note 4, at 468.

7. *Id.*

8. *Id.*

9. The first tort treatise appeared in 1859. THOMAS H. KOENIG & MICHAEL L. RUSTAD, *IN DEFENSE OF TORT LAW* 15 (2001). Perhaps no scholarly treatise achieved the same renown in the 19th century as THOMAS M. COOLEY, *A TREATISE ON THE LAW OF TORTS OR THE WRONGS WHICH ARISE INDEPENDENT OF CONTRACT* (1888), in part due to its rejection of forms of action as the organizing principle for torts, in favor of a more plaintiff-rights/defendant-misconduct approach. See Kenneth S. Abraham & G. Edward White, *Conceptualizing Tort Law: The Continuous (and Continuing) Struggle*, 80 MD. L. REV. 293, 307 (2021). Presciently, Cooley recognized that “new inventions and improvements . . . have a powerful tendency in the direction of creating new wants and desires, and of establishing people in new occupations, and as these increase, the interests, desires

capacity” its machines had “for smashing the human body.”¹⁰ Stringent rules that blocked recovery required reconsideration and adjustment. Assumption of risk and contributory negligence, for example, provided seemingly insuperable barriers to liability. The harshness of these rules gave rise to the “last clear chance” rule that imposed liability regardless of the risk assumed or the plaintiff’s own negligence when the tortfeasor had a final opportunity to avoid the injury.¹¹ Even further down the road, contributory negligence was largely replaced with comparative negligence.¹²

Once again, we are living in an age of great technological change, ushered in by ubiquitous smart devices. In 2011, thirty-five percent of Americans owned a smartphone.¹³ A decade later, that number has jumped to eighty-five percent, with those aged eighteen to forty-nine having reached more than ninety-five percent in smartphone usage.¹⁴ The trend toward youthful adoption suggests that smartphones will continue to claim common adherence in all but the poorest and least industrialized nations.

and passions of men must necessarily breed more frequent controversies.” COOLEY, *supra* note 9, at 1. Cooley expressed doubt that the necessary “infinity of legislation” could keep up with “new conditions” but put his faith in “judicial legislation,” his term for the common law, as a “necessary condition of any steady improvement in the law.” *Id.* at 2, 11–12. Because so much of tort law is common law, the law, more generally, experienced that steady improvement disproportionately through tort. In fact, even today, Marshall Shapo calls tort the “quintessential common law subject.” Marshall S. Shapo, *Millennial Torts*, 33 Ga. L. Rev. 1021, 1021 (1999). Tort became a law-school class separate from other subjects in 1870 and only subsequently came to be considered “a discrete branch of law.” G. EDWARD WHITE, *TORT LAW IN AMERICA: AN INTELLECTUAL HISTORY* 3 (1980).

10. FRIEDMAN, *supra* note 4, at 467.

11. WHITE, *supra* note 9, at 47.

12. Contributory negligence was a common-law doctrine developed in the early 19th century that barred recovery if the plaintiff’s own negligence contributed in any way to the injury. 78 A.L.R.3d 339 (Originally published in 1977). The harshness of that doctrine was recognized quickly, but largely survived into the 20th century until the use of comparative negligence, which assigns percentages of fault, became the majority rule. Still today, four states continue to employ contributory negligence. Peter Nash Swisher, *Virginia Should Abolish the Archaic Tort Defense of Contributory Negligence and Adopt A Comparative Negligence Defense in Its Place*, 46 U. RICH. L. REV. 359, 360 (2011). Nonetheless, four states and the District of Columbia still utilize contributory negligence to this day in negligence actions. *See, e.g.*, *Uniroyal Goodrich Tire Co. v. Hall*, 681 So.2d 126, 130 (Ala. 1996) (holding that failure to instruct jury that contributory negligence was a defense constituted reversible error); *Asal v. Mina*, 247 A.3d 260, 271 (D.C. 2021) (“In the District, a plaintiff in a negligence action generally cannot recover when he or she is found to have been contributorily negligent.”); *Harrison v. Montgomery Cnty. Bd. of Educ.*, 456 A.2d 894, 905 (Md. 1983) (“All things considered, we are unable to say that the circumstances of modern life have so changed as to render contributory negligence a vestige of the past, no longer suitable to the needs of the people of Maryland.”); *Proffitt v. Gosnell*, 809 S.E.2d 200, 209 (N.C. Ct. App. 2017) (recognizing that failure to yield the right-of-way to a motor vehicle may constitute contributory negligence as a matter of law); *Rascher v. Friend*, 689 S.E.2d 661, 664 (Va. 2010) (recognizing that contributory negligence remains an affirmative defense).

13. *Mobile Fact Sheet*, PEW RSCH. CTR. (Apr. 7, 2021), <https://www.pewresearch.org/internet/fact-sheet/mobile/>.

14. *Id.* Globally, more than half of the world’s 5 billion cellphone users have smartphones. Laura Silver, *Smartphone Ownership Is Growing Rapidly Around the World, but Not Always Equally*, PEW RSCH. CTR. (Feb. 5, 2019), <https://www.pewresearch.org/global/2019/02/05/smartphone-ownership-is-growing-rapidly-around-the-world-but-not-always-equally/>.

Smartphones, though, are but the tip of the iceberg. Computers, connected to other computers through the Internet, can be found in a wide variety of everyday items. At least one projection estimates that “by 2035 the world will have a trillion connected computers, built into everything from food packaging to bridges and clothes.”¹⁵ These connections, known as the Internet of Things, or IoT, enable communication between computers to assure efficiency and convenience.¹⁶ As the ability to do so increases at the same time that costs decrease, “[c]ountless tiny chips will be woven into buildings, cities, clothes and human bodies, all linked by the internet.”¹⁷

The IoT has already touched nearly all aspects of everyday life. It has revolutionized government services, interpersonal communications, modern education, healthcare delivery, and business relations.¹⁸ And, as with every previous major societal change, the law struggles to keep up. Nowhere is that more evident than in the areas where duties and liability attach. Some of that is a function of old concepts and doctrines continuing to hold sway, given the tradition-bound and precedent-oriented nature of law. Yet, as with other liability-inhibiting doctrines, certain existing liability rules that may have once made sense will require reexamination and, perhaps, abandonment, as continued adherence to them becomes less a matter of considered choice than blind allegiance to a world that no longer exists.

Products liability provides helpful perspective on how law must adapt to the changes of a society more connected than ever before through the Internet. It raises challenges that have historical antecedents and others that require reinvention. It also taps into the value of a common-law system capable, if properly utilized, of advancing in tandem with rapidly progressing technology.

This paper attempts to sketch out some of the challenges and potential doctrinal changes ahead, understanding that change occurs swiftly in ways that we often cannot anticipate. One must always be mindful that many past predictions about technology and its impact have demonstrated little prescience.

15. *How the World Will Change as Computers Spread into Everyday Objects*, ECONOMIST (Sept. 12, 2019), <https://www.economist.com/leaders/2019/09/12/how-the-world-will-change-as-computers-spread-into-everyday-objects>. In 2020, the number of IoT devices was 11.3 billion, despite slowdowns because of COVID-19 and a shortage of computer chips. Satyajit Sinha, *State of IoT 2021: Number of connected IoT devices growing 9% to 12.3 Billion Globally, Cellular IoT Now Surpassing 2 Billion*, IOT ANALYTICS (Sept. 22, 2021), <https://iot-analytics.com/number-connected-iot-devices/>.

16. See FED. TRADE COMM’N, INTERNET OF THINGS: PRIVACY & SECURITY IN A CONNECTED WORLD 5 (2015), <https://www.ftc.gov/system/files/documents/reports/federal-trade-commission-staff-report-november-2013-workshop-entitled-internet-things-privacy/150127iotrpt.pdf>.

17. *Drastic Falls in Cost are Powering Another Computer Revolution*, ECONOMIST (Sept. 14, 2019), <https://www.economist.com/technology-quarterly/2019/09/12/drastic-falls-in-cost-are-powering-another-computer-revolution>.

18. See Peter M. Lefkowitz, *Making Sense of the Internet of Things*, 59 BOS. BAR J., NO. 4, 2015, at 22.

I. THE INADEQUATE STATE OF PRODUCTS LIABILITY LAW

While some products liability law sports a certain timeless quality that has proven infinitely adaptable to more modern applications, other aspects of it seem as antiquated as *caveat emptor* as a useful guiding principle for consumer rights. At its most basic level, products liability law permits parties injured by defective products to sue manufacturers and sellers for negligence, breach of warranty, strict liability, or misrepresentation.¹⁹ The rationale behind products liability contemplates that a manufacturer is in the best position to understand the risks to a user that a product creates while marketing the item in a quest for profit, thereby undertaking a duty to the product's users.²⁰

A. A SHORT HISTORY OF PRODUCTS LIABILITY

Modern products liability owes its development to the arrival of new technology, automobiles,²¹ and Benjamin Cardozo's revolutionary opinion in *MacPherson v. Buick Motor Co.*²² To assess liability over a broken wheel due to defective wooden spokes, *MacPherson* loosened the then-prevalent privity rule to allow the injured plaintiff to sue the manufacturer directly, even though the vehicle was purchased from an intermediary retailer so that the buyer had no relationship with the manufacturer.²³ Cardozo reasoned, in terms familiar today, that the manufacturer should have discovered the wheel's flaw upon reasonable inspection and must take responsibility.²⁴ Ever since, legal historian Lawrence Friedman has described the evolution of products liability spawned by *MacPherson* as a movement away from requirements of privity.²⁵

It took nearly another thirty years after *MacPherson* for products liability to develop further in a significant way. An exploding Coca-Cola bottle injured the hand of a waitress who had just picked it up.²⁶ She sued successfully based on *res ipsa loquitur* even though the cause of the bottle's shattering remained unexplained,²⁷ but a concurring opinion by California Justice Roger Traynor laid the groundwork for strict liability. Traynor wrote that "it should now be recognized that a manufacturer incurs an absolute liability when an article that

19. See generally RESTATEMENT (SECOND) OF TORTS § 402A (AM. L. INST. 1965); RESTATEMENT (THIRD) OF TORTS: PRODUCT LIABILITY §§ 1-2 (AM. L. INST. 1998).

20. See David G. Owen, *The Moral Foundations of Products Liability Law: Toward First Principles*, 68 NOTRE DAME L. REV. 427, 430 (1993).

21. Automobiles have also had a profound effect on tort law outside of products liability. For a helpful discussion of that development, see generally Nora Freeman Engstrom, *When Cars Crash: The Automobile's Tort Law Legacy*, 53 WAKE FOREST L. REV. 293 (2018). An early observation of how "automobile law" had grown quickly was written by then-student and later U.S. president Richard Nixon. See generally Richard M. Nixon, *Changing Rules of Liability in Automobile Accident Litigation*, 3 LAW & CONTEMP. PROBS. 476 (1936).

22. *MacPherson v. Buick Motor Co.*, 111 N.E. 1050 (N.Y. 1916).

23. *Id.* at 1051.

24. *Id.*

25. LAWRENCE M. FRIEDMAN, *AMERICAN LAW IN THE 20TH CENTURY* 356 (2002).

26. *Escola v. Coca Cola Bottling Co.*, 150 P.2d 436, 437-38 (Cal. 1944).

27. *Id.* at 440.

he has placed on the market, knowing that it is to be used without inspection, proves to have a defect that causes injury to human beings.”²⁸ Proof of negligence, he said, was unnecessary, had proven unworkable, and usually spelled doom for an injured plaintiff.²⁹ Traynor had to bide his time to see his advocacy of doctrinal change implemented. That time came nearly two decades later when he wrote the majority opinion in *Greenman v. Yuba Power Products, Inc.*,³⁰ adopting the view he had expressed in 1944.

Soon afterwards, the American Law Institute (ALI) incorporated that view into section 402A of the Restatement (Second) of Torts, guided to that result by its reporter, William Prosser.³¹ Section 402A stated that a defendant should be liable for selling “any product in a defective condition unreasonably dangerous to the user or consumer.”³² That emerging principle is widely regarded as the most important and most cited section of any Restatement produced by the ALI.³³ With the ALI’s endorsement of strict liability for product defects, courts throughout the nation quickly adopted the approach,³⁴ and products liability law came into its own.

The growth of product liability in the aftermath of strict liability has predictably produced a certain amount of retrenchment as manufacturers and insurers have fought to limit their exposure and bring back concepts of negligence.³⁵ Much of the retrenchment took on life when then professor Guido Calabresi suggested a seemingly neutral principle, the “cheapest cost avoider,” as a guide to where liability should lie.³⁶ Calabresi’s pioneering work led to the law-and-economics school, which dominates doctrinal thinking today, “not only in the legal academy but also in the decisions of influential state and federal courts, including the U.S. Supreme Court.”³⁷ As recently as 2019, both the majority and the dissent relied upon economic theory to assess, as a matter of common law, the scope of the “duty to warn when the manufacturer’s product requires incorporation of a part (here, asbestos) that the manufacturer knows is

28. *Id.* (Traynor, J., concurring).

29. *Id.* at 440–41 (Traynor, J., concurring).

30. *Greenman v. Yuba Power Products, Inc.*, 377 P.2d 897 (Cal. 1963).

31. See James A. Henderson, Jr. & Aaron D. Twerski, *Drug Design Liability: Farewell to Comment K*, 67 BAYLOR L. REV. 521, 557 (2015).

32. RESTATEMENT (SECOND) OF TORTS § 402A (AM. L. INST. 1965).

33. See James A. Henderson, Jr., *A Proposed Revision of Section 402a of the Restatement (Second) of Torts*, 77 CORNELL L. REV. 1512, 1512 n.1 (1992).

34. David G. Owen, *The Evolution of Products Liability Law*, 26 REV. LITIG. 955, 977 (2007) (describing Section 402A’s adoption as having “spread like wildfire from state to state, as one court after another, and an occasional state legislature, ‘adopted’ the new doctrine”).

35. For a description of those changes, see Michael L. Rustad & Thomas H. Koenig, *Taming the Tort Monster: The American Civil Justice System as a Battleground of Social Theory*, 68 BROOK. L. REV. 1, 88–93 (2002).

36. Guido Calabresi, *Changes for Automobile Claims? Views and Overviews*, 1967 U. ILL. L. F. 600, 608. This theory was spelled out more extensively in GUIDO CALABRESI, *THE COSTS OF ACCIDENTS* (1970).

37. Catherine M. Sharkey, *Modern Tort Law: Preventing Harms, Not Recognizing Wrongs*, 134 HARV. L. REV. 1423, 1424 (2021) (book review).

likely to make the integrated product dangerous for its intended uses.”³⁸ The majority concluded that the “product manufacturer will often be in a better position than the parts manufacturer to warn of the danger from the integrated product.”³⁹ The dissent also took up the project, insisting that the after-product component manufacturer “is in the best position to understand and warn users about its risks; in the language of law and economics, those who make products are generally the least-cost avoiders of their risks.”⁴⁰

B. CONTEMPORARY PRODUCTS LIABILITY PRINCIPLES AND SOME APPLICATIONS

Modern products liability law focuses heavily on the condition of a product when it leaves the hands of the manufacturer or retailer without necessarily ascribing responsibility to them for upgrades or responses to unanticipated developments.⁴¹ The current Restatement classifies products liability into three categories: manufacturing defects, design defects, and inadequate instructions or warnings.⁴²

Restatement (Third) also reformulated some key components of products liability law. Most sweepingly, in design-defect cases, it jettisoned section 402A strict liability and the consumer-expectations test,⁴³ in favor of a “reasonable alternative design” approach, imposing on plaintiffs an obligation to mount a risk-utility case for why a different design approach would have been reasonable and would not have substantially detracted from the products’ features.⁴⁴ The risk-utility test reintroduces negligence into products liability, and many states have adopted it.⁴⁵ Still, state courts are split on which test to apply and sometimes even allow the plaintiff a choice between the two.⁴⁶

The difficulty of using a reasonable alternative design test may be exacerbated in the era of connected devices. When the product design issue arises from miles of coding in a smart device, a demonstration of reasonable alternative design could be particularly problematic, for it forces a plaintiff to

38. *Air & Liquid Sys. Corp. v. DeVries*, 139 S. Ct. 986, 991 (2019).

39. *Id.* at 994.

40. *Id.* at 997 (Gorsuch, J., dissenting).

41. In *Air & Liquid Sys.*, the majority emphasized that “[w]e do not purport to define the proper tort rule outside of the maritime context.” *Id.* at 995. The dissent saw that statement as a “silver lining,” taking comfort that a more restrictive liability principle would remain the law in tort generally, ascribing the majority’s maritime generosity to maritime law’s special solicitude for the conditions that sailors face. *See id.* at 1000 (Gorsuch, J. dissenting).

42. RESTATEMENT (THIRD) OF TORTS: PRODUCT LIABILITY § 19.2 (AM. L. INST. 1998). Still, many jurisdictions have rejected the reasonable alternative design approach.

43. Under the consumer-expectations test, liability hinges on whether the product “failed to perform as safely as an ordinary consumer would expect when used in an intended or reasonably foreseeable manner.” *Tincher v. Omega Flex, Inc.*, 104 A.3d 328, 368 (Pa. 2014).

44. RESTATEMENT (THIRD) OF TORTS PRODUCT LIABILITY § 2 (AM. L. INST. 1998).

45. *See Evans v. Lorillard Tobacco Co.*, 990 N.E.2d 997, 1012 (Mass. 2013).

46. Clayton J. Masterman & W. Kip Viscusi, *The Specific Consumer Expectations Test for Product Defects*, 95 IND. L. REV. 183, 191 (2020).

produce experts that review the code and “fix” the software, an engineering feat that seems beyond what may reasonably be required of an injured plaintiff. Moreover, the product never really leaves the hands of the manufacturer but continues to send data back to its originator while it receives updates in return that frequently modify the product. The assumptions that undergird the risk-utility approach, that assumes the design is complete when the manufacturer relinquishes the product, seems off-kilter when the product remains connected to its maker.

Another potential limitation on liability is the economic-loss doctrine, which bars recovery for purely financial harms that do not involve injury to person or property.⁴⁷ It has proven to be an obstacle in some cybersecurity data breach litigation and has faced calls for its revision.⁴⁸

Proximate cause may also pose some challenges in products-liability litigation. To the extent that smart devices are capable of being hacked or otherwise fail due to atmospheric conditions, weak signals, or overwhelming Internet traffic, questions may arise about whether the outside events were foreseeable and redressable by the manufacturer. Yet, as more of those types of events occur, foreseeability may become an easier question to answer.

II. PRODUCTS LIABILITY AND THE AGE OF THE CONNECTED DEVICE

The distinguishing feature of today’s Internet-connected devices is a continuing relationship between the product and the manufacturer. Just as federal law requires a drug manufacturer to compile adverse incident reports and change warning labels as new and unanticipated dangers are discovered,⁴⁹ consumers’ expectations are high that manufacturers must produce software updates, correct security holes in connected devices, have real-time information about the devices from monitoring sensors that provide continuous data on the device’s operation, and assure the connections essential to basic operations through the Internet.⁵⁰

Connected devices tout potential efficiencies otherwise unavailable. For example:

Microchipped clothes could tell washing machines how to treat them. Smart traffic systems will reduce waiting times at traffic lights and better distribute cars through a city. Some will be the sorts of productivity improvements that are the fundamental drivers of economic growth. Data from factory robots, for

47. Peter Benson, *The Problem with Pure Economic Loss*, 60 S.C. L. REV. 823, 823 (2009).

48. For a discussion of this issue, see Catherine M. Sharkey, *Can Data Breach Claims Survive the Economic Loss Rule?*, 66 DEPAUL L. REV. 339, 382 (2017).

49. 21 U.S.C. § 355(k); *see also* Wyeth v. Levine, 555 U.S. 555, 568 (2009) (describing the “changes being effected” (CBE) regulation, 21 CFR §§ 314.70(c)(6)(iii)(A), (C)).

50. *See generally* CHRIS FOLK, DAN C. HURLEY, WESLEY K. KAPLOW & JAMES F. X. PAYNE, *THE SECURITY IMPLICATIONS OF THE INTERNET OF THINGS* (2015), www.afcea.org/committees/cyber/documents/InternetofThingsFINAL.pdf; Mauricio Paez & Kerianne Tobitsch, *The Industrial Internet of Things: Risks, Liabilities, and Emerging Legal Issues*, 62 N.Y.L. SCH. L. REV. 217, 220–25, 234–44 (2018).

instance, will allow algorithms to predict when they will break down, and schedule maintenance to ensure that does not happen. Implanted sensors will spot early signs of illness in farm animals, and micromanage their feeding.⁵¹

Pampers, the disposable diaper brand, has incorporated sensors into a smart diaper that connects to an app on a parent's phone.⁵² A baby's sleep patterns are recorded and sent both to the app and to Pampers. It also alerts parents when the diaper must be changed.⁵³ Both daily and weekly "sleep insight reports" from Pampers measure a baby's progress and provide coaching on getting the baby to sleep through the night.⁵⁴

In addition, we have smart mattresses that boast sleep tracking capabilities, as well as implanted medical devices that deliver medication when needed, stimulate the heart, and monitor insulin levels.⁵⁵ Automobile insurers encourage drivers to use smart devices that allow the insurance company to monitor driving habits and frequency to calculate risk and assess premiums.⁵⁶

As welcome as some of the assistance offered by connected devices might be, there are downsides that some consumers have already experienced. For example, tractor manufacturer John Deere offers a high-end, advanced technology tractor, which utilizes proprietary connected software that John Deere licenses to purchasers.⁵⁷ The software enables more efficient use of the tractors, resulting in increased productivity, but also prevents farmers from undertaking common repairs to the machinery themselves and has spawned a right-to-repair movement.⁵⁸ In late 2022, John Deere will offer a driverless tractor model that uses GPS to steer and allows farmers to track the tractor's efforts on a smartphone app that will provide video and data.⁵⁹ If the tractor detects a problem it cannot solve, it will stop and send an alert to the farmer.⁶⁰

A. INTERNET-CONNECTED PRODUCTS AND MALFUNCTIONS OR FAILURES

These changes in how manufacturers interact with products long after they have left their hands implicates new duties and new potential liabilities. To understand the continuing relationship between product and manufacturer, consider, for example, Tesla's reaction to Hurricane Dorian in 2019, when it traveled along the Southeast coast of the United States after wreaking havoc in

51. *Drastic Falls in Cost Are Powering Another Computer Revolution*, *supra* note 17.

52. LUMI BY PAMPERS, <https://www.lumibypampers.com/#how-it-works> (last visited July 1, 2022).

53. *Id.*

54. *Id.*

55. *See How the World Will Change as Computers Spread into Everyday Objects*, *supra* note 15.

56. *Id.*

57. Peter Waldman & Lydia Mulvany, *Farmers Fight John Deere Over Who Gets to Fix an \$800,000 Tractor*, BLOOMBERG (Mar. 5, 2020), <https://www.bloomberg.com/news/features/2020-03-05/farmers-fight-john-deere-over-who-gets-to-fix-an-800-000-tractor>.

58. *Id.*

59. *John Deere's Self-Driving Tractor*, CNN (Jan. 4, 2022), <https://www.cnn.com/2022/01/04/tech/ces-2022-tech-highlights/index.html>.

60. *Id.*

the Bahamas. To help his customers get away from the storm, owner Elon Musk announced that some Tesla drivers would discover their electric vehicles boasted an unexpected increased range.⁶¹ It turns out that even the most basic Teslas can drive much further than the car's specifications indicate because implanted software lowers the range, apparently to encourage sales of their longer-range option.⁶²

Recognizing the danger to a customer trapped in a hurricane because the battery charge gave out, Tesla, headquartered in Palo Alto, California, simply removed the battery limitations at the "tap of a keyboard" and provided drivers with "temporary access to the full power of their batteries."⁶³

But consider if Tesla had not done so. Tesla drivers might have been stranded and injured in the storm because their vehicle lost power preventing them from reaching safety. Or, the loss of precious time taken to recharge en route, which was actually unnecessary, might support an argument that the company had a duty to undertake the assistance that it actually provided in this instance. That Tesla has now done so at least once suggests that customers may have similar expectations when a future catastrophe occurs. A Tesla driver stuck in dangerous circumstances might even call the company and ask for the same range-enhancing treatment. If that assistance does not come to pass and injury occurs, it is not difficult to imagine a case that argues in favor of a duty to assist, as well as a defense about the driver's own lack of foresight in fully charging the vehicle before the emergency occurred.

In some ways, Tesla's ability to enable longer drives for their vehicles might be comparable to the complaints that exist when cellphone service providers slow Internet speeds on their devices. When the customer has an "unlimited" plan, some carriers will "throttle," or slow the speed of the connection, after customers hit a defined usage amount.⁶⁴ In a crisis affecting a portion of the country, when overwhelming cellphone usage could otherwise jam networks, continued throttling could become a "but-for" cause of injury.

Other failures can occur when a manufacturer loses interest in the smart product it once enthusiastically marketed. Microsoft, for example, after two years in the ebook business, shut down its library in 2019, deleting all content from the devices that customers used to read the books and thought that they had purchased.⁶⁵ The capability to delete remotely, even after the content had been saved to a personal device, exists because a "digital media transaction is

61. *How the World Will Change as Computers Spread into Everyday Objects*, *supra* note 15.

62. *See id.*

63. *Id.*

64. Rayna Hollander, *The 4 Biggest US Wireless Carriers Are Reportedly Throttling Mobile Video Content — Even When Networks Aren't Congested*, INSIDER (Aug. 21, 2019), <https://www.businessinsider.com/big-four-us-carriers-are-throttling-mobile-video-streams-2019-8> (reporting on study by researchers at Northeastern University and the University of Massachusetts Amherst).

65. Josh Axelrod and Lulu Garcia-Navarro, *Microsoft Closes the Book on Its E-Library, Erasing All User Content*, NPR (July 7, 2019), <https://www.npr.org/2019/07/07/739316746/microsoft-closes-the-book-on-its-e-library-erasing-all-user-content>. Microsoft refunded their customers payments to make up for the decision. *Id.*

continuous, linking buyer and seller, and giving the seller post-transaction power that would be impossible in physical markets.”⁶⁶

Smart devices contain software that make the devices work. For the most part, as in Microsoft ebooks, the John Deere connected tractors, and Tesla’s battery capabilities, the software to run them is licensed to the consumer, rather than purchased by them,⁶⁷ giving the manufacturer continuing contact and control over the device and making apparent that an operational device never fully leaves the manufacturer’s hands.

That continuing connection is further demonstrated through software updates that can improve the device’s functioning and provide updated security. It often happens without the customer’s intervention, such as when a person finds that Microsoft updated its Windows operating system on a personal computer overnight, causing it to reboot unexpectedly.

Yet, what happens when the delivery system for a connected device fails? Home security systems could leave a door or window open so an intruder may enter; smart thermostats could go offline, resulting in a loss of heat and burst water pipes;⁶⁸ sprinkler systems could spray water inappropriately, creating damage and mold in a home; or, an implanted medical device could under- or over-deliver medication.⁶⁹ Should liability attach? The answer may well depend on how we approach proximate cause and the role we assign to foreseeability. Where a manufacturer discovers a security hole or knows that its over-the-air updates are glitchy but takes no steps to either warn customers or overcome the obstacle, liability may attach. As is traditional in tort law, that means redefining what constitutes a duty, as Justice Traynor did in developing the concept of strict liability.

At the same time, the ongoing connection between the manufacturer and the device, essential to its functioning, makes the actual discharge of that duty relatively easy to accomplish. Yet, for a variety of unanticipated reasons, the update may be delayed. Thus, capability and foresight may be critical considerations. While programming errors probably provide no defense, lines will need to be drawn about delays in software updates, understandings about Internet traffic, and other malfunctions and failures—and perhaps warnings at specific times, rather than through boilerplate disclaimers.

66. Aaron Perzanowski & Chris Jay Hoffnagle, *What We Buy When We Buy Now*, 165 U. PENN. L. REV. 315, 318 (2017).

67. *Id.* at 318–21.

68. H. MICHAEL O’BRIEN, *THE IMPACT OF THE SMART HOME REVOLUTION ON PRODUCT LIABILITY AND FIRE CAUSE DETERMINATIONS*, 2, 7 (2016), <https://www.productliabilityadvocate.com/2016/09/the-refrigerator-did-it/>.

69. *See, e.g., Jones v. Medtronic, Inc.*, No. A17-1124, 2018 WL 1462169, at *1 (Minn. Ct. App. Mar. 26, 2018).

B. AUTONOMOUS VEHICLES, HACKING, AND OTHER CYBERSECURITY BREACHES

If the “automobile accident is the bread and butter of tort law,”⁷⁰ collisions involving autonomous vehicles (AVs) may well provide the blueprint for much of smart-device-related tort liability. Although many have treated the manufacturer as the likely liable party when a fully autonomous motor vehicle crashes, because the only conceivable driver is the car itself,⁷¹ even that situation may require some rethinking to achieve that seemingly logical goal.

Early in the development of AVs, Volvo announced in grand fashion that it would accept full liability for injuries and damage for its vehicles in autonomous mode.⁷² Mercedes and Google (Waymo) joined that bandwagon.⁷³ Tesla, a leader in the development of AVs, however, took a different stance, emphasizing how its vehicles *assist* the driver, rather than constitute a replacement.⁷⁴ It explains that its “Autopilot is an advanced driver assistance system that enhances safety and convenience” of the human driver, which, along with “Full Self-Driving Capability,” is “intended for use with a fully attentive driver, who has their hands on the wheel and is prepared to take over at any moment.”⁷⁵ The plain implication of these disclaimers is that Tesla declines to be identified as the vehicle driver.

As one might expect, insurers, too, have an interest in who should be considered the driver. One industry trade group, American Property Casualty Insurance Association, contends that if the human drivers are not in control because the vehicle is truly autonomous, insurers should have access to information kept in an “event data recorder,” like an airplane’s black box,⁷⁶ to provide information about the vehicle’s speed and when the car’s sensors became aware of the person or thing struck.⁷⁷

70. FRIEDMAN, *supra* note 4, at 684.

71. See, e.g., Alexander B. Lemann, *Autonomous Vehicles, Technological Progress, and the Scope Problem in Products Liability*, 12 J. TORT L. 157, 212 (2019); see also Mark A. Geistfeld, *A Roadmap for Autonomous Vehicles: State Tort Liability, Automobile Insurance, and Federal Safety Regulation*, 105 CALIF. L. REV. 1611, 1619 (2017) (calling it a “the shared conclusion”).

72. Kirsten Korosec, *Volvo CEO: We Will Accept All Liability When Our Cars Are in Autonomous Mode*, FORTUNE (Oct. 7, 2015), <https://fortune.com/2015/10/07/volvo-liability-self-driving-cars/>.

73. Bill Whitaker, *Hands Off the Wheel*, CBS NEWS (Oct. 4, 2015), <https://www.cbsnews.com/news/self-driving-cars-google-mercedes-benz-60-minutes/>.

74. See Mike Ramsey, *Who’s Responsible When a Driverless Car Crashes? Tesla’s Got an Idea*, WALL ST. J. (May 13, 2015), <https://www.wsj.com/articles/tesla-electric-cars-soon-to-sport-autopilot-functions-such-as-passing-other-vehicles-1431532720> (“Hitting the turn signal not only tells the car it can pass, but also ensures the driver has given thought to whether the maneuver is safe.”).

75. *Support*, TESLA, <https://www.tesla.com/support/autopilot> (last visited July 1, 2022).

76. The Federal Aviation Administration requires aircraft used in transportation to comply with various flight recorder and cockpit voice recorder requirements used to investigate the causes of crashes and popularly known as black boxes. See 14 C.F.R. § 91.609 (2010).

77. Zoe Sagalow, *Insurers Ask: Who Pays When Self-driving Vehicles Crash?*, ROLL CALL (May 25, 2021), <https://rollcall.com/2021/05/25/insurers-ask-who-pays-when-self-driving-vehicles-crash/>.

Where the AV still requires human intervention, we may see an effort to reinvigorate an assumption of the risk defense, even though it is disfavored in the age of comparative negligence.⁷⁸ Yet, even detailed disclosures of limitations intended to serve as liability-forgiving disclaimers run counter to and inhibit the marketing and promise of autonomous vehicles. When a person purchases a vehicle with “Full Self-Driving Capability,” particularly when a showroom salesman boasts of and demonstrates the no-hands convenience of the vehicle, the disclaimer may well be ineffective—or should be.

Still, liability when the car operates as intended but still causes injury cannot be discussed in isolation. As a type of connected device, AVs are subject not just to updates and over-the-air improvements but to hacking and other breaches. In the largest cyber hack ever, some 18,000 U.S. companies and governmental agencies were hacked.⁷⁹ It occurred because of code embedded in a software patch automatically downloaded and installed on thousands of computers through a tech company called SolarWinds, giving the hackers access to the infiltrated computers and to the stored data on those computers.⁸⁰

In 2015, two researchers proved that they could hack a 2014 Jeep Cherokee traveling on a public highway, taking control of its radio, windshield wipers, in-dash screen, and transmission, prompting Chrysler to recall 1.4 million cars to enhance software security.⁸¹ Reports of the event prompted Chinese researchers to hack a Tesla on an open road from twelve miles away and perform similar control over the vehicle, just to show they could.⁸²

These experiments suggest that a hack of AVs could have cars careening out of control or cause massive traffic jams that impede essential services. A recent report by the European Union Agency for Cybersecurity found that the use of artificial intelligence to improve cognitive functions in autonomous vehicles are “highly vulnerable to a wide range of attacks that could compromise the proper functioning of autonomous vehicles, and pose serious threats to the safety of persons, both inside and outside of a vehicle.”⁸³

Researchers at the RAND Corporation looked at potential civil liability in connection with AVs afflicted by hacking and security holes and concluded:

78. The Restatement (Third) of Apportionment of Liability rejects a generalized assumption of risk defense. RESTATEMENT (THIRD) OF TORTS: APPORTIONMENT OF LIABILITY § 2 cmts. e, i (AM. L. INST. 2000).

79. David E. Sanger, *Nicole Perlroth and Eric Schmitt, Scope of Russian Hacking Becomes Clear: Multiple U.S. Agencies Were Hit*, N.Y. TIMES (Dec. 14, 2020), <https://www.nytimes.com/2020/12/14/us/politics/russia-hack-nsa-homeland-security-pentagon.html>.

80. *Id.*

81. Ryan J. Duplechin, *The Emerging Intersection of Products Liability, Cybersecurity, and Autonomous Vehicles*, 85 TENN. L. REV. 803, 804, 814 (2018).

82. *Id.* at 814.

83. GEORGIA DEDE, ROSSEN NAYDENOV, APOSTOLOS MALATRAS, EURO. UNION AGENCY FOR CYBER SEC’Y, RONAN HAMON, HENRIK JUNKLEWITZ & IGNACIO SANCHEZ, JOINT RSCH. CNTR., CYBERSECURITY CHALLENGES IN THE UPTAKE OF ARTIFICIAL INTELLIGENCE IN AUTONOMOUS DRIVING 6 (2021), <https://www.enisa.europa.eu/publications/enisa-jrc-cybersecurity-challenges-in-the-uptake-of-artificial-intelligence-in-autonomous-driving/>.

AV manufacturers, component part makers, software designers, and distributors “may face civil liability for the criminal hacks on AVs[;]” and, AV owners themselves could also be open to liability for damage their vehicles cause if they have rejected a security update.⁸⁴

The researchers nonetheless expressed confidence that existing liability law has the flexibility to adapt and manage small and medium hacks, and assumed that criminal hacking is a foreseeable event, particularly where known vulnerabilities exist.⁸⁵ They also expect that the cases will require courts to use cost-benefit analyses that will put a premium on judicial understanding of the technology.⁸⁶

Others to consider AVs have suggested that we could see a transition away from individual ownership of vehicles and fleet liability, as well as a diminished cost and need for personal automobile insurance.⁸⁷ That, too, would change the liability picture.

Scholars looking at liability issues for AVs have also lined up on opposing sides of the consumer-expectation versus risk-utility approaches to liability, much as states have.⁸⁸ Professor Geistfeld, for example, has argued that an “imperfect but safer [fully functioning] autonomous vehicle . . . will necessarily drive in a reasonable, safe manner if prior driving experience shows that the operating system at least halves the incidence of crashes relative to conventional vehicles” and, under a risk-utility trade-off, should “satisfy the manufacturer’s tort obligation.”⁸⁹ Others find even that manufacturer-friendly formula too onerous and have suggested dispensing with fault-oriented liability in favor of a “manufacturer-financed, strict responsibility bodily injury compensation system, administered by a fund created through assessments levied on HAV⁹⁰ manufacturers.”⁹¹ Yet another scholar “concludes that the current product liability regime, while imperfect, is probably compatible with the adoption of automated driving systems.”⁹²

What is missing, though, from these analyses is whether the continued connection between product and manufacturer matters and revamps our notions

84. ZAV WINKELMAN, MAYA BUENAVENTURA, JAMES M. ANDERSON, NAHOM M. BEYENE, PAVAN KATKAR & GREG BAUMANN, HACKED AUTONOMOUS VEHICLES: WHO MAY BE LIABLE FOR DAMAGES? AN INITIAL INVESTIGATION INTO HOW CIVIL LIABILITY SYSTEMS CAN PREPARE 2 (2019), https://www.rand.org/pubs/research_briefs/RB10063.html.

85. *Id.*

86. *Id.*

87. Geistfeld, *supra* note 71, at 1614–16.

88. See notes 37–40 *supra* and accompanying text.

89. Geistfeld, *supra* note 71, at 1651.

90. HAV stands for “highly automated vehicles.” Kenneth S. Abraham & Robert L. Rabin, *Automated Vehicles and Manufacturer Responsibility for Accidents: A New Legal Regime for A New Era*, 105 VA. L. REV. 127, 130 (2019).

91. *Id.* at 147; see also Kyle D. Logue, *The Deterrence Case for Comprehensive Automaker Enterprise Liability*, 2019 J.L. & MOBILITY 1, 5; David C. Vladeck, *Machines Without Principals: Liability Rules and Artificial Intelligence*, 89 WASH. L. REV. 117, 129 n.39, 146–47 (2014).

92. Bryant Walker Smith, *Automated Driving and Product Liability*, 2017 MICH. ST. L. REV. 1, 2.

of ownership. I would argue it does. The fact that the owner-manufacturer still exercises a degree of control and, in some respects, has better information about the connected device than does the owner-“operator,” suggests a different paradigm.⁹³ Conceived as a co-ownership relationship, liability should attach to the owner in control. If operating autonomously, control rests with the manufacturer while the co-owning individual has but a passive role in its operation that is more akin to that of a passenger, rendering the manufacturer the most responsible party for any crash—or at least jointly responsible.⁹⁴

On the other hand, where the vehicle fails to perform as expected, solely due to a defect in manufacturing or design, traditional principles that impose manufacturer liability should still apply—even if the manufacturer can be deemed a co-owner. That the cause of the vehicle’s failure was a foreseeable security breach should not change that calculus. For those reasons, I suggest that states adopt a strict-liability regime. Some scholars, recognizing the application of ownership concepts for autonomous vehicles, appear to agree.⁹⁵

To settle on the proper regime, whether a consumer-expectations or risk-utility test should apply, a fundamental decision on the purpose served by tort law must first be made. If it serves its traditional purpose of vindicating the victim’s rights by providing compensation for the consequences of a wrongdoer’s failure to discharge a duty, while operating “secondarily to confirm and reinforce public standards of behavior[.]”⁹⁶ then consumer expectations provide the proper perspective. Such an approach is anchored in understandings of tort law that date back to its earliest conceptions.⁹⁷

At its most basic level, a reasonable consumer would expect an autonomous vehicle to operate according to the rules of the road, so that it does

93. As just one example of how this plays out in cars, Tesla’s Autopilot system, which autonomously can accelerate and brake while disclaiming that it is more than a driver assistance feature, has come under the review of the National Highway Traffic Safety Administration (NHTSA) after 11 incidents in which its vehicles struck parked fire trucks, police cruisers, and other emergency vehicles. In eight other collisions, 10 people died. After Tesla added video games to its touchscreen display for passengers to play, NHTSA opened an investigation into related safety concerns. A day after the investigation was announced, Tesla announced it was changing the games’ software to prevent play while the vehicle was moving. See Neal E. Boudette, *Tesla Agrees to Stop Letting Drivers Play Video Games in Moving Cars*, N.Y. TIMES (Dec. 23, 2021), <https://www.nytimes.com/2021/12/23/business/tesla-video-games.html>. The report shows that, despite Tesla’s proclamation that Autopilot should not be treated as autonomous driving, the system may still be responsible for control of the vehicle. It also shows that Tesla has sufficient control that it is capable of modifying the purchased product in unexpected ways to its operator, and thus maintains a type of control that does not exist with unconnected products. The disabling of the video game feature also demonstrates knowledge that drivers, not just passengers, are likely to engage in gameplay. *Id.*

94. *Cf.* 8 AM. JUR. 2D *Automobiles* § 613.

95. Sophia H. Duffy & Jamie P. Hopkins, *Sit, Stay, Drive: The Future of Autonomous Car Liability*, 16 SMU SCI. & TECH. L. REV. 453, 453 (2013) (“The laws governing canine ownership show that applying strict liability to autonomous car owners accomplishes the dual purpose of fairly assessing liability without hampering the widespread adoption of this marvelous technology.”)

96. DAN B. DOBBS, PAUL T. HAYDEN & ELLEN M. BUBLICK, *THE LAW OF TORTS* § 4 (2d ed. 2021).

97. See, e.g., FRANCIS HILLIARD, *THE LAW OF TORTS* 72 (3d ed. 1866) (“The liability to make reparation for an injury is said to rest upon an original moral duty, enjoined upon every person so as to conduct himself or exercise his own rights as not to injure another.”) (footnote omitted).

not precipitate a collision and reasonably averts those in which others might have some fault.

On the other hand, a risk-utility approach that incorporates a reasonable alternative design requirement sets too heavy a burden because it requires a plaintiff to both determine the design flaw that caused the collision and develop a safer design that would have worked better. An individual or a business, injured by an AV, even employing an expert, lacks the means by which to accomplish what an automotive company's research and development department evidently could not. Thus, giving way to what might be realistic, the alternative reasonable-design approach cannot work without effectively immunizing the manufacturer, regardless of what corners it may have cut.

That is not to say that risk-utility cannot play a role. If risk-utility is instead defined in terms of who has the best opportunity to be the "cheapest cost avoider," the AV manufacturer stands firmly in those shoes. In that respect, the consumer-expectations and lowest-cost-avoider tests converge. A manufacturer exercising significant, if not total, control over the product reasonably should be expected by the consumer and by economic theory to put a product on the road that, represented as a completely autonomous vehicle, should be accountable when it fails to perform in a safe manner and thus insure its safe operation.

C. THE RETAILER AND THE CONNECTED PRODUCT

Retailers have long shared liability with manufacturers,⁹⁸ although some states have enacted statutes that entitle an innocent seller to seek indemnity for litigation costs from the manufacturer of a product alleged to be defective.⁹⁹ Yet, where the retailer assembled the item, implemented modifications, or kept an independent connection to the product, even when coordinated or implemented with the manufacturer's consent or involvement, independent liability may attach.¹⁰⁰

Where, however, the retailer has no connection with the product that duplicates, supplements, or displaces that of the manufacturer, liability ought to still lie, but traditional concepts of indemnity should apply.¹⁰¹ In this respect, the *unconnected* retailer requires no adjustment in traditional products liability.

D. A SHORT NOTE ON PROXIMATE CAUSE

Foreseeability has long served as the touchstone for proximate cause in tort law and should remain a key factor in liability for injuries caused by connected products. Proximate cause itself has a mercurial quality that defies easy

98. See Robert A. Sachs, *Product Liability Reform and Seller Liability: A Proposal for Change*, 55 BAYLOR L. REV. 1031, 1032–33 (2003).

99. See, e.g., Tex. Civ. Prac. & Rem. Code Ann. § 82.002(a).

100. See Sachs, *supra* note 98, at 1101–02 (listing statutes that treat a retailer as a manufacturer in some of these circumstances).

101. See RESTATEMENT (FIRST) OF RESTITUTION § 76 (1937).

definition.¹⁰² Even without the advent of connected devices and the forces that could alter their operation, courts have found proximate cause “notoriously confusing” and characterized by an utter “lack of consensus on any one definition.”¹⁰³

Generally, a proximate cause must only be “substantial enough and close enough to the harm to be recognized by law, [and] a given proximate cause need not be, and frequently is not, the exclusive proximate cause of harm.”¹⁰⁴ It is a tool used to eliminate liability for remote causes, meaning those “so attenuated that the consequence is more aptly described as mere fortuity.”¹⁰⁵ Whether an intervening criminal event, such as hacking, breaks the causal chain and becomes a superseding event, depends upon “whether the type of intervention was a reasonably foreseeable consequence of the product defect.”¹⁰⁶ Still, there is likely to be some fluidity for a time in what might be reasonably anticipated and avoided as the capacity to do so evolves. The experiments in hacking AVs¹⁰⁷ establish that hacking is foreseeable and frequently updated security measures should be expected. The type of lag time that is reasonable between the discovery of a security hole or flaw and its remedy will play out in expert testimony.

Where a cause of action exists by statute, proximate-cause standards are statute-specific,¹⁰⁸ with more lenient requirements applied in some instances,¹⁰⁹ and far more rigorously in others.¹¹⁰ Still, even in the statutory context, the applicable proximate cause must be consonant with “what justice demands.”¹¹¹

For connected devices, a rigid proximate cause standard will often mean an assessment of what the manufacturer knew or should have known and what it should have done and when it should have done it. Still, although significant defects and insecure devices create obvious vulnerabilities to hacking, reasonable efforts at plugging security holes can still prove ineffective. A concept of what justice demands in such instances will need to be developed. Because, in some ways, the manufacturer remains in possession of the device through the software that it alone controls, a far more forgiving causal standard seems apt that looks to a form of strict liability.

102. *Lexmark Int'l, Inc. v. Static Control Components, Inc.*, 572 U.S. 118, 133 (2014).

103. *CSX Transp., Inc. v. McBride*, 564 U.S. 685, 701 (2011); *see also* W. PAGE KEETON, DAN B. DOBBS, ROBERT E. KEETON & DAVID G. OWEN, *PROSSER AND KEETON ON THE LAW OF TORTS* 263 (W. Page Keeton, 5th ed. 1984) (describing the disagreeing opinions as a “welter of confusion”).

104. *Sosa v. Alvarez-Machain*, 542 U.S. 692, 704 (2004).

105. *Paroline v. U.S.*, 572 U.S. 434, 445 (2014) (citation omitted).

106. DAVID G. OWEN & MARY J. DAVIS, OWEN & DAVIS ON PRODUCTS LIABILITY § 1:16 (4th ed. 2014).

107. *See* notes 68–69 and accompanying text *supra*.

108. *Lexmark Int'l, Inc. v. Static Control Components, Inc.*, 572 U.S. 118, 133 (2014).

109. *See CSX Transp., Inc. v. McBride*, 564 U.S. 685, 701 (2011).

110. *See, e.g., Holmes v. Sec. Investor Prot. Corp.*, 503 U.S. 258, 269 (1992).

111. *Id.* at 268.

III. RETHINKING PERSONAL JURISDICTION FOR PRODUCTS LIABILITY

Most products liability cases take place in state court or federal courts sitting in diversity. Modern personal-jurisdiction doctrine is less concerned about haling a defendant into a jurisdiction unknown to it than about federalism limits on a state's authority to try a case.¹¹² Today's generally more restrictive approach to personal jurisdiction is at odds with predictions the Supreme Court ventured more than sixty years ago. In 1957, it assumed that "modern transportation and communication" would continue the trend of "expanding the permissible scope of state jurisdiction over foreign corporations and other nonresidents" in state courts as commercial transactions lead to a further "nationalization of commerce."¹¹³ Forty years later, a federal district court predicted that the Internet, which "makes it possible to conduct business throughout the world entirely from a desktop," creates a "likelihood that personal jurisdiction can be constitutionally exercised [in direct proportion] to the nature and quality of commercial activity that an entity conducts over the Internet."¹¹⁴

These predictions have not come to pass—yet. To date, personal jurisdiction based on the Internet's reach into a jurisdiction is a non-starter.¹¹⁵ A manufacturer's website is generally deemed a passively available way for a customer to interact with a manufacturer. It therefore does not satisfy the requirement that the relationship that conveys jurisdiction "must arise out of contacts that the 'defendant *himself*' creates with the forum State."¹¹⁶ While the website does not reach out to the customer, the manufacturer of a connected device is repeatedly reaching out to the device, wherever located, and that action changes the equation tremendously.

The Supreme Court's most recent pronouncement on personal jurisdiction appears to support that view. *Ford Motor Co. v. Montana Eighth Judicial District Court* involved two cases about Ford vehicles not originally sold in the states where the drivers lived and were injured.¹¹⁷ Ford resisted personal jurisdiction, asserting that it could only be made to answer where the original sale of the vehicle took place, where the car's flawed feature was designed, or where the vehicle had been manufactured.¹¹⁸ The Court rejected those limitations, holding that "[w]hen a company like Ford serves a market for a

112. *Bristol-Myers Squibb Co. v. Superior Court*, 137 S. Ct. 1773, 1780–81 (2017).

113. *McGee v. Int'l Life Ins. Co.*, 355 U.S. 220, 222–23 (1957).

114. *Zippo Mfg. Co. v. Zippo Dot Com, Inc.*, 952 F. Supp. 1119, 1123–24 (W.D. Pa. 1997).

115. *See, e.g., Cadle Co. v. Schlichtmann*, 123 F. App'x 675, 678 (6th Cir. 2005) ("[T]he operation of the website alone is insufficient to confer [personal] jurisdiction . . .").

116. *Walden v. Fiore*, 571 U.S. 277, 284 (2014) (citing *Burger King Corp. v. Rudzewicz*, 471 U.S. 462, 475 (1985)).

117. 141 S. Ct. 1017, 1022 (2021).

118. *Id.*

product in a State and that product causes injury in the State to one of its residents, the State's courts may entertain the resulting suit."¹¹⁹

Influential to its decision was the global reach of Ford's business, where it "markets, sells, and services its products across the United States and overseas."¹²⁰ The Court pointedly noted that nearly all Ford dealerships provide repair and maintenance services for the vehicles to assure they continue to operate long after the sale.¹²¹ Ford also urges customers to "Keep Your Ford a Ford," and "provides original parts to auto supply stores and repair shops across the country," thereby "fostering an ongoing relationship between Ford and its customers."¹²² The *Ford* decision came after a decade of precedent that continuously contracted the reach of personal jurisdiction.¹²³ In a concurrence joined by Justice Thomas, Justice Gorsuch described those limitations as "almost quaint" and certainly dated, suggesting an openness to rethinking personal jurisdiction's due process limitations.¹²⁴

Connected devices may accelerate that rethinking. Their features satisfy traditional considerations because the manufacturer continuously reaches out to the device for data, provides updates, and usually owns the device's embedded software. Its "ongoing relationship," to use *Ford's* terminology, is directly with the device and thus implicitly with the customer or user of the device. Its actions initiate contact with the device, which may not be the type of purposeful availment that has animated some personal-jurisdiction jurisprudence but still provides the type of contact that a defendant initiates itself, irrespective of the device's geographic location.

The increasing presence of connected devices in the marketplace will no doubt accelerate *Ford's* recognition that judicial authority over persons outside a geographically limited area is eminently fair and may yet render true the Supreme Court's 1957 prediction about how modern transportation and communications will change the personal-jurisdiction calculus. As a result, a vastly expanded personal-jurisdiction terrain appears likely.

CONCLUSION

Technology has long shaped the law of products liability, requiring it to adjust to the realities of the types of products manufactured and what consumers face in the marketplace. Connected devices open a new world to consumers and will similarly require a re-conception of aspects of the applicable law. Ownership of a connected device, as a functioning item, may no longer be lodged solely in the purchaser, but shared with the manufacturer who maintains

119. *Id.*

120. *Id.*

121. *Id.* at 1023.

122. *Id.* at 1022–23.

123. See Michael H. Hoffheimer, *The Stealth Revolution in Personal Jurisdiction*, 70 FLA. L. REV. 499, 502–03 (2018).

124. *Ford Motor Co. v. Mont.* Eighth Judicial Dist., 141 S. Ct. 1017, 1034 (2021) (Gorsuch, J., concurring).

proprietary software within the device. The relationship might not be accurately characterized as manufacturer and customer, but as co-owners or service provider and customer.

The manufacturer maintains frequent, if not continuous interaction with the device, giving it a form of shared possession over the product. Preserving the device's usefulness through software and security updates, capturing real-time data about its use and functioning, and conveying useful information to the customer are central features of connected devices. The new relationship that grows out of those attributes will necessarily impose new duties that, if not discharged or if discharged negligently, will produce liability. To the extent that consumers can expect to rely on those features, it may even bring a revitalization and expansion of strict liability. Perhaps most inevitably, it will expand the reach of personal jurisdiction in state courts. The result will not be evolutionary, but revolutionary.