

NOT WHO BUT WHAT:

Assigning liability for collisions of autonomous vehicles

By William Reed, Sherman & Howard L.L.C.

I. Introduction

On the wind-whipped morning of March 13, 2004, teams of automotive engineers gathered in the Mojave Desert in Nevada, with spectators in grandstands and helicopters overhead looking on. The engineers' self-driving creations rolled onto the desert sand and started the 150-mile race route that comprised the \$1 million challenge staged by the Defense Advanced Research Projects Agency ("DARPA"). DARPA wanted to develop self-driving vehicles primarily to counter the danger of improvised explosive devices in Iraq, but the military was struggling to ace the technical challenges of such an enterprise. The private teams of engineers and academics struggled as well – one by one the robotic vehicles flamed out on the desert course that day, some quite literally. Much of the press coverage of the time depicted the project as a pipe dream.

Undeterred by the debacle in the desert, DARPA upped the prize to \$2 million and set a new race date. The engineering teams set to work. On October 8, 2005, five self-driving vehicles completed a 132-mile route through the desert, accomplishing what had seemed impossible the year before. Next, DARPA set its sights on an urban challenge more similar to conditions in urban war zones.¹ And the transition to urban driving conditions also illuminated the application of self-driving vehicles to everyday life, helping to spur a technological revolution that will fundamentally transform automobiles.

¹ For a much more detailed account of the DARPA challenges, see Lawrence D. Burns with Christopher Shulgan, *Autonomy: The Quest to Build the Driverless Car – And How It Will Reshape Our World* 13-73 (2018).

Experts in the field predict that cars will eventually be summoned by an app when needed, take the passenger to a destination, and then leave – like full-time Uber-ing without drivers. The disruption in the way we drive will change automobile ownership, insurance, maintenance, and parking.² The disruption also promises to drastically cut the number of deaths and injuries from car crashes, and to simultaneously free up travel time for productivity or leisure. These drastic changes, however, will not come without challenges.

The changes in how we drive will also change the calculus of liability for auto collisions. As a general trend, liability will shift from driver negligence to products liability, a shift from *who* to *what* is at fault. However, the transition will be dynamic and fluid as society transitions through phases of autonomous vehicle adoption. The assignment of liability may also affect the rate and success of autonomous vehicle adoption and a system of liability at the outset of this revolution may avoid growing pains later.

This paper explores (1) a brief discussion of traditional liability for automobile accidents; (2) the foreseeable levels of autonomous vehicle adoption; and (3) the advantages and disadvantages of possible liability frameworks. Notwithstanding the many unknowns that remain regarding autonomous vehicle technology and adoption, it is worthwhile to anticipate, prepare for, and maybe even help shape the liability questions that will inevitably follow this transition.

II. Past and Present: Who is at fault?

A. Past

² Hod Lipson and Melba Kurman, *Driverless: Intelligent Cars and the Road Ahead* 172 (2016) (“While driverless cars will save lives, fuel, and time, the losers will be the companies whose business models rely on the morbid profits generated by car accidents. These morbid merchants include a broad array of businesses, from car insurers to personal-injury lawyers, from body shops to part suppliers, from highway-patrol officers to defensive-driving instructors, from organ-donation organizations to emergency-room operators, and from traffic courts to jails.”).

At the dawn of the 20th Century, horseless buggies were a new-fangled contraption that many detested. “I’ll never insure a gasoline can on wheels, the noisy stinking things!” declared Charles Platt, the president of Insurance Company of North America (INA).³ Some jurors saw things the same way. The proud owner of an 1899 Rikker jumped out when his wheel got lodged in a Pittsburgh streetcar track, only to see a trolley car smash his pride and joy after the driver had left the controls to chat with the conductor. The Rikker owner sued, and in court the streetcar company’s attorney explained that the poor working man’s mode of transportation “should not be penalized for damaging a rich man’s plaything, which was good only to frighten women, children, and horses.” The jury awarded the Rikker owner \$1.⁴ Liability (and the damages awarded for that liability) are inextricably linked to societal norms and value judgments.

B. Present

Despite early detractors, the automobile was woven into the fabric of American culture by the middle of the 20th century. The number of motor vehicle registrations in the United States grew from 8,000 in 1900, to 49 million in 1950, to 201 million by 1995.⁵ “Today in the United States, 212 million licensed drivers own 252 million light-duty vehicles and drive 3.2 trillion miles a year,” and these numbers continue to climb.⁶ All those drivers, vehicles, and miles

³ John A. Bogardus Jr., “‘A Gasoline Can on Wheels’ – Spreading the Risks: Insuring the American Experience,” IRMI, January 2004 (<https://www.irmi.com/articles/expert-commentary/spreading-the-risks-insuring-the-american-experience>).

⁴ *Id.* (quoting from Ronald W. Vinson and John Cosgrove, “Challenging Risks: The Saga of American Insurance,” unpublished manuscript).

⁵ U.S. Department of Transportation, Federal Highway Administration (<https://www.fhwa.dot.gov/ohim/summary95/mv200.pdf>).

⁶ Lawrence D. Burns with Christopher Shulgan, *Autonomy: The Quest to Build the Driverless Car – And How It Will Reshape Our World 2* (2018).

inexorably lead to crashes. In 2017, there were more than 6.4 million crashes causing death, injury, or property damage.⁷

Growing alongside the auto industry was a familiar system of liability and insurance. More than 90 percent of crashes are caused by human error.⁸ The legal question following most car crashes is one of negligence – who was at fault. Who was speeding? Who was texting? Who ran a red light? Or was there shared culpability among drivers? “When people get into car crashes with one another, vehicular negligence is typically the cause. Determining which party is negligent, and therefore at fault, is central to the common understanding of automotive risk. Negligence means liability, and liability translates the human failing of a vehicle operator into financial compensation.”⁹

Most cases today are small, easily understood by adjusters or factfinders, and follow predictable patterns. Of those 6.4 million crashes annually, more than 70 percent involve only property damage (no injuries or deaths).¹⁰ The National Safety Council reports that property damage averages a cost of only \$4,400 per vehicle, as compared to fatal crashes that average a cost of \$1,615,000 per death but comprise only 0.5 percent of total crashes.¹¹ The bottom line is that the vast majority of cases are not worth the cost of litigation and are efficiently handled by insurers using the familiar parameters of driver negligence that can often be decided by a police

⁷ U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 2017* (released Sept. 2019) <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812806>

⁸ Paul Tullis, “Self-Driving Cars Might Kill Auto Insurance as We Know It,” Bloomberg, Feb. 19, 2019 (<https://www.bloomberg.com/news/articles/2019-02-19/autonomous-vehicles-may-one-day-kill-car-insurance-as-we-know-it>).

⁹ Ian Bogost, “Can You Sue a Robocar?” The Atlantic (March 20, 2018) <https://www.theatlantic.com/technology/archive/2018/03/can-you-sue-a-robocar/556007/>

¹⁰ *Supra*, note 6

¹¹ National Safety Council <https://injuryfacts.nsc.org/all-injuries/costs/guide-to-calculating-costs/data-details/>; *supra*, note 6

report at the scene and a brief interview of the witnesses. Liability can typically be determined efficiently and cost-effectively.

C. Future

Autonomous vehicles promise to drastically reduce the total number of auto accidents by eliminating human error, but will fundamentally change the question of liability for the remaining accidents. Instead of evaluating human error for negligence, auto accident cases in the future will evaluate the failure of software or mechanical systems. It is unlikely the causes of these crashes can be determined by police at the scene or by witnesses, can be easily understood by factfinders without expert witnesses, or can be affordably litigated. Yet, the vast majority of property damage crashes will not be worth the cost of complex litigation. This will require an entirely new system of assigning liability.

III. Levels of Autonomous Vehicle Adoption

Another pothole in the road to determining liability for autonomous vehicle crashes is that adoption of the technology will not be immediate or uniform. First, vehicles use different levels of autonomy. Second, individuals purchase the vehicles one by one, so they will be integrated with driven cars during the transition period. These factors will affect liability determinations. Although prognosticators think we will eventually move away from individual vehicle ownership in favor of fleets of corporately-owned self-driving cars, it may take decades to reach that point. Liability may remain fluid during this long transition.

A. Levels of Autonomy

Makers of autonomous vehicles have developed distinct levels of autonomy:

- Level 0: No Automation. Nothing beyond cruise control, like most cars today.
- Level 1: Driver Assistance. Adaptive cruise control and lane assist, to help drivers.

- Level 2: Partial Automation. Assists with speed, steering, and maintaining distance with other cars, like Tesla's Autopilot and Volvo's Pilot Assist.
- Level 3: Conditional Automation. Vehicle can drive itself under ideal conditions, such as a divided highway at a certain speed. The human driver takes over in all other conditions. An example is the 2019 Audi A8.
- Level 4: High Automation. Vehicle can drive itself on known routes. Waymo has developed this technology, but regulatory and legal obstacles remain in most states before widespread public use.
- Level 5: Full Automation. This is the true driverless car that can navigate all road conditions and requires no human driver.

Although public adoption of Level 2 and Level 3 technology is occurring right now, some view this as the most dangerous phase of development and think we should avoid these levels altogether. The Handoff Problem describes the difficulty of handing over control to the car, while asking the human driver to remain vigilant. Google's research indicates that once the vehicle takes over, the human driver checks out. Testing by NHTSA indicates that some drivers require up to 17 seconds to retake control, which is much too long to avoid a crash. The perils of the Handoff Problem evidenced themselves in the 2016 death of a driver using Tesla's Autopilot mode on a highway, who broadsided a tractor-trailer making a left in front of the vehicle.¹²

The implications for liability are unclear in Levels 2 and 3. On one hand, a product malfunction may be the immediate cause of the crash. On the other hand, at these levels of automation, the human driver is asked to remain engaged and retake control is a problem arises. So, it is muddy whether the vehicle manufacturer is at fault for the technology or for making an

¹² Supra, note 1, chapter "Human Factors"

unreasonable demand on the driver, or whether the human driver is ultimately responsible. Once the technology reaches Level 4 and Level 5, it becomes plain that the liability should be assigned to the product.

B. Mix of Vehicles

There is almost no chance that an edict will come down that all Americans must scrap their current vehicles and move to AV. Instead, the technology will likely be incorporated over time, as is happening now. Even when Level 5 vehicles are available, only some individuals will buy them. This market penetration doesn't figure to happen quickly; the Stevens Institute of Technology in New Jersey issued a report estimating that 23 million autonomous vehicles will be on American roads by 2035, still less than 10 percent. This will result in a long-term mix on the road of human drivers and autonomous vehicles.

Again, this will muddy the waters of liability. When an autonomous vehicle crashes with a traditional vehicle, two entirely different systems of liability will also collide. The human driver may have acted negligently and caused the crash; or the autonomous vehicle may have malfunctioned and caused the crash. The ownership patterns for new technology mean that wealthier individuals will probably own driverless cars first and the new-fangled contraption may be viewed askance as a "rich (wo)man's plaything," just as the first automobiles were 120 years ago. To the contrary, the fact that more than 90 percent of vehicle crashes are caused by human error may lead to at least a tacit presumption that the human driver was at fault. Some researchers theorize that human drivers may engage in more risky driving behavior around autonomous vehicles because they know the self-driving cars must play by the strict rules of their programming.¹³

¹³ Researchers at Columbia Engineering and Columbia Law School unveiled a game theory approach that describes the interactions among law makers, manufacturers, the self-driving car, and human drivers, and develops a fault-

The mix of human error and AV technology was on display in the March 2018 Uber crash in Arizona that killed a pedestrian. There was evidence that the pedestrian was impaired and jaywalked into the road from the shadows, but questions remained as to whether a human driver would have anticipated and avoided her. The National Transportation Safety Board investigated and found plenty of blame to go around, splitting the fault between the pedestrian, Uber’s vehicle design and safety culture, the state of Arizona for insufficient oversight of AV testing on public roadways, and primarily the distracted safety driver in the vehicle (who was watching “The Voice” on her cell phone, which relates back to the dangers of disengaged human drivers of self-driving cars).¹⁴ The NTSB’s approach of blaming everyone and everything involved hints that complex apportionments of comparative negligence may be the current rule in these cases.

C. The Final Level

Assuming the visions of a driverless future come true, the time will come when we have only autonomous vehicles on the road and very few of these vehicles will be owned by individuals. Some crashes will still occur, but they will be far less common. And, at this point, the initial liability question will be whether or which automated car malfunctioned. The natural assumption is that we will simply shift from a negligence liability framework to a products liability framework. But is it that simple?

based liability rule that evolves as autonomous vehicles gain market penetration. Translating this heady research into policy may prove to be a challenge. See Xuan Di, Xu Chen and Eric Talley, “Liability Design for Autonomous Vehicles and Human-Driven Vehicles: A Hierarchical Game Theoretic Approach,” (Nov. 11, 2019) (accessed at <https://arxiv.org/pdf/1911.02405.pdf>).

¹⁴ The NTSB report is summarized at <https://www.nts.gov/news/events/Documents/2019-HWY18MH010-BMG-abstract.pdf>

IV. Frameworks for Liability: What is at fault?

Countless systems of liability are possible for autonomous vehicle crashes and, just like insurers' efficient solutions for traditional car crashes, these systems may grow up organically over the next several decades in a formulation that is difficult to fathom today. Nevertheless, anticipating the shifts in liability could be useful for business purposes and developing a cogent system of liability early on may ease the transition to driverless cars. Below is a discussion of three possible liability frameworks: (1) strict products liability, (2) negligence products liability, and (3) a victim compensation fund.

A. Product Liability - Strict

Liability will almost certainly migrate from human drivers to the machines that drive humans. A slow transition from driver negligence to products liability as vehicles ascend the levels of autonomy appears inevitable. Led by the early commentary of legal scholar Bryant Walker Smith, a professor at the University of South Carolina, this view has become conventional wisdom and made its way from legal journals to popular press like *The Atlantic*, which reports: "Overall, there's recognition that self-driving cars implicate the manufacturer of the vehicle more than its driver or operator."¹⁵

The product liability view makes sense as a starting point for understanding liability in autonomous vehicle crashes. If cars have no steering wheel or pedals, it's difficult to see how a driver can possibly be at fault. Product liability in the autonomous vehicle context has the appeal of *res ipsa loquitur* logic – if the car crashed, something must be wrong with the product. Product liability also feels fair. The companies reaping the profits from this anticipated

¹⁵ Ian Bogost, "Can You Sue a Robocar?" *The Atlantic* (March 20, 2018) <https://www.theatlantic.com/technology/archive/2018/03/can-you-sue-a-robocar/556007/>

technological revolution can surely bear the burden of its costs and strive to make a safer product.

Yet, even if the crash involves only autonomous vehicles, the assignment of liability may not be so simple: “If the lidar goes on the blink, is that the fault of the carmaker or the supplier of the lidar? What if the driver failed to get the latest firmware update—so now it’s his fault? If a Cadillac with Super Cruise loses its internet connection, is that on General Motors or Verizon? What if the car gets hacked and redirected to a thief’s lot? What if municipal infrastructure managing traffic flow loses its data?”¹⁶ Figuring out which system screwed up is not necessarily easy.

And even if a shift toward manufacturer liability seems inevitable as the macro trend, this is not the end of the liability question. Will the legal system maintain the traditional liability standards, that human drivers are evaluated under a standard of negligence while manufacturers are evaluated under a strict liability standard? Some legal scholars are now bucking the idea that the move toward strict product liability is inevitable or even desirable.¹⁷

The primary problem is that products liability litigation costs a lot of money. “Products liability litigation is notoriously time-consuming and difficult—thus, invariably, expensive.”¹⁸ Products liability is complex, will require experts on software and vehicle design, and cannot be quickly assessed at the time of the crash. On the consumer side, this may hurt plaintiffs in car crashes. Recall that more than 70 percent of car crashes today involve only property damage,

¹⁶ Paul Tullis, “Self-Driving Cars Might Kill Auto Insurance as We Know It,” Bloomberg, Feb. 19, 2019 (<https://www.bloomberg.com/news/articles/2019-02-19/autonomous-vehicles-may-one-day-kill-car-insurance-as-we-know-it>).

¹⁷ Gordon Anderson and Austin Brown, “Product Liability Is the Wrong Standard for Self-Driving Cars,” UC Davis Policy Institute for Energy, Environment, and the Economy (March 29, 2019) (accessed at <https://policyinstitute.ucdavis.edu/product-liability-is-the-wrong-standard-for-self-driving-cars/>).

¹⁸ *Id.*

and the amount of property damage averages less than \$5,000 per vehicle. No one can litigate a products liability case for those stakes. Granted, the calculus will change: crashes may be less frequent but more serious; the cost of AV parts may be much higher; and if consumers no longer own the vehicles, only injury and death cases would yield consumer claims. Nevertheless, plaintiffs suffering property damage or non-disabling injuries (and their insurers) may fall into a gap where it is more cost-efficient to pay routine claims than to litigate liability. On the manufacturer side, the costs of recurring products liability cases for crashes may drive many companies from the market, increase the prices to consumers, and dramatically slow the adoption of AV technology.¹⁹

One possible solution for litigation costs is to group car crashes into class actions. This may work for situations where a single design flaw in software or sensors causes many crashes, akin to the sticking accelerator cases that Toyota faced. A systematic problem may be well suited to class litigation, but the solution is not ideal in most instances. Most car crashes do not fit the mold of a systematic failure; the cases may not be similar enough to qualify for class treatment; the attorney fees often cut deep into the recovery; and individuals in routine car crashes will not want to be embroiled in drawn out class litigation.

In their article critiquing a strict products liability standard for autonomous vehicle crashes, Gordon Anderson and Austin Brown offer two additional alternatives: a negligence standard for manufacturers or a victim compensation fund.

B. Products Liability - Negligence

Anderson and Brown propose adopting a manufacturer negligence standard. Courts would assess what the autonomous vehicle actually did under a “reasonable human driver”

¹⁹ *See id.*

standard. The appeal of this standard is that it would essentially keep the current system of assessing liability in place, including the efficiencies that allow drivers and insurers to work through the 6.4 million crashes occurring each year. The focus on what the car actually did – did it run a red light or fail to yield – is much simpler and less costly than a deep dive into the car’s software. During the long transition period when human drivers and autonomous vehicles share the road, this would also level the playing field so that each vehicle is evaluated under the same standard.

One drawback to the reasonable human driver standard is that it will not reach the root causes of crashes of driverless cars. One of the chief societal goals of autonomous technology is to reduce crashes and the process of assessing the car’s inner workings after crashes – albeit painful – provides more incentive and information to enhance safety. As a society, we want driverless cars to be better than human drivers.

Researchers at Columbia University, referred to above, have attacked the liability problem with a similar negligence-based solution, particularly the assignment of liability when we have a mix of human drivers and autonomous vehicles.²⁰ In some ways, the Columbia proposal is quite complex, using a game theory approach that evolves as driverless cars become more common. But the fundamental approach to liability is not novel. At its root, the Columbia proposal embraces a negligence standard²¹ and assumes most crashes will involve comparative fault that must be divvied up between humans and machines. Game theory comes into play as a way to assign this comparative fault.

²⁰ See Xuan Di, Xu Chen and Eric Talley, “Liability Design for Autonomous Vehicles and Human-Driven Vehicles: A Hierarchical Game Theoretic Approach,” (Nov. 11, 2019) (accessed at <https://arxiv.org/pdf/1911.02405.pdf>).

²¹ *Id.* at 2 (“Negligence-based liability is shown to be both necessary and sufficient to ensure an efficient liability rule . . . , thus will be the focus of this paper.”).

The Columbia approach has the advantage of developing a liability system that may probe the root causes of accidents, not just what the autonomous vehicle did. However, it is difficult to imagine the American legal system employing game theory to assign liability, as it would mark such a radical shift in the way legal decisions are made. The Columbia proposal may be more useful as a way to inform the policy around autonomous vehicles, which could then be adopted into standards and legislation on liability.

The issue with any negligence-based liability framework for autonomous vehicles is that not all crashes occur as a result of negligence. If 90 to 95 percent of car crashes are caused by driver error, then 5 to 10 percent are not. Some crashes cannot reasonably be avoided because of the particular circumstances, or weather conditions, or a host of other reasons. As driver error is reduced by the elimination of human drivers, the proportion of no-negligence crashes should rise. This may be fine when each driver has her own car, her own insurance policy, and the insurer covers its own insured for no-fault wrecks. But if an individual no longer owns a car, no longer carries an auto policy, and is riding in a driverless Uber that crashes with no fault, who will pay for that passenger's injuries? Perhaps the negligence liability framework need not change, but then the way that consumers insure themselves must change, such as through ride-service coverage for passengers or individual passenger policies.

A related complication is that driving occasionally involves moral decisions that cannot be weighed on a negligence standard.²² Ethicists call this the Trolley Problem, which essentially involves choosing one human life over another. Imagine this scenario: A car is headed down a two-lane country highway. Out of a hidden driveway comes a bouncing basketball, and after the ball comes a child onto the roadway. The car is traveling at a high rate of speed and cannot stop

²² See generally Samuel I. Schwartz, *No One at the Wheel: Driverless Cars and the Road of the Future*, Chapter 6: Makers, Drivers, Passengers, and Pedestrians: Hard Questions and Moral Dilemmas (2018).

in time. But there is an oncoming car in the opposite lane, and if the car swerves left, it will hit the oncoming car. And there is a large tree just off the shoulder to the right, so if the car swerves right it will collide with the tree. A human driver may choose to sacrifice her own safety and swerve into the tree to avoid hitting the child or the oncoming car. But if a computer is at the wheel of an autonomous vehicle, what should it do in this split second? Should it sacrifice the passenger within the vehicle for the sake of the child? Would a consumer want a product that may choose to sacrifice that consumer's life?²³

Presumably this is a decision that software engineers had to make before the car ever left the factory. Yet these are weighty decisions to place on individuals or even individual companies. Germany's Federal Ministry of Transport and Digital Infrastructure developed a list of twenty guidelines for autonomous vehicle makers, including the mandate that saving human life must supersede any other consideration and the vehicle cannot distinguish between humans based on factors like age or disabilities.²⁴ The takeaway is that assigning negligence in retrospect does not address all situations. Part of the solution must be development of policy as a society that is then programmed into self-driving vehicles. No fault should be assigned to car-makers for implementing these policies in their vehicles.

C. Victim Compensation Fund

The other solution proposed by Anderson and Brown is to create a victim compensation fund.²⁵ The idea is to skip the courts and assignment of liability altogether. Instead, manufacturers of autonomous vehicles would be required to contribute to the fund by proportion

²³ Schwartz concedes that the Trolley Problem will not occur often, but estimates that the 12 trillion miles driven each year will yield about 1,000 such situations.

²⁴ *See id.*

²⁵ *Supra*, note 17

of market share or percentage of crashes. Then victims of crashes could quickly recover compensation.

The tension underlying this proposal is the reach and effectiveness of government policy. While the government has certainly been involved in aspects of the automobile industry for 120 years, setting standards for everything from speed limits to emissions, the assignment of liability has generally been the realm of the courts and private ordering. Nevertheless, as discussed above, it is probably necessary for government to provide ethical standards for the algorithms in autonomous vehicles. Requiring contributions based on the number of crashes involving each manufacturer's vehicles would maintain a safety incentive. And the nature of the risk will change from human randomness to product defects. Hyejin Youn, a professor of management and organizations at Northwestern University, has opined that the changing nature of the liability and risk is a "public policy problem, best addressed in government."²⁶

V. Conclusion

Autonomous vehicles will undoubtedly change the assessment of liability for automotive crashes. And a cogent system of liability could drastically affect the rate of adoption of autonomous vehicles. The stakes are high. In 2017, there were more than 6.4 million crashes in the United States causing death, injury, or property damage.²⁷ These crashes resulted in 37,133 deaths and 2,746,000 injuries.²⁸ The government estimates that the economic cost of traffic crashes in 2010 (most recent available) was \$242 billion.²⁹ Given the potential of autonomous

²⁶ *Supra* n.8

²⁷ U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 2017* (released Sept. 2019) <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812806>

²⁸ *Id.*

²⁹ *Id.*

vehicles to eliminate the 90 percent of crashes caused by human error, developing a system of liability that responsibly fosters their acceptance should be a priority.