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Autonomous Vehicles: A Future Fast Approaching with No One Behind the Wheel

Sean Bollman*

Driverless automobiles may redefine public safety and efficiency, while turning the automobile industry on its head. These innovative machines will pose a challenge to regulatory schemes spanning from transportation and insurance to products liability and internet laws. Enormous companies like BMW, Audi, Uber, and Google have already taken part in placing this rapidly growing technology into consumer hands. The rift that this innovation will create in other industries, coupled with the safety and privacy concerns surrounding its design, will be the catalyst for contentious legislative and legal debates. This Note will explore the ways in which industry flexibility, state and federal involvement, and clearer regulations may be carefully balanced to help the driverless car industry stay on the road. Part one will address the development and historical challenges of driverless vehicles, while Parts Two and Three will look at potential solutions to these challenges.

I. BACKGROUND AND CHALLENGES OF AUTONOMOUS VEHICLES

A. *The Advent of the Driverless Car*

The idea of a machine so sophisticated and precise that it can safely operate a car on public streets would have been viewed as science fiction in the not-so-distant past. Concepts of autonomous vehicles have captured the human imagination as far back as the 1939 World's Fair in New York.¹ Within two decades, General Motors would partner with the Radio Corporation of America to develop driverless technology that could operate the steering wheel of a car while driving.² Then, in the 1980s, Erick Dickmanns, a German aerospace engineer, conducted tests using cameras and microprocessors placed on a vehicle, thereby giving the vehicle its own eyes and ears.³

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¹ Sunghyo Kim, *Crashed Software: Assessing Product Liability for Software Defects in Automated Vehicles*, 16 DUKE L. & TECH. REV. 300, 302 (2018).

² *Id.*

³ *Id.*

The development of the driverless car reached a tipping point in 1995 when Carnegie Mellon University (CMU) Robotics successfully navigated a driverless car almost 70 miles without a human driver.⁴ Competition led to further development of autonomous vehicles in 2005 when the Defense Advanced Research Projects Agency (DARPA) hosted its Grand Challenge long-distance competition for driverless cars.⁵ The competition resulted in the development of five driverless vehicles completing the 132-mile course.⁶ By 2009, Google and other major companies began developing their own self-driving vehicles.⁷ This development promised to empower individuals that could not otherwise operate a car, such as the blind, disabled, elderly, or children, by offering them the ability to travel in a car unassisted.⁸

Google's self-driving car program would be among those at the forefront of developing this amazing technology. By May 2017, Google's autonomous vehicle had driven more than 3 million miles without any human assistance.⁹ Google's milestone achievement illustrated the statement made by the National Highway Traffic Safety Administration (NHTSA) just one year prior: "partially and fully automated vehicles are nearing the point at which widespread deployment is feasible."¹⁰

For the automobile industry, this promising new technology is a welcomed development. Injuries, deaths, and the general inefficiencies of human-operated automobiles are painfully clear when compared to the potential improvements of driverless technology. For example, in 2012 alone, there were 33,561 total traffic accidents (92 per day), 5,615,000 reported crashes (15,110 per day), and 2,362,000 people injured as a result of automobile crashes (6,252 per day).¹¹ Moreover, there were 10,322 people killed in alcohol-impaired-driving crashes (28 per day) and 169,000 children age 14 and younger injured in automobile crashes just in the United States.¹² Motor vehicle crashes were also the leading cause of death for children aged

⁴ *Id.*

⁵ *Id.*

⁶ *Id.*

⁷ Damien A. Riehl, *Car Minus Driver: Autonomous Vehicles Driving Regulation, Liability and Policy*, 73 BENCH & B. MINN. 18, 19 (2016).

⁸ *Id.*

⁹ Kim, *supra* note 1, at 302–03.

¹⁰ *Id.* at 303.

¹¹ Adam Thierer & Ryan Hagemann, *Removing Roadblocks to Intelligent Vehicles and Driverless Cars*, 5 WAKE FOREST J.L. & POL'Y 339, 351 (2015).

¹² *Id.*

four, as well as those between the ages of 11–14.¹³ At approximately 32,000 deaths annually, auto crashes amounted to nearly three times the number of deaths as those who die in firearm homicides.¹⁴ In addition to the injuries and tragic loss of life caused by these incidents, there is an annual cost of over \$300 billion (2% of GDP) associated with automobile crashes.¹⁵

While there is limited data regarding accident statistics of autonomous vehicles, many experts believe that autonomous vehicles can substantially reduce both the human and financial costs of conventional vehicles. In a November 2013 study by Morgan Stanley, it was estimated that driverless cars could save the U.S. economy \$1.3 trillion annually.¹⁶ This study explains that the savings would result from a decline in resources expended on fuel and accidents, plus an annual productivity increase of approximately \$507 billion.¹⁷

As exciting as the prospect of safer, more efficient automobiles is, there are many issues to address regarding the technology and policies governing driverless cars. As with any emergent technology, automated vehicles have safety issues. For example, Google's self-driving car was involved in a low speed collision with a bus on February 14, 2016, marking one of the first major safety incidents with the technology.¹⁸ In a more tragic turn of events, a woman was killed in March of 2018 in Arizona after being struck by one of Uber's driverless cars as she crossed an intersection at night.¹⁹ This fatality occurred despite an emergency backup driver sitting behind the wheel of the car, which raises some unsettling questions regarding the public use of this technology in its current state.²⁰ Soon after the accident, Uber halted testing of its driverless cars in Pittsburgh, San Francisco, and Toronto.²¹ Perhaps it is unfair to demand perfection from autonomous vehicles at this early stage, but this tragic accident sheds an unsettling light on the safety measures currently in place.

¹³ *Id.*

¹⁴ Riehl, *supra* note 7, at 20.

¹⁵ Thierer & Hagemann, *supra* note 11, at 352.

¹⁶ *Id.* at 354.

¹⁷ *Id.*

¹⁸ Daniel A. Crane, Kyle D. Logye & Bryce C. Pilz, *A Survey of Legal Issues Arising From The Deployment of Autonomous and Connected Vehicles*, 23 MICH. TELECOM. & TECH. L. REV. 191, 195 (2017).

¹⁹ Daisuke Wakabayashi, *Self-Driving Uber Car Kills Pedestrian in Arizona, Where Robots Roam*, N.Y. TIMES (Mar. 19, 2018), <https://www.nytimes.com/2018/03/19/technology/uber-driverless-fatality.html>.

²⁰ *Id.*

²¹ *Id.*

A U T O N O M O U S V E H I C L E S

B. Current Solutions

Describing the obstacles of the driverless car industry as complex would be an understatement. As autonomous vehicles become commonplace on public roadways, a number of interrelated challenges will face the companies, consumers, and regulators of the industry. Allocation of risk and liability must be considered, as well as how to develop regulations that can keep pace with this rapidly changing, multi-faceted technology. There is also the question of balancing technological development with consumer safety. Experts and academics have taken steps to mitigate some of these issues, but many remain partly or wholly unresolved.

1. Addressing the Risks

Collecting and analyzing data on driverless cars has been, and will continue to be, an imperative duty for addressing the issues facing the industry. Research at institutions like the University of Michigan is one approach to assembling more data.²² In July 2015, the University launched a project that it called “Mcity,” which is a 32-acre mock city designed to test driverless cars in a public space.²³ Similarly, Uber has joined with CMU to achieve the goal “to end car ownership and help create our ‘driverless future.’”²⁴ Utilizing partnerships between universities and the driverless car industry is one possible way to address the need for more data to refine and promote the development of driverless technology.²⁵

However, the companies comprising the driverless car industry will ultimately have to take the reins to address the current shortfalls and issues facing the technology. Some of the major players in the industry, such as Mercedes, Google, and Volvo have announced their willingness to accept fault when a crash occurs while one of their cars is driving autonomously.²⁶ This apparent willingness to assume the risk of damages caused by driverless cars is a reassuring sign for the future of this technology.²⁷ Without such cooperation from driverless car manufacturers, consumers would remain financially unprotected from damages caused by the vehicles to themselves and others.

State actors have also been active in the industry. Under current laws, drivers of autonomous vehicles must have insurance coverage for not less than \$15,000 per

²² See Crane et al., *supra* note 18, at 193.

²³ *Id.*

²⁴ Riehl, *supra* note 7, at 19.

²⁵ Crane et al., *supra* note 18, at 193.

²⁶ *Id.* at 194–95.

²⁷ See *id.*

person and \$30,000 per incident.²⁸ The federal government, under the Obama Administration, also issued the Federal Automated Vehicles Policy in September 2017 calling on states to create a framework of regulations for driverless vehicles.²⁹ This policy also asked states to impose specific insurance requirements for driverless vehicles.³⁰

2. *Governmental and Industry Efforts*

Companies engaged in the autonomous vehicle industry are not diametrically opposed to government involvement. Indeed, major companies like Google, General Motors, Lyft, and Delphi have urged Congress to offer guidance by enacting stand-alone legislation regarding autonomous vehicles.³¹ In fact, the NHTSA responded to Google’s request for guidelines by clarifying the definition of the term “driver” as it is used within the Federal Motor Vehicle Safety Standards.³² The federal government, under President Obama, further demonstrated its commitment to the industry by proposing a 10-year, \$4 billion investment into driverless vehicles.³³

State governments have taken numerous steps to regulate driverless technology. In fact, the NHTSA is relying on states to establish a significant amount of the regulatory landscape for driverless cars.³⁴ Nevada became the first state to pass such regulations in 2011, with other states and localities following suit, including Florida, California, Miami, and the District of Columbia.³⁵ Since 2012, six additional states have passed legislation pertaining to driverless cars with another eight states considering the same move.³⁶ These state efforts have generally focused on basic issues, like defining the parameters of the terms “autonomous technology” and “autonomous vehicle.”³⁷ States have also strictly prohibited driverless vehicles that

²⁸ CLYDE MCGRADY, *NEW JERSEY CONSIDERS INSURANCE STANDARDS FOR DRIVERLESS CARS* (WESTLAW 279390, 2017).

²⁹ *Id.*

³⁰ *Id.*

³¹ Tracy Hresko Pearl, *Fast & Furious: The Misregulation of Driverless Cars*, 73 N.Y.U. ANN. SURV. AM. L. 19, 45–46 (2017).

³² Crane et al., *supra* note 18, at 196–97.

³³ *Id.*

³⁴ See HRESKO PEARL, *supra* note 31, at 44.

³⁵ See Crane et al., *supra* note 18, at 213.

³⁶ See HRESKO PEARL, *supra* note 31, at 45.

³⁷ Crane et al., *supra* note 18, at 213–14.

fall outside of those expressly permitted by statute.³⁸ However, states are also careful to avoid areas of regulation that are already being handled by the NHTSA, such as technology involving “blind spot assistance, crash avoidance, emergency braking, parking assistance, adaptive cruise control, lane-keeping assistance, lane departure warning, or traffic jam and queuing assistance.”³⁹

Some states have mandated the use of electronic safety and recording devices within driverless cars. For instance, Nevada requires the use of electronic data recorders while driverless cars are being tested.⁴⁰ Texas also requires individuals operating driverless cars to be the owner of the vehicle, notify the proper authorities of their use, and operate the vehicle for research purposes only.⁴¹ Similarly, California has drafted regulations requiring manufacturers to address cyber-attacks by applying measures to alert the driver when a cyber-attack may be occurring so that the driver may take command of the vehicle.⁴²

In the interest of clarity, the NHTSA has attempted to delineate the various levels of automation that an automobile may exhibit.⁴³ The levels of automation range from Level Zero to Level Four as follows:

Level 0—No automation

Level 1—Function-Specific Automation (e.g. vehicle assists with braking to enable driver to regain control over vehicle or stop faster than acting alone)

Level 2—Combined Function Automation (automation of two or more primary control functions designed to work in unison, such as adaptive cruise control with lane steering)

Level 3—Limited Self-Driving Automation (driver must be available for occasional control, but with substantial transition time)

Level 4—Full Self-Driving Automation (driver only provides destination/navigation input and is not expected to assume control at any point)⁴⁴

³⁸ See *id.* at 214.

³⁹ *Id.*

⁴⁰ See *id.* at 213.

⁴¹ Holton Westbrook, *Look MA, No Hands: Providing Automated Vehicle Regulations and Precedents Inclusive of Disabled Individuals*, 19 TEX. TECH. ADMIN. L.J. 385, 406 (2018).

⁴² Crane et al., *supra* note 18, at 222.

⁴³ See Thierer & Hagemann, *supra* note 11, at 343.

⁴⁴ *Id.*

With these categories of automation in place, state and federal governments can make more targeted, laws and regulations for each level of automation.

The NHTSA has also laid out a framework of safety principles to guide the industry and provide general objective. They include the following:

- 1) “Ensuring a safe, simple, and timely process for transitioning from self-driving mode to driver control”
- 2) “Promoting systems that have the capability to detect, record, and inform drivers in the event that automated systems have malfunctioned”
- 3) “Ensuring the installation and operation of autonomous technologies do not disable or otherwise interfere with federally mandated safety features”
- 4) “Ensuring that, in the event of a crash or loss of vehicular control, appropriate information is recorded about the status of automated control systems”⁴⁵

These principles share a common theme of data collection and driver safety, which speaks to several major issues that remain to be addressed in the driverless car industry. Namely, the NHTSA principles offer guidance for revising the policies that govern insurance, liability, and safety standards, among other things. Nevertheless, regulatory guidance is only one factor that will determine the future success or failure of autonomous vehicles.

Despite the guidance already provided by the state and federal government, driverless car companies must bear the responsibility of carrying out these policies. With regard to Google’s request for federal guidance, the NHTSA stated, “[o]ur interpretation that the self-driving computer system of a car could, in fact, be a driver is significant. But the burden remains on self-driving car manufacturers to prove that their vehicles meet rigorous safety standards.”⁴⁶

3. Basic Safeguards for Privacy and Cybersecurity

With the modern trend of reduced privacy of our personal data, one may be reasonably concerned about the information that a car manufacturer, software developer, the government, or any third party may obtain by tracking the use of

⁴⁵ *Id.* at 375.

⁴⁶ David Shepardson & Paul Lienert, *Google Says U.S. Guidance Crucial to Development of Self-Driving Cars*, REUTERS (Feb. 13, 2016), <https://www.reuters.com/article/us-alphabet-autos-selfdriving-idUSKCN0VJ2F2>.

driverless cars. One may also be uneasy about the prospect of a third party gaining control over the technology that operates a driverless car, similar to the manner in which personal computers or smartphones may be hacked. Fortunately, major players in the driverless car industry have already begun to address these issues.

The Driver's Privacy Protection Act (DPPA) of 1994 stands as one safeguard against the use of personal data.⁴⁷ The DPPA protects individuals' personal information assembled by state DMVs.⁴⁸ Despite pushback from some state lawmakers, it was amended five years after enactment to expand its privacy protections.⁴⁹ Under the DPPA, state agencies must receive a driver's express consent before being able to release any personal information, whether the request is directed at one individual or many for marketing purposes.⁵⁰

In response to the threat of cyberattacks on autonomous vehicles, engineers have applied methods similar to those used to verify online credit card purchases.⁵¹ This process involves two-way data verification schemes.⁵² In practice, this means "routing software installs and updates through remote servers to check and double-check for malware adopting routine security protocols like encrypting files with digital signatures and other experimental treatments."⁵³ Manufacturers will be incentivized to implement and improve security measures like these in order to protect their reputation within the industry.⁵⁴

In response to concerns about the adequacy of privacy and cybersecurity measures in driverless cars, some have argued that these threats already exist for many driver-controlled automobiles on the road.⁵⁵ The technology already found in many cars "controls and monitors the vehicle using millions of lines of code connected by internal networks."⁵⁶ In essence, cars are becoming more like

⁴⁷ See Anthony Jones, *Autonomous Cars: Navigating the Patchwork of Data Privacy Laws That Could Impact the Industry*, 25 CATH. U. J.L. & TECH. 180, 189–90 (2017).

⁴⁸ *Id.*

⁴⁹ *Id.*

⁵⁰ *Id.*

⁵¹ Thierer & Hagemann, *supra* note 11, at 377.

⁵² *Id.*

⁵³ *Id.*

⁵⁴ *Id.*

⁵⁵ See Christopher Wing, *Better Keep Your Hands on the Wheel in That Autonomous Car: Examining Society's Need to Navigate the Cybersecurity Roadblocks for Intelligent Vehicles*, 45 HOFSTRA L. REV. 707, 707 (2016).

⁵⁶ *Id.*

computers and less like automobiles.⁵⁷ *Scientific American* reporter Larry Greenemeier has stated that “[a]utomobiles have already become sophisticated networks controlled by dozens of computers—called electronic control units (ECUs)—that manage critical, real-time systems.”⁵⁸ Greenemeier’s comment illustrates a real and growing safety concern already facing the automobile industry, regardless of whether driverless cars are widely adopted.⁵⁹

These concerns have been addressed by the Security and Privacy in Your Car Act (SPY Car Act) of 2015.⁶⁰ The SPY Car Act amends the current powers that Title 19 of the U.S. Code affords to the Department of Transportation (DOT), Federal Trade Commission (FTC), and NHTSA to regulate driverless cars. Its purpose is “[t]o protect consumers from security and privacy threats to their motor vehicles, and for other purposes.”⁶¹ This goal is accomplished by restricting manufacturers with rules and regulations that carry civil penalties for violation.⁶² The Act also provides consumers with a clear process for bringing claims against companies that are in violation of their own privacy policies.⁶³

Nevertheless, the SPY Car Act is not without its shortcomings. Its approach to preserving security and privacy has been criticized for causing disjointed communication between key players in the industry, as well as government agencies.⁶⁴ The key method of communication between consumers, the government, and the industry is through notices of proposed rulemaking by the proper agencies.⁶⁵ While this method is somewhat effective, some have criticized it for underutilizing available technology to bolster communication between the groups involved.⁶⁶ By

⁵⁷ *Id.* at 708.

⁵⁸ Thierer & Hagemann, *supra* note 11, at 375–76.

⁵⁹ *Id.* at 375.

⁶⁰ Benjamin L. Bollinger, *The Security and Privacy in Your Car Act: Will it Actually Protect You?*, 18 N.C. J.L. & TECH. 214, 229 (2017).

⁶¹ *Id.*

⁶² *Id.*

⁶³ *Id.* at 241–42.

⁶⁴ *Id.* at 242.

⁶⁵ Liz Allison, *You Can’t Hack This: The Regulatory Future of Cybersecurity in Automobiles*, 21 J. TECH. L. & POL’Y 15, 20 (2016).

⁶⁶ Bollinger, *supra* note 60, at 242.

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creating a more intuitive rulemaking process, the FTC could benefit from helpful consumer feedback while empowering consumers to have their voices heard.⁶⁷

4. *Agency Framework*

In its current state, the NHTSA and FTC will oversee the regulatory framework for automated vehicles.⁶⁸ These agencies must consult one another before issuing regulations, as the NHTSA handles regulation for the vehicle itself, while the FTC manages regulations for internet-based operational features.⁶⁹ Normally, the NHTSA promulgates Federal Motor Vehicle Safety Standards with which auto manufacturers must comply.⁷⁰ So far, no major issues have arisen from the lack of Federal Motor Vehicle Safety Standards for driverless cars, because the NHTSA may “identify safety defects, allowing the agency to recall vehicles or equipment that pose an unreasonable risk to safety.”⁷¹ Alternatively, the FTC operates in a consultative capacity.⁷² The FTC offers its expertise to the industry by consulting on matters of cybersecurity due to the prominence of wireless technologies in driverless cars.⁷³

C. *Remaining Challenges*

While some concerns have been addressed, the road ahead for the autonomous vehicle is fraught with issues that have not yet been resolved. Indeed, it is nearly impossible to account for the ripple effect that driverless cars will have in society. Frank Dian of TCS Global Consulting predicts a plethora of changes in other industries brought about by reductions in car accidents, commute times, and general traffic congestion.⁷⁴ Dian foresees a reduction in car and gas sales, highway construction spending, hospital and health insurer revenue, and government revenue from traffic fines.⁷⁵ He further anticipates a lesser need for police officers on the road, reduced need for prison capacity, a decline in revenue for utility companies

⁶⁷ *Id.* at 229.

⁶⁸ *Id.* at 219-20.

⁶⁹ Scott L. Wenzel, *Not Even Remotely Liable: Smart Car Hacking Liability*, 2017 U. ILL. J.L. TECH & POL’Y 49, 61 (2017).

⁷⁰ *Id.*

⁷¹ *Id.*

⁷² *Id.*

⁷³ Bollinger, *supra* note 60, at 219–20.

⁷⁴ Thierer & Hagemann, *supra* note 11, at 356–57.

⁷⁵ *Id.*

(e.g. companies supplying electricity to traffic and street lights), and fewer parking lots, thereby making more land available for development.⁷⁶

However, not all of the changes caused by driverless cars will be positive. Importantly, there is still much to consider about privacy concerns, regulatory ambiguity, and rapidly changing insurance and liability policies.

1. Privacy Concerns and Regulatory Ambiguity

Several major issues remain to be addressed by the federal government. These include addressing the uniformity of automated vehicle regulations, revising current regulations, and incentivizing the development of automated vehicles through liability protections, reinsurance, and other methods.⁷⁷ There also remains the question of how risk will be allocated amongst automated vehicle companies regarding cybersecurity issues.⁷⁸ This is especially troubling given the potential for wildly different levels of damage caused by cybersecurity breaches, ranging from theft of personal data, to property damage, serious bodily injury, or even death.

There is also the issue of how the DPPA will be applied. The concern lies in the ambiguity surrounding some of the exceptions to the DPPA.⁷⁹ For instance, the DPPA can be circumvented if a legitimate need exists by a government agency carrying out its functions.⁸⁰ To further obfuscate matters, the DPPA can be avoided by a “use in connection with matters of motor vehicle or driver safety and theft” or even simply for “motor vehicle research activities.”⁸¹ These exceptions to the DPPA are undoubtedly aimed at legitimate safety and research goals, but there is much ambiguity surrounding them, especially at this early stage of their application to driverless cars.

The industry for driverless cars has sought guidance regarding this statutory ambiguity. In particular, Google has requested clarification regarding the statutes that are currently in place for conventional automobiles that might nevertheless be applied to driverless automobiles.⁸² Google pointed to statutes requiring steering wheels and brake pedals, which would need to be rewritten before the company could

⁷⁶ *Id.*

⁷⁷ Crane et al., *supra* note 18, at 319.

⁷⁸ *Id.*

⁷⁹ See Jones, *supra* note 47, at 190.

⁸⁰ *Id.*

⁸¹ *Id.*

⁸² Shepardson & Lienert, *supra* note 46.

produce driverless cars without such features.⁸³ Autonomous vehicles without these features might not come into production until such time when driver intervention is entirely unnecessary, but Google's concern is valid for future development and underscores the need for clarification.

2. *Rapidly Changing Insurance and Liability Policies*

The industry for car insurance is also likely to see a major transformation due to the nature of driverless cars and their associated risks. For example, it is predicted that auto insurance will undergo an enormous shift away from individual drivers.⁸⁴ Insurance laws requiring mandatory accident coverage for individuals will likely need to be reworked because fully autonomous cars will remove driver error from the equation.⁸⁵ This issue will need to be addressed once driverless cars make the transition from needing at least some human intervention to needing none at all and exhibiting full autonomy.

Paradoxically, the technology needed to allow the driver to take control is sometimes more complex than fully autonomous driving software.⁸⁶ Presently, the technology of autonomous vehicles seems to be at a stage where the option for driver override is still needed.⁸⁷ This is illustrated by some of the failures experienced by major companies like Google. From September 2014 to November 2015, Google's automated vehicles experienced 272 internal failures and 13 incidents that would have resulted in an accident had a human driver not taken over control of the car.⁸⁸ This likely means that the insurance industry will need to continue to evolve along with the autonomous vehicle technology as it continues to improve to the point of eliminating the need for any human intervention.

II. PROPOSED SOLUTIONS

A. *Government Involvement: The Carrot, the Stick, or Neither*

Agencies and the Federal government have used clear incentives and disincentives to guide the automobile industry in the past. These measures have already been used with the autonomous vehicle industry, but only to a limited degree. The question then remains *what balance of incentives and disincentives is optimal?*

⁸³ *Id.*

⁸⁴ See Hasan Siddiqui, *Gone in Sixty Seconds: Fading Automobile Costs in a Driverless Future*, 2018 U. ILL. J.L. TECH. & POL'Y 221, 229 (2018).

⁸⁵ *Id.*

⁸⁶ *Id.* at 230.

⁸⁷ *Id.* at 231.

⁸⁸ *Id.*

And, to what extent should these tools be used to intervene in the driverless car industry?

1. *The Hands-on Approach*

Government intervention should provide, at a minimum, greater clarity in a developing industry like that of the driverless car. Clarence Ditlow, the head of the Center for Auto Safety has stated that “[i]t’s better to write a stand-alone rule for driverless vehicles. It may take more work, but the end result is better for the consumer and the driverless vehicle maker. And it may take less time than rewriting all the standards.”⁸⁹ Chris Urmson, a lead member of Google’s driverless car program, also observed that without federal guidance, “operating self-driving cars across state boundaries would be an unworkable situation.”⁹⁰ This approach would involve greater legislative and administrative resources, but would also provide greater clarity.⁹¹ Creating rules and regulations specifically for driverless cars would also free the industry from having to comply with existing law that was drafted well before legislators could have even imagined driverless cars and, therefore, should really have no application to the industry. For instance, driverless cars could be specifically exempted from federal regulations requiring brakes and a steering wheel in all vehicles, which will be necessary if the technology reaches a level of complete autonomy.⁹²

The burden of this new regulatory and statutory scheme could be balanced between the resources of federal and state governments. Guidelines proposed under the Obama Administration’s Federal Automated Vehicles Policy would delegate the responsibility of insurance and liability matters to states, while the federal government would bear the burden of the promulgation and enforcement of safety standards.⁹³ Under this proposal, the federal government would also take the initiative (and incur the cost) of educating the public on pertinent driverless car issues.⁹⁴

Federal incentive programs and the imposition of data pooling between companies may be the lynchpin for constructive federal involvement in the autonomous vehicle industry. Through federal subsidies, the government may

⁸⁹ Shepardson & Lienert, *supra* note 46.

⁹⁰ Hresko Pearl, *supra* note 31, at 46.

⁹¹ Shepardson & Lienert, *supra* note 46.

⁹² *Id.*

⁹³ MCGRADY, *supra* note 28.

⁹⁴ *Id.*

persuade consumers to buy driverless cars when they would otherwise be unable to afford the expensive new technology.⁹⁵ This would not be the first time such measures have been used by the government.

The Energy Improvement and Extension Act of 2008 gave consumers a tax credit for purchasing plug-in electric vehicles, which the government recognized as “cost[ing] thousands of dollars more to purchase than conventional vehicles of comparable size and performance.”⁹⁶ In a similar fashion, the Cars Allowance Rebate System (“CARS,” a.k.a. “Cash for Clunkers”) gave buyers a bonus for trading in their current car and purchasing a car that had better gas mileage.⁹⁷ In both of these examples, the government effectively promoted newer, more efficient and environmentally friendly automobiles that would have otherwise been prohibitively expensive to many consumers. The same approach may be applied to further develop the driverless car market.

Implementing a driverless car policy similar to the Energy Improvement and Extension Act, or Cash for Clunkers is entirely possible. There is a significant incentive for federal and state governing bodies to encourage driverless car usage.⁹⁸ Driverless cars may reduce or even eliminate the human error that is often found as the primary factor in automobile accidents.⁹⁹ Autonomous vehicles would address this issue by reducing the number of distracted drivers who are drunk, texting, or even just drowsy, all of whom contribute to the millions of traffic accidents in the U.S. each year.¹⁰⁰ It has been estimated that if only 10% of the cars on U.S. roads were automated vehicles, there would be 211,000 fewer crashes and 1,100 fewer fatalities annually.¹⁰¹

To that end, a direct rebate to consumers at the time of sale would be the most effective method to incentivize consumers to make the switch to driverless cars.¹⁰² Ideally, the rebate should equal the price premium of a driverless car over a

⁹⁵ Marie Williams, *Steering Consumers Toward Driverless Vehicles: A Federal Rebate Program as a Catalyst for Early Technology Adoption*, 23 MICH. TELECOMM. & TECH. L. REV. 327, 334 (2017).

⁹⁶ *Id.* at 337.

⁹⁷ Marianne Tyrrell, *The “Cash for Clunkers” Program: A Sustainability Evaluation*, 42 U. TOL. L. REV. 467, 468 (2011).

⁹⁸ Williams, *supra* note 95, at 339.

⁹⁹ Kevin Funkhouser, *Paving the Road Ahead: Autonomous Vehicles, Products Liability, and the Need for a New Approach*, 2013 UTAH L. REV. 437, 438 (2013).

¹⁰⁰ *Id.*

¹⁰¹ Williams, *supra* note 95, at 339.

¹⁰² *Id.*

conventional, human-operated car, which is estimated to be a gap of \$7,000–\$10,000 (as of 2017).¹⁰³ It has been estimated that such an initiative could succeed if it began with the same budget as the Cash for Clunkers program with \$2 billion in initial funding.¹⁰⁴ This conservative estimate assumes a \$10,000 rebate per driverless car, which would put 200,000 driverless cars on the road, and amount to more than 10% of all cars on the road in the United States.¹⁰⁵

Data pooling is the other critical aspect of this federal initiative, as it directly impacts the safety and efficiency of the driverless technology. This is because machine learning algorithms used in driverless cars depend largely on the data that is applied to them.¹⁰⁶ Larger pools of data will teach the vehicles to drive more safely, improving safety for passengers inside and out of the car.¹⁰⁷ The need for more data creates a powerful public safety incentive for compelling companies to share driverless car data with one another, which will likely require federal regulations to overcome opposition from companies trying to avoid sharing their improved data pools with competitors.¹⁰⁸

The dangers of driverless cars operating with inadequate pools of data can be illustrated by imagining cars from different companies operating with two separate data pools. When the two autonomous vehicles are operating near one another, they may interpret the situation differently.¹⁰⁹ For instance, one car may attempt to change lanes in what it understands to be a safe maneuver, while the other car interprets the lane change as a serious danger and steers drastically to avoid the perceived danger, thereby endangering the passengers in both vehicles.¹¹⁰

2. *The Hands-off Approach*

On the other hand, some believe that government intrusion in the driverless car industry would be altogether inefficient.¹¹¹ This argument considers the value of companies and individuals freely experimenting without rigid restrictions being

¹⁰³ *Id.* at 339–40.

¹⁰⁴ *Id.*

¹⁰⁵ *Id.*

¹⁰⁶ Williams, *supra* note 95, at 447.

¹⁰⁷ *Id.*

¹⁰⁸ Paul J. Pearah, *Opening the Door to Self-Driving Cars: How Will This Change the Rules of the Road?*, 18 J. HIGH TECH. L. 38, 50 (2017).

¹⁰⁹ Williams, *supra* note 95, at 448.

¹¹⁰ *Id.*

¹¹¹ See Thierer & Hagemann, *supra* note 11, at 347.

imposed upon them.¹¹² Such an approach can be described as “permissionless innovation” or a “bottom-up solution.”¹¹³ These terms “[refer] to the notion that experimentation with new technologies and business models should generally be permitted by default.”¹¹⁴ It is the argument that precautionary regulatory policies will only raise the cost of products and cause general inefficiencies in their development.¹¹⁵ The internet is one example of a success story for permissionless design.¹¹⁶

This view is opposite to what could be called the “precautionary principle,” which would instead take careful steps to strictly avoid failures and mistakes.¹¹⁷ Proponents of permissionless design would claim that the precautionary principle is short-sighted, and threatens technological progress, economic entrepreneurialism, social adaptation, and prosperity in the long run.¹¹⁸ Those opposed to the precautionary principle would see it as offering fewer choices, lower-quality goods and services, diminished economic growth, and an overall decline in the standard of living.¹¹⁹

In practice, supporters of permissionless design would have policymakers focus on issues that *currently* require resolution rather than focusing on what might occur.¹²⁰ This disposition to policymaking is described as “dynamism,” which some argue is the most effective approach for keeping an open mind to new ideas and ongoing experimentation.¹²¹

B. Redefining Liability and Insurance

All types of insurance related to automobiles appear to be headed toward a turbulent future as autonomous vehicles shift liability to different parties and redefine the most fundamental concepts of risk in the industry. TCS Global Consulting, a multinational information technology service consulting company,

¹¹² *Id.*

¹¹³ Thierer & Hagemann, *supra* note 11, at 347.

¹¹⁴ Adam Marcus & Adam Thierer, *Guns, Limbs, and Toys: What Future for 3D Printing?*, 17 MINN. J.L. SCI. & TECH. 805, 815 (2016).

¹¹⁵ *Id.* at 817.

¹¹⁶ Thierer & Hagemann, *supra* note 11, at 347.

¹¹⁷ *Id.*

¹¹⁸ *Id.*

¹¹⁹ *Id.*

¹²⁰ *Id.* at 348.

¹²¹ *Id.* at 348–49.

anticipates that 90% of insurance premiums for personal auto insurance may disappear.¹²² This process appears to have already begun with states like California implementing highly restrictive regulations for the insurance of driverless cars.¹²³ California's SB 1298, which was passed on September 25, 2012, requires manufacturers to provide insurance or equivalent protection of at least \$5,000,000.¹²⁴ To further complicate matters, insurance companies have struggled to quantify the risk of damages associated with cybersecurity in driverless cars.¹²⁵

1. General Comments About Liability

Liability for accidents caused by driverless cars will inevitably need to be allocated between the major players of the industry. This will likely begin with liability shifting from drivers to manufacturers.¹²⁶ In cases involving demonstrable software and decision-making errors, liability would reasonably be assigned to the developer that created the operating system.¹²⁷ Conversely, if the accident was not caused by an operating system error, but rather by a physical defect in the car, then liability should shift to the manufacturer.¹²⁸ Either scenario presumes, however, that the owner has not tampered with the functionality of the vehicle in any meaningful way, which would absolve the manufacturer or software developer of some or all liability.¹²⁹

Proving which party or parties are liable is an issue that could be resolved through various technologies.¹³⁰ Event Data Recorders (a.k.a. "black boxes") record data immediately before, during, and after an accident and could provide key details (e.g. speed, whether seatbelts were in use, GPS location, etc.) for determining liability.¹³¹ Some predict that insurance companies will incentivize their customers

¹²² *Id.* at 356–57.

¹²³ Crane et al., *supra* note 18, at 213–14.

¹²⁴ *Id.* at 215–16.

¹²⁵ *Id.* at 239–40.

¹²⁶ See MICHAEL J. KEATING & THOMAS H. CASE, CORPORATE COMPLIANCE SERIES: DESIGNING AN EFFECTIVE PRODUCTS LIABILITY COMPLIANCE PROGRAM § 1:31 (2018–2019), WL CORPC-PL § 1:31.

¹²⁷ Siddiqui, *supra* note 84, at 229.

¹²⁸ *Id.*

¹²⁹ *Id.*

¹³⁰ *Id.*

¹³¹ *Id.*

to use this technology in driverless cars.¹³² Similarly, dashboard cameras may be implemented to monitor the awareness of the driver. Dashboard cameras would be especially useful during emergency situations or anytime that the driver may have the need or desire to assume control of the vehicle.¹³³

2. *A Framework of Comparative Fault*

Until driverless cars become entirely autonomous, the issue of personal liability will be determined by whether the driver was reasonably able to prevent the accident.¹³⁴ Some have analyzed the issue of personal liability through the lens of what “type” of driver was behind the wheel when a manual over-ride became necessary.¹³⁵ This approach categorizes drivers into the following general scenarios to determine liability: the distracted driver, the diminished capabilities driver, the disabled driver, and the attentive driver.¹³⁶ The distracted driver is entirely inattentive to what the car is doing and relies completely on the vehicle’s autonomous capabilities.¹³⁷ The diminished capabilities driver normally would not be driving due to his or her current condition (e.g. elderly, minor, intoxicated, etc.) and would have to rely upon others to drive them if not for the autonomous vehicle.¹³⁸ In the case of the disabled driver, the person behind the wheel is one that cannot drive a conventional car due to a physical infirmity (e.g. amputated limb, blindness).¹³⁹ Finally, the attentive driver is one who actively watches what the vehicle is doing the same as if he or she was operating a conventional vehicle.¹⁴⁰

This framework would assign liability based “on the ability of the person to prevent the accident, rather than what the driver was doing prior to the accident.”¹⁴¹ This four-scenario approach focuses on optimizing the efficiency of autonomous cars by not requiring the driver to maintain focus on the road or even have the ability to

¹³² KEATING & CASE, *supra* note 126.

¹³³ Siddiqui, *supra* note 84, at 230.

¹³⁴ Jeffrey K. Gurney, *Sue My Car Not Me: Products Liability and Accidents Involving Autonomous Vehicles*, 2013 U. ILL. J.L. TECH. & POL’Y 247, 274 (2013).

¹³⁵ *See id.* at 255.

¹³⁶ *Id.*

¹³⁷ *Id.* at 255–56.

¹³⁸ *Id.* at 256.

¹³⁹ *Id.* at 257.

¹⁴⁰ *Id.*

¹⁴¹ *Id.* at 267.

operate the car at all.¹⁴² Under this approach, the disabled driver would be absolved of any liability because they are completely unable to prevent an accident.¹⁴³ The diminished capabilities driver's and the distracted driver's liabilities would each be highly fact-specific and consider what ability the person had to gain control of the vehicle and avoid an accident.¹⁴⁴ The attentive driver, however, would be in the best position among each of the scenarios to prevent an accident, and thus, would be personally liable unless evidence was introduced that the accident could not be avoided.¹⁴⁵ This framework takes the position that these standards for liability should be created legislatively rather than judicially, because without state guidance, courts will simply apply products liability laws to driverless cars, leading to uncertain conclusions for drivers concerned about liability.¹⁴⁶

C. *Privacy*

Expectations of privacy have undergone a major shift in the twenty-first century, but how will autonomous vehicles affect this trend, if at all? While there may not be a clear answer to this question, some commentators have speculated that privacy concerns for driverless cars will eventually be outweighed by improvements in safety because of data collection and sharing.¹⁴⁷ While this outcome may not be satisfactory for many, it reflects the realities of rapidly evolving social norms, which are undeniably subjective and change over time.¹⁴⁸ There are nevertheless steps that may be taken to preserve consumer privacy in the autonomous vehicle industry. For example, companies must be more transparent about personal data collected from their driverless cars. This practice would avoid alienating customers that may be uncomfortable with such intrusive surveillance of their personal behavior.¹⁴⁹

I. *The Constitution*

While concerns for privacy in driverless cars are a legitimate concern, there may be protections already in place that are insulated from the decisions of regulators, governments, and companies. That is, the Constitution provides defenses against the government's use of such data. For example, a concurring opinion in the

¹⁴² *Id.*

¹⁴³ *Id.*

¹⁴⁴ *Id.* at 268.

¹⁴⁵ *Id.* at 267.

¹⁴⁶ *Id.* at 276–77.

¹⁴⁷ See Thierer & Hagemann, *supra* note 11, at 381.

¹⁴⁸ *Id.* at 382.

¹⁴⁹ *Id.*

Supreme Court case of *United States v. Jones* found that “the Government’s unrestrained power to assemble data that reveals private aspects of identity is susceptible to abuse.”¹⁵⁰ This opinion reasoned that intrusive collection of data by the government would encroach on association and expressive freedoms of individuals who were aware that their activities were being monitored.¹⁵¹ The Court emphasized the “mosaic theory,” which observes that regular disclosure of location data can expose a great deal of personal information.¹⁵²

The Supreme Court further acknowledged the constitutional safeguards against unfettered government use of private data in the case of *Riley v. California*.¹⁵³ The Court held that police may not search digital information on a cellphone from someone under arrest unless they have a warrant.¹⁵⁴ Other states may analogize the facts of this case to cases where data is being collected from autonomous vehicles.¹⁵⁵ This could provide a precedent for restricting law enforcement agencies from having free reign to personal data in such cases.¹⁵⁶ Absent such restrictions, law enforcement would be empowered to violate individuals’ constitutional right to privacy. Emails, text messages, phone calls, browsing history, personal photos, and more would be completely unprotected from warrantless searches by law enforcement. Individuals’ personal freedoms must be protected by legislators from these perverse intrusions.

III. EXPLORING FURTHER SOLUTIONS

A. *Balancing Privacy, Safety, and Progress*

The driverless car industry has demonstrated its potential for rapid growth, but much of this progress has occurred in a vacuum, protected from criticism about safety or privacy. This poses a conundrum for autonomous vehicles, as pursuing only safety would stifle industry growth with rigorous regulations and safety protocols.¹⁵⁷ Conversely, a driverless car industry too focused on individual privacy would hamper the sharing of valuable research data between companies, universities, and the government, effectively halting progress.¹⁵⁸ In essence, none of these

¹⁵⁰ Jones, *supra* note 47, at 192–93.

¹⁵¹ *Id.* at 192–93.

¹⁵² *Id.* at 267.

¹⁵³ Riley v. California, 134 S. Ct. 2473, 2485 (2014).

¹⁵⁴ Jones, *supra* note 47, at 193–94.

¹⁵⁵ *Id.*

¹⁵⁶ *Id.*

¹⁵⁷ Thierer & Hagemann, *supra* note 11, at 347.

¹⁵⁸ Williams, *supra* note 95, at 339.

components of the industry may exist without the others. To that end, major actors in the driverless car industry should apply a comparative analysis to other industries to strike a balance between these three components.

Comparing the autonomous vehicle industry with the privacy of social media would be a potential start. While privacy and safety may both be quantified to an extent, they both involve an element of subjectivity. It is unlikely that the privacy (or lack thereof) expected by social media users today would be equivalent to the privacy expectation of social media users just ten years ago. Similarly, safety standards on automobiles have improved considerably since the twentieth century.

By analyzing these cultural indicators, driverless car manufacturers might gauge public tolerance for safety and privacy costs to achieve greater progress as an industry. For instance, the previously mentioned statistics on accidents for conventional automobiles demonstrates the major safety issues with driver-controlled vehicles, which may allow driverless car companies more leeway when keeping up with safety standards.¹⁵⁹ Social media may be a less reliable measurement for privacy expectations, however, given the tumultuous response the public has had toward social media outlets sharing their data. Consequently, driverless car companies may seek to avoid the most disfavored policies employed by social media companies in the interest of maintaining customers' trust. That is to say, the social media industry's handling of its customers' private information should be viewed as a cautionary tale of what *not* to do.

B. Insurance: The End of an Era

With the potential decline of individual car insurance on the horizon, insurance companies will need to find new groups to insure.¹⁶⁰ This decision will depend largely upon the state courts and legislatures defining liability policies.¹⁶¹ If state legislators engage in active policymaking for driverless cars, insurance companies will benefit from this much needed guidance for determining which groups will see an increased need for insurance. As previously stated, however, this need for guidance must be weighed against the driverless car industry's need for innovative freedom, which has driven improvements for autonomous vehicle technology since the industry's inception.¹⁶²

¹⁵⁹ Thierer & Hagemann, *supra* note 11, at 351.

¹⁶⁰ Crane et al., *supra* note 18, at 356–57.

¹⁶¹ See MCGRADY, *supra* note 28.

¹⁶² Thierer & Hagemann, *supra* note 11, at 348–49.

If state legislatures adopt a comparative fault scheme for liability, the demand for private car insurance will not disappear entirely.¹⁶³ Private auto insurance may nevertheless become a more convoluted matter as insurers attempt to distinguish risks between disabled and other individuals.¹⁶⁴ Insurance companies will also be confronted with the massive range of damages caused by cyber-attack incidents on driverless cars.¹⁶⁵ Here, collection of company and university research data by the Federal Government may prove invaluable in discerning the risk between different classes of individuals and cyber-attacks.

It is unlikely that companies in the autonomous vehicle industry will quietly accept liability for driverless car accidents as the fault of individual drivers gradually disappears. Nonetheless, these companies, and indeed the industry as a whole, will experience stunted growth if the companies do not have adequate insurance when liability is assigned to them. To this end, state mandated minimum insurance coverage should be applied to driverless car manufacturers alongside the liability framework that is adopted. The goal of this approach would be to protect companies from being bankrupted by inevitable insurance claims and providing clarity to insurance providers for the likely outcome of accident claims for driverless cars.

C. Federal Involvement

Although active regulating and permissionless innovation may appear to be diametrically opposed, a balance may be struck between the two philosophies. This solution is more realistic than a wholly one-sided approach because it acknowledges the realities of a new and growing industry, like that of the driverless car. Permissionless innovation has fueled tremendous progress for driverless cars,¹⁶⁶ but a major segment of the automobile industry that is sparsely regulated could be disastrous for the safety and efficiency of U.S. roadways.¹⁶⁷ By applying a hybrid of the two methods, major companies may be given a great deal of freedom to innovate, while the government is still able to provide guidance for impending issues. Such an approach may become tantamount to the successful transition of driverless cars from the experimental stage to widespread public use.

Federal funding for academic research aimed at collecting and analyzing driverless car data will be highly beneficial for the development of driverless cars as

¹⁶³ Gurney, *supra* note 134, at 273.

¹⁶⁴ *Id.* at 274.

¹⁶⁵ Crane et al., *supra* note 18, at 319.

¹⁶⁶ Thierer & Hagemann, *supra* note 11, at 348–49.

¹⁶⁷ Shepardson & Lienert, *supra* note 46.

well. Just as the federal government may subsidize individuals purchasing driverless cars, it could also subsidize research universities like the University of Michigan.¹⁶⁸ Innovative research like that of the “Mcity” test project could lead to a massive increase in the data available to manufacturers and developers, which is critical for improving the safety of driverless cars.¹⁶⁹ This cooperative effort between the federal government and research universities can be further improved by government sharing of anonymized data from driverless car companies to universities, allowing for efficient, targeted research.

Federal tax incentives could also be used to promote further cooperation between the driverless car industry and research universities. While regulators may impose fines on companies that altogether refuse to share data with research facilities and other companies, those companies that actively collaborate with university researchers may be rewarded with federal tax breaks, or even direct funding where the effort is substantial. In this manner, companies would have clear incentives to not only provide basic driving data to others engaged in the development of driverless cars, but there would also be incentives for coordinated research efforts between companies and universities. These shared research goals, alongside the enormous pool of data it would produce, might be the catalyst for breakthrough developments in driverless car technology.

D. Conclusion

The driverless car industry has made astounding progress over the last half century and particularly in the last ten years. With innovative companies like Google, BMW, Audi, and Uber forming the vanguard of this exciting new industry, consumers have witnessed driverless cars transform from science fiction into reality. Nevertheless, ensuring continued success for the driverless car industry will be an arduous task for all players involved.

The various interests of key industry players must be considered for the industry’s future success to become reality. Driverless car manufacturers should balance consumers’ needs for privacy and safety with the need for progress by looking to cultural indicators, such as social media, to find an appropriate balance. States should mandate minimum insurance coverage for these companies alongside a liability framework to provide clarity for manufacturers, insurers, and consumers. The federal government should share anonymized research data from manufacturers to research universities to further propel the development of driverless technology. Universities’ research efforts may be bolstered further through federal funding, as

¹⁶⁸ Crane et al., *supra* note 18, at 193.

¹⁶⁹ *Id.*; Jesse Krompfer, *Safety First: The Case for Mandatory Data Sharing as a Federal Safety Standard for Self-Driving Cars*, U. ILL. J.L. TECH. & POL’Y 439, 439 (2017).

well as programs incentivizing manufacturers to collaborate with academic institutions in return for tax breaks and other benefits.

As a general matter, governmental regulators should take care not to stifle industry growth by over-regulating the development of driverless technology in its infancy. Through industry flexibility, state and federal involvement, and clearer regulations, the driverless car industry may employ each of the aforementioned strategies with great success. The interests of key industry players must be placed in alignment or the industry may quickly find itself swerving off the road.