

NAMIC ISSUE ANALYSIS



VALIDATING SAFETY: THE NEXT PHASE IN DEVELOPING AUTOMATED DRIVING SYSTEMS

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INTRODUCTION

The development of Automated Driving Systems (ADS) may be the most consequential transportation issue of our time. New technology and novel service strategies promise faster and better mobility that will be less expensive, and more environmentally friendly. Spring boarding from existing and widely accepted “assisted driving” systems such as cruise control, ADS developers promise a wider array of functions from greater driver assistance to vehicles that will perform every driving operation with no human intervention.

The single most important reason to support the development of highly automated driving systems is the potential for ADS to enhance safety and save lives. While the idea of working, napping, or watching a movie while the car drives itself may be enticing to many, enhanced safety must always be the primary focus of ADS development. ADS that are proven safer than existing drivers will have innumerable benefits to society.

The development and deployment of proven, safe ADS will require significant technological advances, revisions to the regulatory paradigm, and the active participation of far more than just the auto manufacturers and technology companies. The potential of technology to move the needle on crash statistics is extraordinary; however, there will still be crashes, especially in an environment where autonomous vehicles continue to share the road with human drivers. It is important to note that ADS, in and of themselves, do not fundamentally change the legal theories of liability associated with motor vehicle crashes. Insurance will still play a crucial role for manufacturers, suppliers, owners, operators, and passengers.

The critical issues related to passenger safety, liability, and compensation after a crash require that insurance companies are included in the development, deployment, regulation, and use of ADS. Consumers will continue to look to property/casualty insurers to provide them with the protections they have come to expect as this new frontier of automotive products and services evolves.



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EYES ON THE PRIZE: IN A SHIFTING REGULATORY PARADIGM FOCUS MUST REMAIN ON POTENTIAL TO ENHANCE SAFETY AND SAVE LIVES

Safety must be the primary goal for ADS development, but defining and proving what “improved safety” means for ADS are not simple. Currently, federal auto safety regulations focus more on the structure and design of vehicles and less on the driving operations that are subject to human control. With ADS, the vehicle will assume driving operations formerly performed by the human driver. Thus, the safety responsibilities of the vehicle will expand and will continue to expand until the vehicle assumes all driving operations without any human control.

On the one hand, most car crashes involve driver error¹ and ADS promises computer systems that will not replicate the conditions that lead to those errors – i.e. sleeping, intoxication, distraction, speeding. According to the [National Highway Traffic Safety Administration](#) (NHTSA) “Fully automated vehicles that can see more and act faster than human drivers could greatly reduce errors, the resulting crashes, and their toll.” On the other hand, the elimination of certain human errors does not tell us anything about the introduction of computer, sensor, or software error.

Safe ADS will require a substantial amount of specialized software, sensors, controllers, and actuators to collectively perform without error the large universe of operations that human drivers already perform, or at least as well as those human drivers. The bar for performance has been set high: human drivers average 3.4 million vehicle hours (390 years of non-stop driving) between fatal crashes and 61,400 vehicle hours (7 years of non-stop driving) between injury crashes.

POST-“DRIVER” SAFETY REGULATION

There is a growing recognition that some change to the regulatory environment may be needed to foster the development of ADS. As Secretary of the U.S. Department of Transportation (DOT) Elaine Chao has [stated](#), “What we are trying to do is to reduce the number of regulations that are hampering the growth of technology in this area. We do not know best what is happening [with self-driving vehicles]. So, we want to partner with the sector. We want to ensure that we are not doing things that hamper [progress].”

Under the existing regulatory structure, defining and validating the overall safety of the vehicles have been the focus of NHTSA, a division of the DOT, which has the mission to “Save lives, prevent injuries, reduce vehicle-related crashes.” Congress empowers NHTSA to write and enforce [Federal Motor Vehicle Safety Standards](#) (FMVSS). Under current law, auto manufacturers bear the responsibility to self-certify that all the vehicles they manufacture comply with all applicable FMVSS. If the self-certified vehicle is not compliant with the FMVSS, manufacturers are subject to NHTSA’s defects, recall, and enforcement authority. NHTSA does not certify vehicle safety or require pre-market verification but, instead, relies on the manufacturers’ self-certification.

¹ A [2015 NHTSA survey](#) that concluded “driver” error was a critical reason for 94 percent of crashes is often misquoted as concluding that “human” error is the reason. ADS may not fall asleep or be drunk like humans, but ADS can be as susceptible, if not more susceptible, to driving recognition errors, decision errors, performance errors, and non-performance errors. The absence of some errors does not establish the absence of all errors.

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The development of ADS will require a new way to look at the fundamental nature of driving, and that development should not be hindered by requiring outdated safety requirements that do not apply to new technologies. At the extreme end of the spectrum, the development of ADS with no driver controls will mean that vehicle features that are now required for human operation may not be necessary or practical. Sound policy should include a review of which requirements would no longer be relevant for a fully autonomous vehicle. The FMVSS are the U.S. federal regulations specifying nationwide design, construction, performance, and durability requirements for auto-safety-related components, systems, and design features. FMVSS focus mostly on crash avoidance, crashworthiness, and crash survivability. Existing FMVSS specify that controls and displays must be located where they are visible to or within the reach of a person sitting in the driver's seat. If the occupants have limited or no control of an ADS, there may not be a "driver's seat" or the relevant controls or displays of driving operations may vary with the driving operations that the human retains. In various iterations of ADS, auto parts subject to FMVSS such as rearview mirrors may be superfluous for driving operations. Similarly, controls for turn signals, lights, or wipers may not be required and may not be subject to safety standards.



With respect to ADS, in 2016, NHTSA issued a 116-page [Federal Automated Vehicles Policy](#), which was updated in 2017 with a 36-page automated driving systems policy [document](#). The NHTSA ADS policy detailed in these documents outlines ADS Vehicle Performance Guidance and requests that manufacturers provide Voluntary Safety Assessment Letters to NHTSA on ADS development and deployment. However, entities are not required to submit an assessment letter, nor is there any mechanism to compel entities to do so. NHTSA does not require that entities provide disclosures nor are they required to delay testing or deployment. Assessments are also not subject to federal approval.

Under the existing system, with the DOT establishing national safety standards for automobiles, the states are generally prohibited from requiring additional safety features. States have retained the responsibilities of: licensing human drivers and registering motor vehicles in their jurisdictions; enacting and enforcing traffic laws and regulations; conducting safety inspections; and regulating motor vehicle insurance. State law also governs liability issues surrounding auto accidents. For vehicles in which increasing numbers of autonomous driving functions have replaced the human driver, it makes sense for the existing NHTSA and state roles and responsibilities to be closely reexamined. However, the current federal/state dichotomy is likely to lead to the most efficient development and deployment of ADS on the nation's roadways.

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The focus must remain on ensuring that critical safety aspects are examined and validated and that any safety assurance gaps that may be created by the introduction of ADS onto the roads are identified and addressed. This is far more complicated than it may seem. While many human-driver-focused FMVSS do not make sense for ADS, perhaps ADS-specific safety tests should accompany broad exemptions. Pre-market approval has many downsides, but some level of independent ADS safety review could supplement self-certification. Existing self-certification should be supplemented by governmentally defined and publicly disclosed standards and then supplemented by third-party validation of design and testing.

In many ways, ADS is a game changer for a vast number of issues and challenges that are still being developed and explored.

THE TECHNOLOGICAL CHALLENGES: WE'RE NOT THERE ... YET

Replacing a human driver with an amalgamation of integrated software, sensors, actuators, controllers, and other hardware is no simple task. Human errors may contribute to most accidents, but human drivers have proven to be capable of performing millions of miles of complex and demanding driving operations without crashes. Robotic, automated systems have achieved incredible progress, but in many ways they still lag basic human operations. In the high-level [Defense Advanced Research Projects Agency Robotics Challenge](#), which has been focusing on humanoid robotics executing complex task underway since 2012, there was great celebration in 2018 when the robot finally was able to ... open a door.

ADS mishaps, crashes, and tragedies have and will happen, and they will continue to make headlines. These highly publicized ADS problems, many resulting from the complexity of driving tasks, diminish the confidence of the public that ADS will be safe. The ADS-related fatalities in Florida, Arizona, and California have seriously challenged many people's beliefs in the current progress of ADS technology. The National Transportation Safety Board review of those fatalities shine a bright light on potential safety concerns for ADS.

Unfortunately, the list of ADS problems does not end with the recent tragedies. In January 2018 alone:

- General Motors was [sued](#) in federal court in the Northern District of California by a motorcyclist alleging that a Chevy Bolt utilizing ADS injured the cyclist by negligent self-driving.
- In Pittsburgh, an automated test vehicle with Argo AI, a startup backed by Ford, was [reportedly](#) involved in an accident that sent two people to the hospital.
- Waymo [announced](#) that it would acquire thousands of Fiat Chrysler Pacifica minivans for its driverless ride-hailing service to the public, but Fiat Chrysler Automobiles [issued](#) a recall of more than 162,000 Chrysler Pacifica minivans due to a potential software glitch that may cause the vehicle to stall.
- A Tesla Model S slammed into the back of a stopped fire truck on the 405 freeway in Los Angeles County. [Reportedly](#), Tesla acknowledged that the driver assistance system ignored the stationary vehicle and instead accelerated to the cruise speed the driver punched in. The driver was required to intervene and apply the brakes.

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Other recent events include:

- A [driverless shuttle bus](#) operating in Las Vegas did not move and was struck by a truck that was backing into a driveway.
- [Uber](#) grounded its fleet of self-driving cars in Pittsburgh as the company investigated a crash involving one of its vehicles. Uber grounded its fleet nationwide in March after a self-driving Uber vehicle was involved in a fatal crash in Tempe, Arizona.
- GM tried to show off its automated GM Cruise to reporters in San Francisco, but the vehicle was [reported](#) to have issues with traffic cones and double-parked vehicles.

These and other incidents have led to the public remaining unconvinced and skeptical of ADS technology. One respected 2017 [survey](#) concluded that 40 percent of respondents anticipate ADS will reduce the number of people killed or injured in traffic accidents. But the remaining 60 percent are evenly split between those who think traffic fatalities will increase with ADS and those who expect fatalities will neither increase nor decrease.

By a 2:1 margin, Californians say driverless cars should not be allowed on the streets “where I live,” [a recent survey](#) found. When asked “Who should be ultimately responsible for deciding where driverless cars are allowed and where they are not allowed” only 4 percent of respondents said the car manufacturer. Roughly half the respondents thought that state and local authorities were best suited to make such decisions. Fifty-eight percent said they did not believe the cars should be allowed on their neighborhood streets, while 57 percent said they would feel “unsafe” or “very unsafe” riding in such a vehicle.

The public belief in improving ADS safety is critical to any long-term development and acceptance of ADS. Government approval and technical development will mean little if people do not accept ADS as directly reducing the number of people killed or injured in traffic accidents.

That requisite public/market acceptance of safety improvement through ADS is far from certain:

- The [2018 AAA Vehicle Technology Survey](#) reveals that 63 percent of U.S. drivers report feeling afraid to ride in a fully self-driving vehicle. It also found that 46 percent of U.S. drivers report that they would feel less safe sharing the road with a self-driving vehicle.
- A [2018 CARAVAN Public Opinion Poll](#) found that 64 percent of respondents expressed concern about sharing the road with driverless cars and 80 percent support minimum performance requirements for computers that operate driverless cars. More than eight in 10 respondents support uniform DOT rules to ensure that the human driver is alert to safely take control from the computer and 73 percent support DOT developing safety standards for new features related to the operation of driverless cars.
- A [2017 MIT white paper](#) on consumer interest in automation found that while the percentage of respondents favoring automation that helps the driver perform increased by 50 percent from 2016 to 2017, the percentage of people who were comfortable with features relieving the driver of control for extended periods or the entire drive dropped. Roughly half of all respondents said they would never buy a car that completely drives itself.
- A [2018 study](#) by Morning Consult concluded almost half of Americans don't believe that ADS will ever fully replace human drivers. The same study found that while 58 percent of Americans do not trust ADS, their opinions could change as the technology evolves.

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- [Pew Research](#) in 2017 reported that 54 percent of Americans expressed worry compared to only 40 percent who expressed enthusiasm about the development of driverless vehicles. More than half reported they would not want to ride in a driverless vehicle if given the opportunity.
- Seventy-five percent of persons surveyed by AIG in 2017 said they think there is a threat that hackers would take control of automated vehicles.

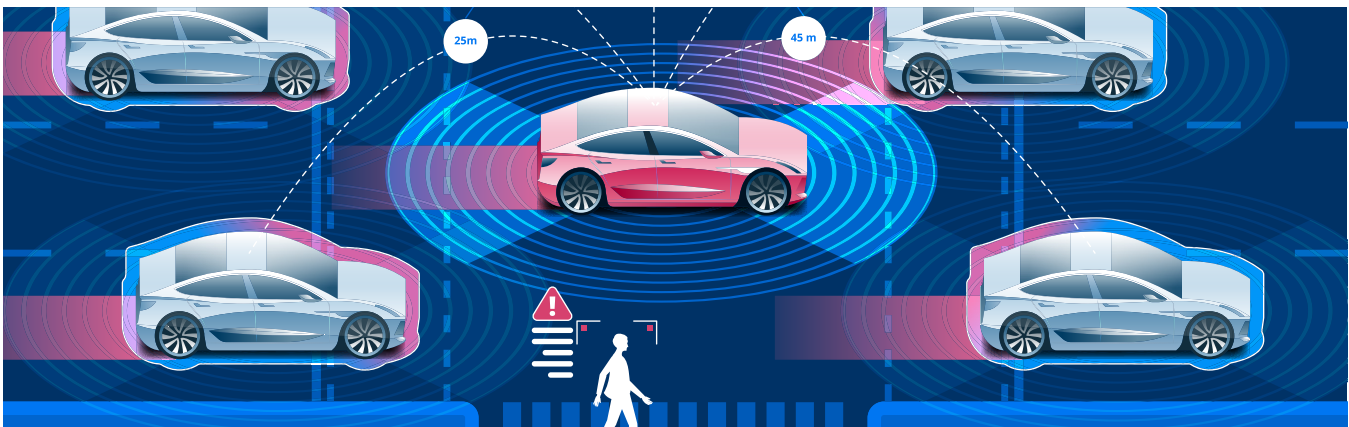
These events and statistics strongly favor an appropriately robust, tailored regulatory environment, without which more accidents will likely occur. Without a strong regulatory environment, there is an increasing risk that the public trust both in ADS and the government institutions that approve and regulate them may erode.

CHAMPIONS OF SAFETY: PROPERTY/CASUALTY INSURANCE COMPANIES LEADING ADVOCATES FOR AUTO PASSENGER SAFETY

Insurers have long championed auto and highway safety issues and have helped raise public awareness through the creation of auto safety research organizations such as the Insurance Institute for Highway Safety. The IIHS is an independent, nonprofit scientific and educational organization dedicated to reducing the losses – deaths, injuries, and property damage – from motor vehicle crashes. Insurers have allied with safety groups such as the Advocates for Highway and Auto Safety to work together to make America's roads safer.

The business of insurance demands that it applies hard data and institutes actuarial science to assess and mitigate risk. It was more than 30 years ago that [coalitions of insurance companies](#) together with consumer groups first favored state requirements for seat belts and air bags and opposed the auto makers reluctance to provide such safety features. Insurers have a long and proven history of working hand-in-glove with regulators and auto manufacturers to facilitate developments that save lives and prevent injuries and damage.

The revolutionary replacement of the human driver with ADS will require auto insurers to understand each vehicle's design and operation. Ultimately, drivers may not be comfortable with no control whatsoever, which means that the insurer of that human driver must understand the planned automated driving operations as well as any possible human operation of the vehicle under any circumstances.



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The insurance industry understands that new and different data will be needed for insurers to write ADS-related insurance policies. The extensive history and level of human driving data that insurers have developed must now be supplemented by increasingly complex data on the automated driving systems that assist or replace the human drivers. Insurers have a proven track record of assessing driving risks and communicating to auto owners the methods to mitigate that risk.

The types of objective and verifiable data that will be required to provide insurance for ADS – data on frequency, severity, repairs – are the same types of data that can authoritatively validate safety levels of ADS to the public and regulators.

Auto insurance rates and coverage are established by insurance companies using vast amounts of historical data and established actuarial science, analyzing years of relevant data on frequency and severity of incidents. The rates determined by insurance companies are then frequently subject to a review by the state insurance regulators to ensure that they are fair and supported by data.

WHEN MORE IS BETTER: VALID AND UNDERSTANDABLE DATA ON ADS IS CRITICAL TO SAFETY

The development and deployment of ADS – particularly the proposed ADS with no controls for a human driver – is a game changer. It will entail a fundamental change in transportation, mobility, infrastructure, and myriad other areas. The adoption of ADS on a wide scale will impact millions of people and will require adaptation by governments, industries, and the culture in general.

The precondition to this development is an accepted belief that ADS improve safety, which will itself require sufficient data and information upon which to validate that belief. To date, information about ADS development in general and safety specifically has been limited.

NHTSA's Federal Automated Vehicles Policy encourages entities to disclose Voluntary Safety Self-Assessments demonstrating their varied approaches to achieving safety in the testing and deployment of ADS. NHTSA suggestions for the voluntary ADS disclosure advocates brevity and confidentiality. For instance, the [2017 update](#) to the Federal Automated Vehicles Policy asks only for “concise information” and specifically not “an exhaustive recount of every action the entity took to address a particular safety element.” In addition to NHTSA's one-page [Voluntary Safety Self-Assessment Template](#) related to crashworthiness, only two companies, [Waymo](#) and [GM](#), have published ADS “safety reports.”

At the state level, the California Department of Motor Vehicles requires all companies testing ADS to obtain a permit, file crash reports within 10 days of an incident, and complete annual “disengagement reports” explaining when autonomous technology has failed. Forty-nine companies have permits to test in California, and as of January 29, 2018, the DMV has received [55 Autonomous Vehicle Accident Reports](#).

ADS development is still in the early stages and myriad business, design, technical, and other issues are still only being discussed. In the competition to bring ADS to market, there should be a requisite level of confidentiality; premature disclosure of technical issues can have disastrous financial and developmental effects and potentially stifle innovation. Basic ADS design decisions such as whether to utilize vehicle-to-vehicle communication systems or to include an “emergency stop control” remain subject to internal corporate debate, technical questions, and related business considerations. Insurance companies

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understand confidential information and have a long history of working with auto companies to obtain and use available data. Similarly, insurance companies have deep experience in data security and the wide scope of data privacy requirements.

Basic ADS design decisions such as whether to utilize vehicle-to-vehicle communication systems or to include an “emergency stop control” remain subject to internal corporate debate, technical questions, and related business considerations. Insurance companies understand confidential information and have a long history of working with auto companies to obtain and use available data.

At the same time, there is a significant level of concern that this system of voluntary self-certification by manufacturers of the safety of ADS may not be adequate to enable the development and public acceptance of safe ADS. Having defined and transparent government standards will result in more and better data and information on ADS that will help its development, the understanding and acceptance by the public of ADS, and the development of related businesses like insurance that will be critical to ADS use. Countries outside the U.S. have developed ideas to address data access, and ADS companies in those countries may be getting an acceptance advantage over U.S. companies. German companies and legislators are developing readouts of data in self-driving cars that will be simple and as standardized as possible. And in Japan, the government plans to make onboard data recorders compulsory for ADS vehicles.

The market acceptance critical to ADS development will be greatly facilitated by publicly available data that clearly states what the ADS is supposed to do and not do. This could be further enhanced with real-time data that provides the public with a clearer understanding regarding the performance capabilities, or limitations, of ADS. With access to such data, consumers, regulators, DMVs, and other entities could readily understand what aspects of the steering, acceleration, and braking of a specific ADS model are or can be partially or fully automated.

For ADS where a human has some level of control of driving operations, the ADS features, abilities, and limitations could be – absent aftermarket alterations – set and built for that make and model on the factory floor. Every Company X, Model Y built in month Z in Kentucky will have the same ADS features. It is extremely doubtful that auto manufacturers will build each car to custom orders; the assembly line will produce the same car with the same ADS features in the same way. Providing data on the exact ADS features, abilities, and limitations for those cars may be the same and would not involve any private data. This would allow owners and DMVs to understand, dealers to service, and insurers to write coverage based on the same ADS features, abilities, and limitations.

It would be in the best interests of proponents of safe ADS to coordinate and consider new and improved alternatives to communicate on ADS technology and performance. Somewhere between the extreme poles of “just trust us” and reams of federal regulations requiring submission of millions of certified data points is a system of information and communication that is usable and comprehensible for the public, governments, and other industries. Validation of safe ADS development and a resulting public acceptance can be greatly enhanced by a measurable gauge of ADS safety/risks through recognized analysis of most relevant data.

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CONCLUSION

The potential safety benefits of ADS are tremendous, and the insurance industry is committed to supporting the development and deployment of real safety benefits at the earliest time. These benefits are dependent, however, on many and daunting technological, logistical, and regulatory revisions that remain to be designed and successfully implemented.

As noted in this paper, the existing environment of auto safety regulation evolved with a human-driver focus and has not fully considered the many nuances of increased assisted and automated driving systems. As these systems develop and evolve, the risk of regulatory safety gaps increases and the need for a comprehensive reassessment of driving operation safety grows exponentially, starting with the paramount focus on the safety of vehicle occupants, occupants of other vehicles, and the public.

Recent ADS tragedies have clearly illustrated that greater validation of safety features will be necessary to promote the development and deployment of this new world of safe ADS. Like middle school math homework, it may be beneficial to show how we got to the answer; to illustrate the exact steps taken to achieve specific metrics of safety for ADS. Broad assurances of overall safety must be bolstered by facts and data on ADS design and operation. Third-party validation of safety testing will help to develop the requisite public, insurer, and governmental trust to support further ADS deployment.

A prerequisite of that trust, particularly for insurers, is the access to more and better data on the proposed and adopted design and operation of ADS. Through their highly regulated development of rates and coverage, insurers apply many of the objective and independent validations sought for ADS operational safety. Just as with the established and active advocacy of seat belts and air bags, auto insurance companies can work with auto manufacturers and safety advocates to develop and implement commercial standards that can save lives.



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