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August 23, 2019

House Committee on Energy and Commerce
Senate Committee on Commerce, Science, and Transportation

**RE: *Development of Self-Driving Vehicle Legislation***

To the Honorable Members of the Committee:

We are submitting these comments in response to the House Committee on Energy and Commerce and Senate Committee on Commerce, Science, and Transportation's invitation to stakeholders to offer comment on the bipartisan effort to draft legislation regulating vehicles with automated driving systems.

Safety Research & Strategies (SRS) is a multi-discipline group specializing in product safety, with particular expertise in motor vehicle issues. Our company examines hundreds of vehicle-related death and injury crashes each year. We also examine technology and data and develop strategies and solutions for addressing harm caused by potentially defective products and practices for a wide range of clients including attorneys, engineers, supplier and technology companies and government. We are also regular and frequent advocates for improved safety and consumer protection, providing a significant portion our time *pro bono* to individuals, non-profits, and others who share our interest in advancing safety.

We appreciate the Committees' willingness to undertake this complex, but necessary task during a period of great technological change. Foundational regulations during what will likely be a long period of semi-autonomy, are particularly important, lest the gap between the minimum required safety and manufacturers' voluntary standards widens further. This is not the time for the regulators to retreat, it is time for the federal government to use its authority to ensure that transition from human-operated vehicles to full automotive autonomy is orderly and that the public is protected from harm, so that this technology can deliver on its safety promises.

The following comments cover four areas of concern that, in the absence of action by the National Highway Traffic Safety Administration, are in need of Congressional guidance. Attention to these issues is crucial to the development of future regulations associated with fully autonomous vehicles, which include: the lack of functional safety standards for critical vehicle controls; the lack of updated standards related to human-machine interface (HMI) with vehicle controls; the lack of accessible data / interpretation tools to adequately monitor and identify vehicle systems for potential malfunctions and their on-road performance; the need for additional resources and institutional restructuring.

**Lack of Functional Safety Requirements**

Electronics remain a largely unregulated area of vehicle safety, even as they dominate vehicle systems fleet-wide, and NHTSA pushes forward on autonomous vehicle strategies. The effects of the agency's failure to adequately regulate current vehicles and their advanced electronic systems are already having significant impacts on motorists as well as pedestrians and others who are unwitting victims of failed vehicle control systems. The lack of a functional safety requirement for the critical electronic controls that process driver inputs, along with hundreds of other datapoints, in order to make decisions about acceleration, braking and steering, for example, has resulted in designs that, when they fail in expected ways, (e.g., sensor failure, voltage drop, inadequate electrical ground, etc.), can induce crashes, and prevent driver's from controlling their vehicles.

Voluntary Functional Safety Standard ISO 26262 defines functional safety as the absence of unreasonable risk due to hazards caused by malfunctioning behavior of electrical and electronic elements, including such elements as the power supply, sensors and other input devices; communication paths; actuators or other output devices.[1] In an automotive setting, it focuses on the risks arising from random faults as well as systematic faults in system design, hardware and software development or in production. This applies to all electronic systems within the vehicle, but it is of particular importance in critical controls and those intended to prevent crashes, such as mandated Electronic Stability Control, as well as other systems from the engine throttle to restraints such as airbags, which react post-crash to mitigate crash injuries.[2]

In some instances, NHTSA has established regulations involving electronic systems, like FMVSS 126, which requires light vehicles to be equipped with Electronic Stability Control (ESC) systems, an important safety feature that has reduced crashes and saved thousands of lives.[3] However, lacking a functional safety standard for electronic controls like this can – and does – result in scenarios in which a critical system intended to save lives can actually create a new hazard that can take lives. For example, in April 2010, General Motors recalled 40,000 Corvettes because a malfunction in the Steering Wheel Position Sensor could corrupt the signals in the vehicle's Electronic Stability Control system causing it to apply the brakes to one or more rear wheels putting the vehicle into a

[1] ISO 26262-1; Vocabulary Part 1: First Edition; November 15, 2011
[2] Executive Summary Functional Safety in Accordance with ISO 26262; ZVEI German Electrical and Electronics Manufacturers Association; Electronic Components and Systems Division; 2012
[3] Estimating Lives Saved by Electronic Stability Control, 2008-2010, Traffic Safety Facts, DOT HS 811634, NHTSA, Nov. 2012

spin.[4] After more than a year of NHTSA investigation into complaints of sudden unwanted braking, in 2013 Honda recalled nearly 200,000 vehicles because of a damage to an electrical capacitor on the circuit board of the ESC control unit that, when damaged applied the brakes without driver input or increased braking force beyond the driver input.[5]

More recently Fiat-Chrysler recalled 4.8 million 2014 to 2018 Chrysler, Dodge and Jeep models because of an electrical short circuit that prevents the driver from manually shutting off the cruise control or disengaging it with the brakes resulting in the vehicle maintaining its current speed or even accelerating.[6]

The recalls are replete with examples of expected failure conditions that have resulted in loss of driver control and crashes that would have been prevented if functional safety standards were required for these systems. Further evidence of failure to adopt functional safety standards causing similar loss of control scenarios can be found in manufacturer Technical Service Bulletins, reported complaints, claims and lawsuits. Yet these problems, which can often take years to identify and remedy post-market – if they are at all – can remain undetected or result in claims of driver error in large part because the cost and complexity required to investigate and identify electronic failures is frequently beyond the reach of most drivers who bear the burden of these defects. (This is addressed further below in the section on lack of accessible data and interpretation tools to adequately monitor and identify vehicle systems for potential malfunctions.)

Rather than regulating functional safety, it appears that NHTSA is content with the industry-developed voluntary standard, ISO 26262.[7] ISO 26262 is a detailed standard, developed by a Functional Safety industry working group within ISO TC22/SC3/WG16, which included members from nine countries working functional safety throughout the product's entire lifecycle from development to implementation, to servicing to decommissioning. Published in November 2011, ISO 26262 also:

- Supports tailoring the necessary activities during these lifecycle phases
- Provides an automotive-specific risk-based approach to determine integrity levels [Automotive Safety Integrity Levels (ASIL)]
- Uses ASILs to specify applicable requirements of ISO 26262 so as to avoid unreasonable residual risk
- Provides requirements for validation and confirmation measures to ensure a sufficient and acceptable level of safety being achieved; provides requirements for relations with suppliers. [8]

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[4] Recall 10V172; Notice of Defect and Noncompliance; General Motors, April 26, 2012
[5] Recall 13V092; American Honda Motor Co.; March 14, 2013
[6] Recall 18V332, Fiat-Chrysler U.S. LLC, May 17, 2018
[7] International Organization for Standardization; ISO 26262-1:2018 Road Vehicles – Functional Safety
[8] ISO 26262-3; Road vehicles; Functional Safety Part 3: Concept phase; First edition; November 15, 2011

While ISO 26262 may serve as a model for an FMVSS, without codifying a requirement, the standard remains voluntary.

NHTSA should be looking at functional safety in much the same way it designates regulations – at all stages of the failure process:

- Pre-Failure: Component level and component interaction testing, certification and ratings.
- At-Failure: Ensuring minimum levels of failsafe for safety critical electronic deigns.
- Post-Failure: Electronic data recorders for crash data as well as control systems diagnostic data, surveillance of safety data, and examination of past investigations to avoid repeating mistakes and improve outcomes of countermeasures.

In addition, Underwriters Laboratories, known as UL, a global safety certification company, is collaborating with Dr. Philip Koopman, co-founder and CTO of Edge Case Research, an autonomous systems safety consulting company and a professor at Carnegie Mellon University, to author a new autonomous safety standard, covering "safety principles and processes for evaluating autonomous products."[9] "UL 4600 evaluates whether autonomous systems can safely perform their intended functions without human intervention, based on their current state and sensing of their operating environment. The standard also covers the reliability of hardware and software necessary for machine learning, sensing the operating environment, and other safety aspects of autonomy."[10] The first step of this collaboration is the development of a comprehensive set of proposals that will be advanced through the standards development process.

The federal government is a stakeholder in this process, and NHTSA representatives should be *ex-officio* members of this standard-setting process as part of its continuing education about autonomous vehicle technology.

**HMI Concerns**

We have seen how human-machine interface changes, absent regulation, or under an inadequate regulation that doesn't preserve the safety intent, expects drivers to instantly change long-ingrained behaviors, or encourages them to step away from the vehicle's basic operational tasks for a few moments, or intermittently, or only in emergency situations.

The advent of keyless ignition vehicles with push button Start/Stop is another example. Both owner experiences and litigation made it clear that the marriage of electronics with ignitions and locks resulted in unintended consequences: carbon monoxide poisoning, rollaway crashes and easy thefts – hazard scenarios that were previously eliminated under

[9] UL 4600 Fact Sheet; Underwriters Laboratory Inc.; 2019
[10] UL 4600 Fact Sheet; Underwriters Laboratory Inc.; 2019

the FMVSS 114 *Theft Protection and Rollaway Prevention* requirements applicable to traditional metal keys. The standard mandated that the key removal from the ignition cylinder could occur only when the vehicle ignition was in the OFF position and the transmission was locked in Park. However, with the introduction of keyless ignitions, NHTSA redefined the "key" to accommodate aspects of this convenience feature without ensuring that the same safety protections were afforded to drivers with the new technology.[11] As a result, the regulations enabled manufacturers to introduce technically compliant designs that failed to meet the true intent of the standard, which was to discourage drivers from leaving their keys in the ignition and to minimize the chances drivers would exit their vehicle with the transmission not locked in Park.

Most manufacturers refer to the keyless ignition fobs as the "key," which functions as a proximity device allowing drivers to start the engine when the fob is inside of the vehicle. However, the fob is not the key – the key is an invisible code that is transmitted from the fob to an electronic control unit in the vehicle, which then allows the drivers to push a button to start the engine. Rather, the fob, the physical device that is assumed to be the key, is a *one-way proximity device* and it plays no role in shutting off the engine like a traditional key. This change not only upends the decades of driver interaction with standardized systems that included safety features to minimize unintended consequences, but it presents an illogical operational condition to drivers who know their vehicle can only be started with the fob inside the vehicle but do not know or cannot reasonably be expected to intuit that the reverse is not true.

Many keyless ignition designs allow the driver to exit the vehicle, key fob in hand, with the engine running and the vehicle transmission not locked in Park (with the engine on or off). Combined with increasingly quiet engines and a range of features that remain active for some minutes even when the engine is off – like headlights, infotainment systems and instrument panel lighting – drivers can leave a vehicle, travel great distances from the vehicle with the key fob while the engine is running, and leave the transmission in a non-Park gear without being aware that they have done so.

Rollaway hazards and vehicle theft protection concerns were the basis for FMVSS 114, which prevented key removal from the vehicle ignition cylinder unless it was in the full OFF position and the transmission was locked in Park. Thus, the standard set a minimum requirement that led to designs that provided positive assurance to the driver who exited their vehicle with their key in hand that two things were true: The engine was off, and the transmission was locked in Park. Neither one of these is necessarily true when drivers exit a keyless ignition vehicle with the key fob. In fact, NHTSA's redefinition of the "key," which was an attempt to update FMVSS 114 and accommodate new technology, not only failed to ensure that the same safety protections that formed the intent of the standard were met, but it also it resulted in manufacturers creating scenarios that while

[11] NHTSA Final Rule; Docket 2005-22093; 91 FR 17755; April 7, 2006

technically compliant reintroduced the very hazards the standard intended to eliminate.[12] [13]

Another example of the gap between technology and the human-machine interface is automakers' migration to electronic shifters, some with unconventional shifting mechanisms including monostable designs, rotary knobs, and push buttons. The functional operations of the keyless ignition, combined with the multitude of unconventional, non-standard e-shift controls that lack the traditional PRNDL (Park-Reverse-Neutral-Drive-Low) configuration – and also lack the tactile feedback provided from a mechanical detent – enhance the likelihood that a driver may not lock the shift control in Park before exiting.[14] [15] [16]

Many designs enhance the likelihood drivers will shift into a position that was not intended based on counterintuitive designs or designs that may appear to function like a traditional PRNDL but don't. Some automakers' vehicles with keyless ignition and e-shifters provide safety features to automatically lock the transmission in Park under certain scenarios or prevent engine shut down if the driver attempts to shut off the engine or exit the vehicle without shifting into Park. The lack of standardization of these controls and features increases the likelihood of injuries and deaths associated with these systems.

It is also notable that some automakers have recalled models with e-shifters to add the software needed to enable an automatic Park application. For example, in 2016 Fiat-Chrysler recalled certain Jeep and Chrysler models with the monostable e-shift control to add its AutoPark software,[17] which the company describes as: "an enhanced securement strategy which places the vehicle in "PARK" if the driver attempts to exit the vehicle before placing the rotary gear shift selector in the "PARK" position." In 2018, Fiat-Chrysler launched a series of Customer Satisfaction campaigns to add AutoPark to 2014-2017 Dodge and Chrysler models with rotary-style e-shifters.[18] [19]

Another example, are autonomous features designed to allow engagement outside of safe operational parameters, while disengaging other safety features that are expected to

[12] The Persistence of Rollaway; The Safety Record; July 24, 2018; http://www.safetyresearch.net/blog/articles/persistence-rollaway or GM Quietly Installs Keyless Engine Shutoff; March 2, 2018 http://www.safetyresearch.net/blog/articles/general-motors-quietly-installs-keyless-engine-shutoff

[13] GM Quietly Installs Keyless Engine Shutoff; The Safety Record, Safety Research & Strategies, March 2, 2018; http://www.safetyresearch.net/blog/articles/general-motors-quietly-installs-keyless-engine-shutoff

[14] Field study investigating gear shifter usability in car rental scenario; Sanna Lohilahti Bladfält*, Camilla Grane and Jon Friström; Pg.  48th Annual Conference of the Nordic Ergonomics and Human Factors Society's (NES) NES2016 –Ergonomics in Theory and Practice; 2016

[15] SBW Feedback -Design of feedback system for increased usability in monostable SBW shifters; Tanya Alvarez Cabrera; Luleå University of Technology; 2017

[16] Gear Shifter Design – Lack of Dedicated Positions and the Contribution to Cognitive Load and Inattention; Sanna Lohilahti Bladfält, Camilla Grane, and Peter Bengtsson; Luleå University of Technology; 2019

[17] Recall 16V240; Part 573 Notice of Defect and Noncompliance; FCA; August 9, 2016

[18] Customer Satisfaction Notification UO6 AutoPark Functionality; FCA; May 2018

[19] Customer Satisfaction Notification UO5 AutoPark Functionality; FCA; July 2018

operate when using semi-autonomous features. For example, Adaptive Cruise Control (ACC), allows the driver to maintain a certain speed and set a following distance between the subject and a lead vehicle. Using various sensors to maintain the set distance, ACC will automatically adjust the throttle and brakes – and can bring the vehicle to a complete stop and resume again – without driver input to the accelerator or brake pedals. Some ACC systems allow the driver to set speed and following distances that are unsafe and prevent adequate stopping distance, or allow operation at speeds that are above the limits of the automatic emergency braking systems. Thus, drivers who use these systems, which by their very design, will reduce driver engagement, are then expected to provide a rapid response in situations that can't be mitigated by other automated features.

Poorly designed human-machine interfaces combined with new technology can be an unfortunate recipe for injuries and deaths. The May 2016 death of Joshua Brown, a Tesla enthusiast who was driving his Tesla Model S in Autopilot mode when it crashed into an 18-wheel tractor-trailer truck that was turning left in front of it on US 27A, west of Williston, Florida, is a good example.

Koopman argues that automotive autonomy unrealistically expects "human drivers to be super-human."[20]

> High-end driver assistance systems might be asking the impossible of human drivers. Simply warning the driver that (s)he is responsible for vehicle safety doesn't change the well-known fact that humans struggle to supervise high-end autonomy effectively, and that humans are prone to abusing highly automated systems. [21]

A recent paper published by French researchers shows that autonomy lessens the human focus on the driving task – drivers lose situational awareness and drowsiness rises, the longer he/she is in an automated vehicle. Researchers hypothesize that driver may be trapped into an "out-of-loop state," which is well known to have a negative impact on driving performance during take-over."[22]

As long as humans are in the vehicle, there will be a need for vehicle controls of some type. The basic premise that the human occupants of the fully automated vehicle will never play a role in its operation is false. Autonomous technology will fail, and those malfunctions will initiate a response from the human occupants. Will they attempt to exit the vehicle? Will they be able to shut down the vehicle? These are but a couple of obvious scenarios that NHTSA's current guidance on autonomous vehicles fails to address.

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[20] Ethical Problems That Matter for Self-Driving Cars; Safe Autonomy; Philip Koopman; May 28, 2019 safeautonomy.blogspot.com/2019/05/ethical-problems-that-matter-for-self.html

[21] Ethical Problems That Matter for Self-Driving Cars; Safe Autonomy; Philip Koopman; May 28, 2019 safeautonomy.blogspot.com/2019/05/ethical-problems-that-matter-for-self.html

[22] Impact of a long autonomous driving phase on take-over performance; A. Bourrelly, C. Jacobé de Naurois, A. Zran, F. Rampillon, JL. Vercher and C. Bourdin; IET Intelligent Transport Systems Journal; May 7, 2019

In fact, the age of full vehicle autonomy is going to require a thorough and thought-out HMI strategy. Ignoring this critical aspect of automotive safety during the transition to complete automation will make the development and implementation of such a strategy more difficult.

**Data Accessibility, Interpretation and Transparency**

As the vehicle takes over most of the operational functions, the amount of data it must gather, assess, and store, and the speed at which it must process this information will increase exponentially. Indeed, that is already happening – autonomous test vehicles "typically generate between 5TB and 20TB of data per day, per vehicle."[23] Even in current Level 2 vehicles the amount of data that is transmitted between modules, which is stored to widely varying degrees amongst vehicles, is extraordinary, and the tools available to the public, law enforcement and diagnosticians are generally limited to OBD II diagnostic scans and Event Data Recorders.

This leads to the inability to independently examine, document and identify potential vehicle-related failures and can and does result in motorists' being charged civilly and criminally for at-fault crashes without the ability to properly defend themselves. Despite the plethora of data circulating in a vehicle that can be used to identify potential vehicle defects, it may not be recorded unless a preset active fault is flagged. Further, the publicly available tools used to examine the vehicle and driver behavior, which include OBD II diagnostic scanners and scan tools to extract the data from the Event Data Recorder, are able to access only a fraction of what may be needed or available to the manufacturer.

Presumably, failures in fully autonomous vehicles will not lead to at-fault charges of occupants who have no controls. However, this should be clearly stated. And, establishing a framework for data accessibility and interpretation that is not reliant on the manufacturer as the sole arbiter as to its meaning, will be important for accountability and public acceptance. The need to address this is *immediate* and it should be considered as the Committee drafts any legislation for autonomous vehicles.

The Diagnostic Trouble Codes (DTC) relied on to identify potential causes of vehicle malfunctions are an outgrowth of a 1995 U.S. Environmental Protection Agency (EPA) Final Rule regarding On-Board Diagnostics.[24] In the current age of semi-autonomous vehicles, they do not provide the granular detail necessary and are fast becoming relics.

Likewise, Event Data Recorders, while helpful, are also crude gatherers of limited vehicle pre-crash and crash metrics that store limited data at sampling speeds far slower

[23] Data storage is the key to autonomous vehicles' future; Mark Pastor; ioTNow Transport; February 14, 2019

[24] Control of Air Pollution from New Motor Vehicles and New Motor Vehicle Engines; Regulations Requiring Availability of Information for Use of On-Board Diagnostic Systems and Emission-Related Repairs on 1994 and later Model Year Light-Duty Vehicles and Light-Duty Trucks; 60 FR 40474; U.S. Environmental Protection Agency; August 9, 1995

than is adequate to understand the complete vehicle and driver behavior leading up to and during a crash. Further, the lack of transparency by many manufacturers regarding what data are actually recorded, retrieved and analyzed compounds the difficulty in using EDR data. This creates a conflict of interest when one party controls all of the data – particularly when that data may implicate a vehicle defect or provide an incomplete record of the driver's actions during the critical milliseconds leading up to a crash.

Tesla is a case in point. To monitor driver and vehicle performance, Tesla vehicles record gigabytes of data through onboard recording and over-the-air (OTA) transmission. Most of the data, including the vehicle log files containing parametric data, is stored in a proprietary binary format that requires the use of Tesla in-house software tools for conversion into engineering units.

Autonomous automotive technology is being beta tested on public roads with little transparency. This legislation should not neglect the need for data collection and public access – a key issue affecting public confidence in adopting autonomous technology. A 2019 Ipsos/Reuters poll found that "half of U.S. adults think automated vehicles are more dangerous than traditional vehicles operated by people, while nearly two-thirds said they would not buy a fully autonomous vehicle."[25] A 2018 Cox Automotive study found only 16 percent were comfortable "letting an autonomous vehicle drive them without the option of being able to take control."[26]

Adding to the challenges of accessing and understanding the vehicle data, are the lack of available data on the in-service performance of semi-autonomous and autonomous vehicles. Rather than aid the public's understanding, NHTSA has aided manufacturers like Tesla who have repeated unsupported claims about the safety of their vehicles. For example, last October, NHTSA sent Tesla a cease-and-desist letter for asserting "that NHTSA tests showed the Model 3 has 'the lowest probability of injury of all cars the safety agency has ever tested'" is based on crash test performance.[27] The agency also referred the matter to the Federal Trade Commission's Bureau of Consumer Protection.[28]

NHTSA's action was only disclosed recently, when Plainsite, a non-profit that provides accessible information to the public about law and government matters, released the letter, which it obtained through a Freedom of Information Act (FOIA) request. This incident underscores the importance of transparency.

In another instance, NHTSA chose to keep out of view Tesla data it used as the basis for closing a defect investigation into the automaker's Autopilot and Autosteer system

[25] Americans still don't trust self-driving cars, Reuters/Ipsos poll finds; Paul Lienert, Maria Caspani; April 1, 2019

[26] Autonomous Vehicles Face an Uphill Battle for Public Trust; Ian Thibodeau; Detroit News; June 20, 2019

[27] NHTSA sent Tesla cease-and-desist over Model 3 safety claims; AJ Dellinger; engaget.com; August 7, 2019

[28] NHTSA sent Tesla cease-and-desist over Model 3 safety claims; AJ Dellinger; engaget.com; August 7, 2019

following the 2016 Joshua Brown fatal crash involving a Tesla that impacted the side of a tractor trailer while Autopilot was engaged. In January 2017, the Office of Defects Investigation closed the Preliminary Evaluation saying they could find nothing wrong – in fact, the agency's examination of crash data showed that Tesla's Autopilot system, with Autosteer, resulted a 40 percent drop in crashes with airbag deployments after the installation of the technology – either as original equipment or through an over-the-air software update. This remarkable finding, which, if true, would indicate an enormous advancement in public health.

However, in an effort to replicate the NHTSA findings, statistician and researcher Randy A. Whitfield, of Quality Control Systems (QCS) Corp., sought to obtain the data. On February 24, 2017, he filed a FOIA request for "all of the mileage and airbag deployment data supplied by Tesla analyzed by ODI to calculate the crash rates." He also asked for any "statistical formulas, models, adjustments, sample weights, and/or any other data or methods relied upon to calculate the crash rates."[29]

When the agency failed to respond, Whitfield filed a FOIA lawsuit for the data in U.S. District Court in Washington D.C. On July 21, 2017, NHTSA notified Whitfield that it had denied his request, based on two exemptions to the FOIA – 4, which shields information that could cause competitive harm, and 5 – which shields an agency's "deliberative process" from public view. On September 30, 2018, Judge Dabney L. Friedrich denied motions by both Whitfield and NHTSA for a summary judgement. However, in his 13-page ruling ordering the parties to prepare for further proceedings, Judge Friedrich refuted the claims of proprietary data secrets and competitive harm offered by Tesla Director of Field Performance Engineering, Matthew L. Schwall. After this ruling, NHTSA rescinded Tesla's grant of Confidential Treatment for the data Whitfield requested and turned it over to him in late November.[30]

In February, Whitfield released an analysis that challenged a NHTSA assertion that airbag deployments in Tesla vehicles with Autosteer dropped by 40 percent after the installation of the technology. *Whitfield showed that for the subset of vehicles in which all of the relevant data that NHTSA relied upon is known, that in fact there were almost twice as many airbag deployments after the addition of Autosteer as before the technology was added.* [31]

An example of a more open model can be found the California DMV's public databases related to disengagements, (defined as the deactivation of the autonomous mode when an autonomous technology occurs or when the safe operation of the vehicle requires that the test driver take immediate manual control of the vehicle). The CA DMV currently mandates that disengagement reports be made publicly accessible via two databases. The

[29] New Analysis Challenges Tesla's Bold Claims; The Safety Record; Safety Research & Strategies; http://www.safetyresearch.net/blog/articles/new-analysis-challenges-bold-tesla-claims; February 8, 2019
[30] New Analysis Challenges Tesla's Bold Claims; The Safety Record; Safety Research & Strategies; http://www.safetyresearch.net/blog/articles/new-analysis-challenges-bold-tesla-claims; February 8, 2019
[31] NHTSA's Implausible Safety Claim for Tesla's Autosteer Driver Assistance System; Randy and Alice Whitfield; The Risks Digest; February 26, 2019.

Autonomous Vehicle Disengagement Reports Database includes data related to all disengagement reports that occurred during testing on CA public roads between September 2014 and January 2017 as reported by Bosch, Delphi Automotive, Google, Nissan, Mercedes-Benz, Tesla Motors, BMW, GM, Ford, Honda, and Volkswagen Group of America.[32] The Report of Traffic Accidents Involving Autonomous Vehicles Database provides more descriptive and detailed reports for crashes that result in property and/or serious injuries to people) that occurred during the same time span.[33]

**NHTSA Resources and Restructuring**

Any legislation enacted that compels NHTSA to assume its regulatory and enforcement duties over autonomous and semi-autonomous vehicles must include dedicated resources to allow the agency to conduct ongoing research and to educate agency staff independently of the manufacturers.

NHTSA's last four fiscal appropriation requests show a trend of more-or-less level funding, as the share of budget devoted to state highway safety grants grows incrementally. In the agency's FY2017 request, 49.5 percent of the total was to be meted out in grants, and $200 million devoted to autonomous vehicle development.[34] By its FY 2020 request, the percentage of the total going to highway safety grants had grown to 67, and no money was specifically set aside for autonomous vehicle development. It is doubtful the agency learned everything it needed to know about driverless vehicles in one fiscal year.[35]

It is our recommendation that along with any appropriations earmarked for NHTSA's autonomous vehicle development, legislation requiring the agency to file an annual report to Congress, detailing how the money was spent and file a report to Congress every two years showing how the agency used its research to advance regulation and enforcement of safety standards, as they pertain to autonomous vehicles.

As for re-structuring NHTSA, we urge Congress to examine ways to return NHTSA to its roots as a public health agency, once guided by the Haddon Matrix, the pre-eminent injury prevention paradigm, authored by its first administrator, physician William Haddon.

Epidemiology, with its flexible and efficient approach to an ever-shifting landscape of biological threats, offers a model that can be correlated to the transformative technology that is reshaping motor vehicles.

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[32] Examining accident reports involving autonomous vehicles in California; Francesca M. Favarò, Nazanin Nader, Sky O. Eurich, Michelle Tripp, Naresh Varadaraju; PLOS One; September 20, 2017
[33] Examining accident reports involving autonomous vehicles in California; Francesca M. Favarò, Nazanin Nader, Sky O. Eurich, Michelle Tripp, Naresh Varadaraju; PLOS One; September 20, 2017
[34] Budget Estimates, Fiscal Year 2017, NHTSA, Submitted to The Committees on Appropriations.
[35] Budget Estimates, Fiscal Year 2020, NHTSA, Submitted to The Committees on Appropriations

> Epidemiology is the study of epidemics. The primary role of epidemiology is to identify the epidemics and parameters of interest of host, agent, and environment and to generate and test hypotheses in search of causal pathways. Almost all diseases have a specific distribution in relation to time, place, and person and specific "causes" with high effect sizes. Epidemiology then uses such information to develop interventions and test (through clinical trials and natural experiments) their efficacy and effectiveness.[36]

One of epidemiology's most recent successes is the World Health Organization's multi-layered response to the African outbreaks of the Ebola virus, beginning in 2013, when a "mysterious disease was reported in a small village in Guinea."[37] In 2015, WHO published a report on how its initial control efforts "were eventually overwhelmed by the wide geographical dispersion of transmission," and by "the unprecedented operational complexity of the outbreaks, and the many factors that undermined the power of traditional containment measures to disrupt transmission chains."[38] WHO, scientists and the pharmaceutical industry collaborated to develop, test, license, and introduce the first Ebola vaccines, therapies, and point-of-care diagnostic tests. And, this spring, WHO announced the "impressive" results of an experimental Ebola vaccine (protective 97.5 percent of the time), that was being used to contain an outbreak in the Democratic Republic of the Congo.[39]

Indeed, in the U.S., the Centers for Disease Control counts motor vehicle safety as one of the greatest public health successes of the 20$^{th}$ century. [40]

> The reduction of the rate of death attributable to motor-vehicle crashes in the United States represents the successful public health response to a great technologic advance of the 20th century--the motorization of America. Six times as many people drive today as in 1925, and the number of motor vehicles in the country has increased 11-fold since then to approximately 215 million (1). The number of miles traveled in motor vehicles is 10 times higher than in the mid-1920s. Despite this steep increase in motor-vehicle travel, the annual death rate has declined from 18 per 100 million vehicle miles traveled (VMT) in 1925 to 1.7 per 100 million VMT in 1997--a 90% decrease.[41]

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[36] Epidemiology Then and Now; Lewis Kuller; American Journal of Epidemiology, Volume 183, Issue 5, March 1, 2016

[37] One year into the Ebola epidemic: a deadly, tenacious and unforgiving virus; World Health Organization; January 2015

[38] One year into the Ebola epidemic: a deadly, tenacious and unforgiving virus; World Health Organization; January 2015

[39] The data are clear: Ebola vaccine shows 'very impressive' performance in outbreak; Helen Branswell; STAT; April 12, 2019

[40] Achievements in Public Health, 1900-1999 Motor-Vehicle Safety: A 20th Century Public Health Achievement; Morbidity and Mortality Weekly Report; CDC; May 14, 1999

[41] Achievements in Public Health, 1900-1999 Motor-Vehicle Safety: A 20th Century Public Health Achievement; Morbidity and Mortality Weekly Report; CDC; May 14, 1999

The end of the 20th century was also a critical turning point for motor vehicles as electronics became more sophisticated and feasible, they have increasingly played a much larger role in vehicle operations. These systems provide safety enhancements otherwise unachievable. There is little question that today's automobiles are much safer overall than their predecessors. But as we reach another critical turning point, it is important to examine whether it is acceptable to compromise and accept as collateral damage the failures of semi-autonomous and autonomous vehicles and the trauma and devastation that comes with these failures, which could otherwise be prevented through the codification of existing best practices to ensure that they are consistently applied, enforced – and updated. When the great public health achievements of the 21st century are counted, will motor vehicle safety remain on the list?

In conclusion, vehicle autonomy offers promise, but only if it is implemented under a comprehensive and well-thought-out regulatory schema that addresses the complexities of this new technology – and includes uniform protections for consumers. In many ways, this period mirrors the first years of the agency's existence, as the National Highway Safety Bureau, and later as the National Highway Traffic Safety Administration, when the original Federal Motor Vehicle Safety Standards were written. The six decades hence have seen automobiles transition from mechanical to electro-mechanical machines to semi-autonomous, computer-driven machines built on neuro-networks on the way to full automation. This evolution has brought increased convenience and safety to the motoring public including advanced airbags and electronic stability control. But they have also radically altered automotive engineering and design, and the human machine interface. The regulations and the agency's ability to monitor and enforce safety standards have not kept up. This legislative process offers a rare opportunity to rewrite the rulebook to reestablish the relevancy of the FMVSS system and its stewards.

If we can be of further assistance to the Committees as they proceed with this important work, please do not hesitate to reach out.

Sincerely,

Sean E. Kane