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When Rubber Meets the Road: Balancing Innovation and Public Safety in the Regulation of Self-Driving Cars

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WHEN RUBBER MEETS THE ROAD: BALANCING INNOVATION AND PUBLIC SAFETY IN THE REGULATION OF SELF-DRIVING CARS

Abstract: The prospect of self-driving vehicles operating on our roadways brings with it both promise and risks. One of the most prominent risks is ensuring that an appropriate regulatory scheme is in place to permit manufacturers to test and deploy self-driving cars on public roadways while minimizing safety threats to the public. Currently, self-driving cars are operating under a regulatory framework designed for vehicles driven by humans. Legislative proposals have been put forth to remove barriers and adjust the present self-certification model of compliance to fit self-driving cars. This Note explores the current state of the regulatory system for self-driving cars and legislative proposals to change it. It argues that a type approval process, similar to the practice used by the Federal Aviation Administration for aircraft, would serve as a useful regulatory model to ensure public safety without constraining innovation.

INTRODUCTION

Humans are responsible for ninety-four percent of motor vehicle crashes.[1] With 37,133 fatalities on U.S. roadways in 2017, even a modest reduction in human error could have significant benefits for society overall.[2] Accordingly, it is not surprising that the prospect of self-driving cars replacing careless, distracted, and slow-to-react human-driven cars has created so much excitement.[3] A self-driving car can see 360 degrees at all times, never gets distracted or

[1] NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., CRITICAL REASONS FOR CRASHES INVESTIGATED IN THE NATIONAL MOTOR VEHICLE CRASH CAUSATION SURVEY 1 (Feb. 2015), https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812115 [https://perma.cc/4RZU-4DVX].

[2] *See* U.S. DEP'T OF TRANSP., PREPARING FOR THE FUTURE OF TRANSPORTATION: AUTOMATED VEHICLES 3.0, at 1 (2018) [hereinafter AV GUIDANCE 3.0], https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/automated-vehicles/320711/preparing-future-transportation-automated-vehicle-30.pdf [https://perma.cc/7SMM-S8FF] (discussing traffic fatalities).

[3] *See* Stuart Dredge, *Elon Musk: Self-Driving Cars Could Lead to Ban on Human Drivers*, THE GUARDIAN (Mar. 18, 2015, 3:22 AM), https://www.theguardian.com/technology/2015/mar/18/elon-musk-self-driving-cars-ban-human-drivers [https://perma.cc/C4GU-QHNC] (noting that the proliferation of self-driving cars may require human driven cars to be banned). Numerous companies are testing self-driving vehicle prototypes and billions of dollars are pouring in to self-driving car startups. *See Testing of Autonomous Vehicles with a Driver*, CAL. DEP'T OF MOTOR VEHICLES, https://www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/testing [https://perma.cc/AFV8-CBLF] (noting that, as of December 5, 2019, sixty-five entities have permits to test automated vehicles in California); Neal E. Boudette, *Honda Putting $2.75 Billion into G.M.'s Self-Driving Venture*, N.Y. TIMES, Oct. 4, 2018, at B4 (discussing Honda's investment of $2.75 billion into G.M. Cruise Holdings, a subsidiary of General Motors focused on developing automated vehicles).

tired, and can react instantaneously.[4] That is at least how a self-driving car is supposed to work.[5]

On March 18, 2018, Elaine Herzberg became the first pedestrian fatality from a self-driving car, when she was struck and killed by an automated Uber test vehicle operating with its automated driving system engaged.[6] Herzberg was crossing a street at night and not within a crosswalk when she was struck.[7] The automated driving system failed to detect Herzberg as she crossed the street, and the safety driver conducting the testing appeared to be distracted and not monitoring the roadway.[8] Arizona Governor Doug Ducey subsequently suspended Uber's testing operations in Arizona on March 26, 2018.[9] Two months later, on May 23, 2018, Uber announced that it was ending its automated vehicle testing program in Arizona.[10] The accident demonstrates that, even though they may hold great promise for society, self-driving cars also pose a danger to the public when they malfunction.[11]

When rubber meets the road, lawmakers must answer the question of how to regulate self-driving cars.[12] Current regulations are concerned with vehicles designed to operate safely in the hands of human drivers, but future regulations must make sure that computer drivers operate vehicles safely in the presence of humans.[13]

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[4] *Technology*, WAYMO, https://waymo.com/tech/ [https://perma.cc/Y6ZR-BYSN] (noting that its sensors are designed to "scan constantly for objects around the vehicle—pedestrians, cyclists, vehicles, road work, obstructions—and continuously read traffic controls, from traffic light color and railroad crossing gates to temporary stop signs" and that its "vehicles can see up to three football fields away in every direction").

[5] *See* Daisuke Wakabayashi, *Self-Driving Uber Car Kills Pedestrian in Arizona, Where Robots Roam*, N.Y. TIMES, Mar. 20, 2018, at A1 (discussing an accident where a self-driving Uber prototype operating with a human monitor struck and killed a pedestrian).

[6] Troy Griggs & Daisuke Wakabayashi, *How a Self-Driving Uber Killed a Pedestrian in Arizona*, N.Y. TIMES (Mar. 21, 2018), https://www.nytimes.com/interactive/2018/03/20/us/self-driving-uber-pedestrian-killed.html [https://perma.cc/2YDG-EUM6].

[7] Ryan Randazzo, *Victim of Self-Driving Uber Accident Could Be to Blame, Expert Says*, USA TODAY (Mar. 23, 2018, 4:20 PM), https://www.usatoday.com/story/tech/nation-now/2018/03/23/self-driving-uber-pedestrian-accident/453319002/ [https://perma.cc/JR89-S6EZ].

[8] Griggs & Wakabayashi, *supra* note 6.

[9] Alejandro Lazo & Greg Bensinger, *Arizona Governor Suspends Uber's Self-Driving Cars from Roads*, WALL ST. J. (Mar. 26, 2018, 10:51 PM), https://www.wsj.com/articles/arizona-governor-suspends-ubers-self-driving-cars-from-roads-1522113198 [https://perma.cc/BP58-95PE].

[10] Marco della Cava & Ryan Randazzo, *Uber to Shut Down Self-Driving Car Operation in Arizona After Fatality*, USA TODAY (May 23, 2018, 6:43 PM), https://www.usatoday.com/story/tech/news/2018/05/23/uber-shut-down-self-driving-car-operation-arizona-after-fatality/637122002/ [https://perma.cc/U3E6-M2MG].

[11] *See* Wakabayashi, *supra* note 5, (discussing the promise of self-driving cars and the fatality in Arizona).

[12] *See* AV GUIDANCE 3.0, *supra* note 2, at 7 (detailing proposals to regulate self-driving cars).

[13] *See id.* (noting that future standards will need to take into account where the vehicle is capable of driving itself and that performance-based standards may be needed to test the capabilities of automated vehicles).

This Note explores the current state of the regulatory system for self-driving cars and evaluates proposals to adapt it to a driverless future.[14] Part I gives an overview of the classification system for self-driving cars and discusses the current automotive regulatory regime and proposals in Congress to modify it.[15] Part II discusses the objectives of regulating self-driving cars, explores the challenges of balancing competing goals, and examines current policy as well as proposed legislative and regulatory actions.[16] Part III assesses type approval, the process used by the Federal Aviation Administration (FAA) to approve aircraft designs, as a possible mechanism for regulating self-driving cars.[17]

I. THE STATE OF PLAY FOR AUTOMATED VEHICLES

This Part provides an overview of the classification system for self-driving cars as well as the current federal regulatory and legislative environment.[18] Section A details the framework for categorizing self-driving cars.[19] Section B discusses the federal framework for regulating motor vehicles.[20] Section C considers barriers to the proliferation of self-driving cars in the context of the federal regulatory framework for motor vehicles.[21] Section D reviews actions taken by the National Highway Traffic Safety Administration (NHTSA) to clarify policy and remove barriers for self-driving cars.[22] Section E details congressional proposals to adjust the federal regulatory framework to accommodate self-driving cars.[23]

A. Understanding the SAE Definitional and Taxonomical Framework

Self-driving cars may have differing capabilities and various use cases, which necessitated the development of standardized definitions and taxonomy for driving automation systems.[24] Industry members, policymakers, and regu-

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[14] *See infra* notes 18–334 and accompanying text.

[15] *See infra* notes 18–129 and accompanying text.

[16] *See infra* notes 130–285 and accompanying text.

[17] *See infra* notes 286–334 and accompanying text.

[18] *See infra* notes 18–129 and accompanying text.

[19] *See infra* notes 24–43 and accompanying text.

[20] *See infra* notes 44–52 and accompanying text.

[21] *See infra* notes 53–63 and accompanying text.

[22] *See infra* notes 64–75 and accompanying text.

[23] *See infra* notes 79–129 and accompanying text.

[24] *See* NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., PRELIMINARY STATEMENT OF POLICY CONCERNING AUTOMATED VEHICLES 4 (2013) [hereinafter PRELIMINARY STATEMENT OF POLICY CONCERNING AUTOMATED VEHICLES], http://www.nhtsa.gov/staticfiles/rulemaking/pdf/Automated_Vehicles_Policy.pdf [https://perma.cc/FU8Q-6WAE] (discussing how levels of automation serve the need "for clarity in discussing [automated vehicles] with other stakeholders"). In this document, NHTSA originally settled on five levels of automation numbered 0–4. *Id.* at 4–5. In September 2016, NHTSA released FEDERAL AUTOMATED VEHICLES POLICY, a guidance document that superseded its PRELIMINARY STATEMENT OF POLICY CONCERNING AUTOMATED VEHICLES. *See* NAT'L HIGHWAY

lators have coalesced around the definitional and taxonomical framework developed by SAE International (SAE) to guide the discussion.[25]

SAE begins by identifying three main actors that could be involved in driving: a human driver, a driving automation system, and vehicle systems and components that do not include a driving automation system.[26] Each of the three actors is capable of performing all or part of what SAE terms the dynamic driving task.[27] The dynamic driving task includes all of the decision making and inputs needed to operate a vehicle in on-road traffic.[28] More specifically,

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TRAFFIC SAFETY ADMIN., FEDERAL AUTOMATED VEHICLES POLICY 10–11 (2016) [hereinafter AV GUIDANCE 1.0], https://www.transportation.gov/sites/dot.gov/files/docs/AV%20policy%20guidance%20PDF.pdf [https://perma.cc/ET4S-XUYV] (discussing the scope and effective dates of the document). In AV GUIDANCE 1.0, NHTSA adopted the SAE levels of automation and noted that scattered terminology necessitated the adoption of uniform definitions. *Id.* at 9; *see also* SAE INT'L, J3016: TAXONOMY AND DEFINITIONS FOR TERMS RELATED TO DRIVING AUTOMATION SYSTEMS FOR ON-ROAD MOTOR VEHICLES 2 (June 2018) [hereinafter J3016], https://www.sae.org/standards/content/j3016_201806/ [https://perma.cc/2W46-9PE9] (discussing the levels of automation). SAE International, formerly known as the Society of Automotive Engineers, is an organization devoted to, among other things, sharing information and developing standards for engineers in the automotive and aerospace industries. *About SAE International*, SAE INT'L, https://www.sae.org/about/history [https://perma.cc/4AU6-PUAY]. NHTSA and the Department of Transportation (DOT) released three subsequent versions of guidance documents and each adopted the SAE levels of automation. *See* NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., AUTOMATED DRIVING SYSTEMS 2.0: A VISION FOR SAFETY 4 (2017) [hereinafter AV GUIDANCE 2.0], https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf [https://perma.cc/F6MY-W8QP] (utilizing the SAE levels of automation); AV GUIDANCE 3.0, *supra* note 2, at vi (same); U.S. DEP'T OF TRANSP., ENSURING AMERICAN LEADERSHIP IN AUTOMATED VEHICLE TECHNOLOGIES: AUTOMATED VEHICLES 4.0, at 13–14, 18 (2020) [hereinafter AV GUIDANCE 4.0], https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/automated-vehicles/360956/ensuringamericanleadershipav4.pdf [https://perma.cc/QRQ8-WE7F] (same). While AV GUIDANCE 2.0 updated and replaced AV GUIDANCE 1.0, AV GUIDANCE 3.0 "builds upon—but does not replace—voluntary guidance provided in" AV GUIDANCE 2.0. AV GUIDANCE 3.0, *supra* note 2, at viii; *see* AV GUIDANCE 2.0, *supra*, at 1 (noting that the document "updates the Federal Automated Vehicles Policy released in September 2016 and serves as NHTSA's current operating guidance for ADSs"). Similarly, AV GUIDANCE 4.0 supplements, rather than supersedes, AV GUIDANCE 2.0 and AV GUIDANCE 3.0. AV GUIDANCE 4.0, *supra*, at 1.

[25] *See e.g.*, TEX. TRANSP. CODE ANN. § 545.451 (West 2017) (defining Automated Driving System (ADS) using J3016 terminology, including "dynamic driving task"); AV GUIDANCE 3.0, *supra* note 2, at vi (using the SAE levels of automation).

[26] J3016, *supra* note 24, at 2.

[27] *See id.* (discussing the role of the primary actors). SAE defines dynamic driving task as:

> All of the real-time operational and tactical functions required to *operate* a *vehicle* in on-road traffic, excluding the strategic functions such as *trip* scheduling and selection of destinations and waypoints, and including without limitation: Lateral vehicle motion control via steering (operational); *Longitudinal vehicle motion control* via acceleration and deceleration (operational); *Monitoring* the driving environment via object and event detection, recognition, classification, and response preparation (operational and tactical); Object and event response execution (operational and tactical); Maneuver planning (tactical); and Enhancing conspicuity via lighting, signaling and gesturing, etc. (tactical).

Id. at 6.

[28] *See id.* at 6 (defining dynamic driving task).

an actor performing the entire dynamic driving task will control the vehicle's longitudinal and lateral movement, monitor the roadway and surroundings by detecting objects and events, respond to objects and events by executing maneuvers, and increase visibility and communicate to other actors through lighting or signaling when necessary.[29]

SAE has identified six levels of driving automation, numbered 0–5, that evolve sequentially depending on (1) whether the driving automation system performs some or all of the subparts of the dynamic driving task on a sustained basis, (2) whether the actor that performs the dynamic driving task fallback in the case of a system failure is a human driver or the system itself, and (3) whether the driving automation system is limited in its operational design domain.[30] Operational design domain refers to where the automated vehicle can operate and the conditions in which it can operate.[31]

At SAE level 0, or No Driving Automation, a human driver performs the entire dynamic driving task.[32] At SAE level 1, or Driver Assistance, the driving automation system controls either the longitudinal or lateral movement of the

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[29] *Id.* SAE uses the term object and event detection and response as an umbrella term for the dynamic driving task functions related to monitoring and responding to objects and events. *Id.* at 7.

[30] *See id.* at 21–23 (discussing the role of the human driver and the driving automation system in the context of each level of automation). Dynamic driving task fallback is defined as the "response by the *user* to either perform the [dynamic driving task] or achieve a *minimal risk condition* after occurrence of a [dynamic driving task] *performance-relevant system failure(s)* or upon *operational design domain* (*ODD*) exit, or the response by an *ADS* to achieve *minimal risk condition*, given the same circumstances." *Id.* at 7. A minimal risk condition is "[a] condition to which a *user* or an *ADS* may bring a *vehicle* after performing the [dynamic driving task] *fallback* in order to reduce the risk of a crash when a given *trip* cannot or should not be completed." *Id.* at 11. A minimal risk condition depends on which feature is installed in the automated vehicle and may involve, for example, immediately stopping in the roadway, moving over to and stopping on the shoulder of the roadway, or returning itself to a marshalling facility. *Id.* Operational design domain is the "[o]perating conditions under which a given *driving automation system* or *feature* thereof is specifically designed to function, including, but not limited to, environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics." *Id.* at 14.

[31] *Id.* at 14.

[32] J3016, *supra* note 24, at 19. For example, the original Ford Model T would be classified as SAE level 0 because it does not have a driving automation system installed and a human driver is always responsible for all of the dynamic driving task. *See id.* at 20 (classifying features that do not control the dynamic driving task). SAE level 0 could also include a vehicle that has active safety systems installed that do not operate on a sustained basis—such as an automatic emergency braking system—that are only designed to take over longitudinal control of the vehicle in certain situations. *See id.* at 21 (noting that a vehicle classified as SAE level 0 could have "other . . . systems [installed that] may provide warnings or support, such as momentary emergency intervention"); *see also Driver Assistance Technologies*, NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., https://www.nhtsa.gov/equipment/driver-assistance-technologies [https://perma.cc/8B2J-TSDL] ("Automatic emergency braking (AEB) systems detect an impending forward crash with another vehicle in time to avoid or mitigate the crash. These systems first alert the driver to take corrective action and supplement the driver's braking to avoid the crash. If the driver does not respond, the AEB system may automatically apply the brakes to assist in preventing or reducing the severity of a crash.").

vehicle on a sustained basis—but not both.[33] Most cars on the road today, specifically those that only have a cruise control system installed, fall under SAE level 0 because cruise control cannot operate on a sustained basis by changing its speed to respond to roadway events.[34] At SAE level 2, or Partial Driving Automation, the driving automation system controls both the longitudinal and lateral movement of the vehicle on a sustained basis.[35] Similar to SAE level 1, an SAE level 2 feature has a limited operational design domain and requires a human driver to perform the entire dynamic driving task in the case of a driving automation system failure.[36]

The remainder of this Note focuses on SAE levels 3–5, which apply to vehicles truly capable of self-driving.[37] SAE level 3, or Conditional Driving Automation, is the first level at which an Automated Driving System (ADS) performs the entire dynamic driving task when the ADS is engaged and operating in a limited operational design domain.[38] A human driver must be available

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[33] J3016, *supra* note 24, at 19. Object and event detection and response, the other subpart of the dynamic driving task, is performed by the human driver in SAE level 1, as is the entire dynamic driving task in the case of a driving automation system failure. *Id.* An SAE level 1 feature is also limited in its operational design domain. *Id.* For example, adaptive cruise control would be classified as an SAE level 1 driving automation system because it can control the longitudinal movement of the vehicle on an ongoing basis, but requires a human driver to control lateral movement and perform object and event detection and response by monitoring the roadway. *See id.* at 2 (noting "a *driver* who fails to *monitor* the roadway during engagement of a level 1 adaptive cruise control (ACC) system still has the role of *driver*, even while s/he is neglecting it"). Adaptive cruise control requires a human driver to be ready to resume the entire dynamic driving task should there be a system failure. *See id.* at 8 (discussing dynamic driving task fallback). Adaptive cruise control also has a limited operational design domain (freeways, for example). *See id.* at 26 (noting that adaptive cruise control "may be intended to operate only at high speeds, only at low speeds, or at all speeds").

[34] *See id.* at 15 (discussing cruise control).

[35] *Id.* at 19. An SAE level 2 feature does not perform the complete object and event detection and response subtask and requires a human driver to supervise the driving automation system and perform all object and event detection and response that the feature is not designed to handle. *See id.* (discussing the human driver's role). For example, Tesla's Autopilot is an SAE level 2 feature because it requires a human driver to, at all times, perform object and event detection and response. *See* TESLA, MODEL S OWNER'S MANUAL 82 (rev. Oct. 30, 2019), https://www.tesla.com/sites/default/files/model_s_owners_manual_north_america_en_us.pdf [https://perma.cc/B7W6-VWVW] (noting that "[i]t is the driver's responsibility to stay alert, drive safely, and be in control of the vehicle at all times"). Autopilot is a suite of features including: Traffic-Aware Cruise Control, Autosteer, and Autopark. *Id.* Tesla warns that Autosteer is a "hands on feature . . . intended for use only on highways and limited-access roads with a fully attentive driver," which indicates that, although Autopilot features may be capable of performing longitudinal and lateral control, Autopilot cannot perform the complete object and event detection and response subtask and a human driver must complete the remainder of the dynamic driving task. *Id.* at 91.

[36] J3016, *supra* note 24, at 19.

[37] *See id.* at 3 (noting that an ADS, classified as levels 3–5, is capable of performing the entire dynamic driving task and object and event detection and response). Hereinafter, this Note will use the term "automated vehicles" to refer to vehicles containing an SAE level 3–5 ADS.

[38] *Id.* at 19. SAE notes that "[t]he upper three levels of *driving automation* (3–5) refer to cases in which the *Automated Driving System (ADS)* performs the entire . . . [dynamic driving task] on a *sustained* basis while it is engaged." *Id.* at 24. An SAE level 3 feature could include an ADS capable of

and be capable of performing the dynamic driving task fallback in the case of an ADS failure or when the vehicle exits its operational design domain.[39] At SAE level 4, or High Driving Automation, an ADS performs the entire dynamic driving task while it is engaged and the vehicle is operating in its limited operational design domain.[40] The key difference between SAE levels 3 and 4 is that in SAE level 4 the ADS, and not a human driver, performs the dynamic driving task fallback and must be capable of achieving a minimal risk condition without intervention by a human driver.[41] At SAE level 5, or Full Driving Automation, an ADS performs the entire dynamic driving task and also the dynamic driving task fallback.[42] The only difference between SAE levels 4 and 5 is that an SAE level 5 ADS has an unlimited operational design domain, meaning that the vehicle can operate under all conditions, including anywhere a human driver could take it.[43]

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operating in freeway traffic jam conditions. *See id.* at 8 (discussing a level 3 traffic jam feature); *Audi Piloted Driving*, AUDI, https://media.audiusa.com/models/piloted-driving [https://perma.cc/NW5U-Q9TT] (discussing an SAE level 3 traffic jam feature). Audi's Traffic Jam Pilot feature handles the complete dynamic driving task when operating in its operational design domain and a human driver is only required to resume control after receiving a request to intervene. *See Audi Piloted Driving*, *supra* (discussing the role of the human driver). Traffic Jam Pilot operates in a limited operational design domain that includes freeways with physical barriers in the median and only at speeds lower than thirty-five miles per hour. *See id.* (detailing the functionality of the traffic jam pilot feature).

[39] *See* J3016, *supra* note 24, at 19 (noting the role of the human driver at SAE level 3). At SAE level 3, "[t]he [dynamic driving task] *fallback-ready user* . . . is expected to be prepared to either resume the [dynamic driving task] when the *ADS* issues a *request to intervene* or to perform the *fallback* and achieve a *minimal risk condition* if the failure condition precludes normal operation." *Id.* at 24.

[40] *See id.* at 19 (charting the roles of human driver and ADS). A vehicle with an SAE level 4 feature installed is capable of operating in a geographic area without the need for a human to assume control in the case of a system failure. *See id.* at 22 (discussing the role of a passenger). For example, a vehicle with an SAE level 4 feature installed and operating in a ridesharing platform could be summoned by using a mobile phone application and drive the user to his or her destination, as long as the route between the pick-up and drop-off location is within the vehicle's operational design domain. *See* Jamie L. LaReau, *How General Motors Is Leading the Race for Self-Driving Cars*, DETROIT FREE PRESS (Jul. 19, 2018, 6:00 AM), https://www.freep.com/story/money/cars/general-motors/2018/07/19/general-motors-cruise-av-autonomous-car/782570002/ [https://perma.cc/2LQ9-W5B8] (detailing ridesharing use cases for automated vehicles). Both Cruise—a subsidiary of General Motors—and Waymo—a subsidiary of Alphabet (the holding company for Google)—are working to develop SAE level 4 vehicles to operate in a ridesharing platform. *See id.* (discussing Cruise's vehicles and their use cases); WAYMO, *Waymo Safety Report: On the Road to Full Self-Driving* 13, 16 (2018), https://storage.googleapis.com/sdc-prod/v1/safety-report/Safety%20Report%202018.pdf [https://perma.cc/97S3-NZEA] (discussing Waymo's vehicles and the company's strategy).

[41] *See* J3016, *supra* note 24, at 19, 22 (comparing SAE levels 3 and 4); *see also supra* text accompanying note 30 (describing dynamic driving task fallback and a minimal risk condition).

[42] J3016, *supra* note 24, at 19.

[43] *See id.* (charting the differences between SAE levels 4 and 5). Because a vehicle equipped with an SAE level 5 feature would be able to operate anywhere, some industry experts, including Waymo CEO John Krafcik, speculate that an SAE level 5 feature may take decades to develop, or that such a feature may not be capable of development. *See* Mark Gurman, *Waymo CEO Says Self-Driving Cars Won't Be Ubiquitous for Decades*, BLOOMBERG (Nov. 13, 2018, 12:53 PM), https://www.bloomberg.com/news/articles/2018-11-13/waymo-ceo-says-self-driving-cars-won-t-be-ubiqitious-for-decades

B. Federal Regulation of Motor Vehicles

The origins of the regulatory system for motor vehicles in the United States can be traced back to the Highway Safety Act of 1966 and the National Traffic and Motor Vehicle Safety Act of 1966 (Vehicle Safety Act), signed into law by President Lyndon B. Johnson.[44] The Highway Safety Act of 1966 and Vehicle Safety Act created the National Highway Safety Bureau, which subsequently became NHTSA.[45] NHTSA is tasked with promulgating safety standards for motor vehicles that are known as Federal Motor Vehicle Safety Standards (FMVSS).[46] FMVSS are minimum safety requirements for motor vehicles and motor vehicle equipment.[47]

The Vehicle Safety Act creates a self-certification system for motor vehicle manufacturers to comply with FMVSS.[48] To self-certify, a motor vehicle manufacturer is required to affix a label to each newly produced vehicle attesting that the vehicle complies with FMVSS.[49] The self-certification system, however, does not permit NHTSA to pre-approve the manner in which manufacturers comply with FMVSS.[50] Instead, NHTSA selects vehicles from the on-road fleet to test for compliance with FMVSS and undertakes enforcement actions in cases of non-compliance or if it discovers defects that may result in

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[https://perma.cc/V5YT-6U9Y] (noting Krafcik theorizes that an automated vehicle may never be able to operate in all weather conditions).

[44] *Understanding the National Highway Traffic Safety Administration (NHTSA)*, U.S. DEP'T OF TRANSP., https://www.transportation.gov/transition/understanding-national-highway-traffic-safety-administration-nhtsa [https://perma.cc/Z89F-YUFJ]. The November 30, 1965, publication of the book *Unsafe at Any Speed: The Designed-In Dangers of the American Automobile* by Ralph Nader, which discussed the tendency of the Chevrolet Corvair to roll over, is seen as a watershed moment in the push for an increased government role in automotive safety. Christopher Jensen, *50 Years Ago, 'Unsafe at Any Speed' Shook the Auto World*, N.Y. TIMES, Nov. 27, 2015, at B3.

[45] *Understanding the National Highway Traffic Safety Administration (NHTSA)*, *supra* note 44.

[46] *See* 49 U.S.C. § 30111 (2018) (vesting authority in the Secretary of Transportation to promulgate regulations); NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., QUICK REFERENCE GUIDE (2010 VERSION) TO FEDERAL MOTOR VEHICLE SAFETY STANDARDS AND REGULATIONS, at ii (2011) [hereinafter QUICK REFERENCE GUIDE], https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/fmvss-quickrefguide-hs811439.pdf [https://perma.cc/R3ND-GTXE] (noting NHTSA's authority to promulgate FMVSS arises from Title 49). The first FMVSS, No. 209 for Seat Belt Assemblies, became effective March 1, 1967. QUICK REFERENCE GUIDE, *supra*, at ii.

[47] QUICK REFERENCE GUIDE, *supra* note 46, at ii.

[48] *See* 49 U.S.C. § 30115 ("A manufacturer or distributor of a motor vehicle or motor vehicle equipment shall certify to the distributor or dealer at delivery that the vehicle or equipment complies with applicable motor vehicle safety standards prescribed under this chapter.").

[49] 49 C.F.R. § 567.4 (2018). The regulation requires the following statement for passenger cars: "This vehicle conforms to all applicable Federal motor vehicle safety, bumper, and theft prevention standards in effect on the date of manufacture shown above." *Id.*

[50] NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., UNDERSTANDING NHTSA'S REGULATORY TOOLS: INSTRUCTIONS, PRACTICAL GUIDANCE, AND ASSISTANCE FOR ENTITIES SEEKING TO EMPLOY NHTSA'S REGULATORY TOOLS 2 (2017) [hereinafter UNDERSTANDING NHTSA'S REGULATORY TOOLS], https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/understanding_nhtsas_current_regulatory_tools-tag.pdf [https://perma.cc/GNP6-7FRB].

an unreasonable risk to safety.[51] NHTSA also possesses broad enforcement authority and the ability to conduct recalls, even in the absence of applicable FMVSS, if it determines a defect poses an unreasonable risk to safety.[52]

C. Federal Regulatory Impediments to Automated Vehicles

Current FMVSS were developed with human drivers in mind and include some equipment requirements, such as manual controls, that are not necessary for a vehicle equipped with an SAE level 4 or level 5 ADS, which can perform both the dynamic driving task and the dynamic driving task fallback.[53] As a result, questions arise whether automated vehicles that lack manual controls could be certified to comply with FMVSS.[54] If a manufacturer believes that FMVSS are an impediment to the introduction of an advanced technology, such as an ADS feature, the manufacturer's current course of action is limited to the regulatory tools NHTSA has at its disposal.[55] NHTSA can conduct rulemaking to amend or create new FMVSS, grant exemptions from FMVSS, or interpret FMVSS via interpretation letters.[56]

Rulemaking, however, is a time-consuming course of action because it requires extensive research by NHTSA and adherence to the Administrative Procedures Act, which may not be ideal for technology that is rapidly evolving.[57] NHTSA recognizes that future rulemaking for automated vehicles must be faster and more nimble to accommodate rapidly evolving technology, alt-

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[51] *Id.*

[52] AV GUIDANCE 1.0, *supra* note 24, at 50.

[53] *See* ANITA KIM ET AL., REVIEW OF FEDERAL MOTOR VEHICLE SAFETY STANDARDS (FMVSS) FOR AUTOMATED VEHICLES: IDENTIFYING POTENTIAL BARRIERS AND CHALLENGES FOR THE CERTIFICATION OF AUTOMATED VEHICLES USING EXISTING FMVSS, at viii–ix (2016) (noting "that there are few barriers for automated vehicles to comply with FMVSS, as long as the vehicle does not significantly diverge from a conventional vehicle design" but "[a]utomated vehicles that begin to push the boundaries of conventional design (e.g., alternative cabin layouts, omission of manual controls) would be constrained by the current FMVSS or may conflict with policy objectives of the FMVSS").

[54] *See* Letter from Chris Urmson, Dir., Self-Driving Car Project, Google, Inc., to Paul A. Hemmersbaugh, Chief Counsel, Nat'l Highway Traffic Safety Admin. 2 (Nov. 12, 2015), https://www.autosafety.org/sites/default/files/imce_staff_uploads/Google%20NHTSA%20letter%2012%20Nov%202016.pdf [https://perma.cc/4HYG-NW25] (requesting an interpretation of several FMVSS as they relate to automated vehicles).

[55] *See* UNDERSTANDING NHTSA'S REGULATORY TOOLS, *supra* note 50, at 2 (discussing the regulatory tools available to NHTSA).

[56] *Id.*

[57] *See* 5 U.S.C. §§ 553–557 (2018) (discussing rulemaking); George Soodoo, *A Primer on the NHTSA Rulemaking Process*, ENO CTR. FOR TRANSP. (Mar. 17, 2017), https://www.enotrans.org/article/primer-nhtsa-rulemaking-process/ [https://perma.cc/YK3V-BUD8] (discussing steps in the rulemaking process at NHTSA). Rulemaking of moderate complexity may take a minimum of five years because, in addition to conducting large amounts of research, the Administrative Procedures Act requires NHTSA to "1) publish in the Federal Register [a notice of proposed rulemaking] that provides details about its proposal; 2) give the public an opportunity to comment on the proposal; and 3) publish the final rule." Soodoo, *supra*.

hough it has not yet determined how best to streamline the process.[58] NHTSA may also issue exemptions from compliance with one or more FMVSS under circumstances that are usually temporary and small in number.[59] A manufacturer may receive a temporary exemption—limited to 2,500 vehicles—from FMVSS for two years for the purpose of testing a new safety feature with a safety level at least equal to the applicable FMVSS or if the manufacturer can provide an analysis showing that the exempted vehicle is at least as safe as a non-exempt vehicle overall.[60] Interpretation letters are the narrowest of NHTSA's tools and sought when a manufacturer is interested in clarifying how NHTSA believes a statute or regulation applies to its product.[61] Although exemptions and interpretation requests are a faster course of action than rulemaking, both typically take NHTSA years to process.[62] To clear interpretation-related obstacles to automated vehicles that offer improved safety, NHTSA adopted a new policy whereby the agency will attempt to respond to simple ADS interpretation requests within sixty days and complex ADS interpretation requests within ninety days.[63]

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[58] *See* AV GUIDANCE 3.0, *supra* note 2, at 7 (discussing new approaches to creating FMVSS, and noting performance standards or testing standards as possibilities).

[59] UNDERSTANDING NHTSA'S REGULATORY TOOLS, *supra* note 50, at 8.

[60] *Id.* at 9. Under 49 U.S.C. § 30112(b)(10), which was enacted in 2015, "the introduction of a motor vehicle in interstate commerce solely for purposes of testing or evaluation by a manufacturer that agrees not to sell or offer for sale the motor vehicle at the conclusion of the testing or evaluation" is permitted without compliance with FMVSS so long as the manufacturer "has manufactured and distributed motor vehicles into the United States that are certified to comply with all applicable Federal motor vehicle safety standards" when the statute was enacted. 49 U.S.C. § 30112(b)(10) (2018). The statute effectively permits established manufacturers (and likely only automakers), as of December 4, 2015, to operate non-FMVSS compliant vehicles for testing and evaluation without NHTSA's permission. *See id.* (exempting established manufacturers). Non-established manufacturers—such as Waymo or other startup companies that do not manufacture and distribute vehicles as a regular part of their business—would still need permission from NHTSA to do so. *See id.* (applying the exemption only to those who make and distribute FMVSS compliant vehicles).

[61] *See* UNDERSTANDING NHTSA'S REGULATORY TOOLS, *supra* note 50, at 5 (discussing the purpose of interpretation requests). An interpretation letter "may clarify a statutory or regulatory term or provide sharper and more detailed lines than the regulation or statute it interprets. An interpretation may not, however, make a substantive change to a statute or regulation or to their clear provisions and requirements." *Id.*

[62] *See* AV GUIDANCE 1.0, *supra* note 24, at 103 n.3 (noting the timeframe for exemptions and interpretation requests).

[63] UNDERSTANDING NHTSA'S REGULATORY TOOLS, *supra* note 50, at 7. Factors considered to determine processing time and whether the interpretation request is simple or complex include: (1) "whether the information and justification provided is adequate for [NHTSA] to assess the merits of granting or denying the request," (2) "whether [NHTSA] is deciding on an exemption request consistently with prior decisions on prior similar requests, if any, and whether such a decision remains consistent with [NHTSA]'s best current thinking on the topic," (3) "[c]omplexity of the exemption request and issues presented" and (4) "[NHTSA] workload." *Id.* at 10.

D. Federal Guidance Documents for Automated Vehicles

NHTSA and the U.S. Department of Transportation (DOT) issued a preliminary statement of policy and four guidance documents to inform interested parties of issues the agency sees in the development of ADS and to define the federal government's future role.[64] Released in 2013, the first guidance document details fifteen safety-related areas—such as privacy, system safety, and crashworthiness—that entities developing ADSs should consider during the design process.[65] NHTSA requests that entities developing ADSs voluntarily submit a Safety Assessment Letter detailing whether the ADS complies or fails to comply with these guidance areas, or whether the guidance area is inapplicable to the ADS being developed.[66] Although submission is presented as voluntary, NHTSA expects that manufacturers submit a Safety Assessment Letter at least four months before on-road testing of an ADS and submit new Safety Assessment Letters when significant updates are made to the ADS.[67] NHTSA notes that rulemaking to make the Safety Assessment Letter mandatory, rather than voluntary, is possible.[68]

Following the transition to the administration of President Donald J. Trump, NHTSA released a second guidance document that superseded the prior version.[69] In this second guidance document, NHTSA winnows down the fifteen safety assessment areas to twelve safety elements.[70] NHTSA also

[64] AV GUIDANCE 2.0, *supra* note 24; AV GUIDANCE 1.0, *supra* note 24; PRELIMINARY STATEMENT OF POLICY CONCERNING AUTOMATED VEHICLES, *supra* note 24; AV GUIDANCE 4.0, *supra* note 24; AV GUIDANCE 3.0, *supra* note 2; *see also supra* text accompanying note 24 (discussing the succession of policy and guidance documents).

[65] AV GUIDANCE 1.0, *supra* note 24, at 17–31. The fifteen areas identified by NHTSA are: (1) data recording and sharing, (2) privacy, (3) system safety, (4) vehicle cybersecurity, (5) human machine interface, (6) crashworthiness, (7) consumer education and training, (8) registration and certification, (9) post-crash behavior, (10) federal, state, and local laws, (11) ethical considerations, (12) operational design domain, (13) object and event detection and response, (14) fall back (minimal risk condition), and (15) validation methods. *Id.*

[66] *See id.* at 15–16 (detailing the process for indicating compliance with the safety assessment areas).

[67] *See id.* (discussing NHTSA's expectations for the Safety Assessment Letter). NHTSA also requires the Safety Assessment Letter to include, next to each safety assessment area, the name, title, and a signature of a company representative "to ensure appropriate transparency, awareness, and oversight within the submitting organization." *Id.* at 16.

[68] *Id.* at 15.

[69] *See* AV GUIDANCE 2.0, *supra* note 24, at 1 (released in September 2017 and replacing AV GUIDANCE 1.0); AV GUIDANCE 1.0, *supra* note 24, at 15 (released in September 2016).

[70] *See* AV GUIDANCE 2.0, *supra* note 24, at 5–15 (listing the safety elements). The twelve safety elements are: (1) system safety, (2) operation design domain, (3) object and event detection and response, (4) fallback (minimal risk condition), (5) validation methods, (6) human machine interface, (7) vehicle cybersecurity, (8) crashworthiness, (9) post-crash ADS behavior, (10) data recording, (11) consumer education and training, and (12) federal, state, and local laws. *Id.* Privacy, registration and certification, and ethical considerations—listed as safety assessment areas in AV GUIDANCE 1.0—are

changed the name of the Safety Assessment Letter to the Voluntary Safety Self-Assessment.[71] In contrast to its first guidance document, NHTSA notes that, though submissions are welcomed prior to testing on public roads, entities need not delay testing in order to submit a Voluntary Safety Self-Assessment.[72] In each Voluntary Safety Self-Assessment, NHTSA encourages entities to indicate whether the "safety element was considered" or whether the "safety element is not applicable."[73]

In the third guidance document, which supplements but does not supersede the second guidance document, the DOT, NHTSA's parent department, applies the principles detailed in the second guidance document to transportation automation in different sectors, such as commercial vehicles and commercial carriers that are regulated by the Federal Motor Carrier Safety Administration.[74] The third guidance document affirms the policy of encouraging entities to submit Voluntary Safety Self-Assessments, and also suggests that entities make such submissions available to the public.[75]

The fourth and most recent guidance document, released by the DOT in January 2020, continues to build upon, but does not replace, the principles set forth in the second and third guidance documents.[76] The fourth guidance document attempts to present a uniform federal policy toward automated vehicles by compiling actions taken to date by the DOT and other federal agencies and detailing the responsibilities of federal agencies outside the DOT and NHTSA in the development of automated vehicles.[77] The document also affirms the

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not included in the safety elements in AV GUIDANCE 2.0. *Id.*; AV GUIDANCE 1.0, *supra* note 24, at 17–31.

[71] AV GUIDANCE 2.0, *supra* note 24, at 16.

[72] *See id.* ("Entities are not required to submit a Voluntary Safety Self-Assessment, nor is there any mechanism to compel entities to do so. While these assessments are encouraged prior to testing and deployment, NHTSA does not require that entities provide submissions nor are they required to delay testing or deployment. Assessments are not subject to Federal approval.").

[73] *Id.* The second guidance document also dispensed with the requirement for a signature from a company representative for each safety assessment area. *See id.* (omitting a signature requirement); *see also supra* text accompanying note 67 (discussing the signature requirements in AV GUIDANCE 1.0).

[74] AV GUIDANCE 3.0, *supra* note 2, at viii, x, 27; *see also supra* text accompanying note 24 (discussing the iteration of guidance documents).

[75] AV GUIDANCE 3.0, *supra* note 2, at 26. NHTSA has released a template for the Voluntary Safety Self-Assessment. NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., *Voluntary Safety Self-Assessment Template*, https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/voluntary_safety_self-assessment_for_web_101117_v1.pdf [https://perma.cc/A2CF-TKTE]. For an example of a completed Voluntary Safety Self-Assessment, see generally GEN. MOTORS, 2018 SELF-DRIVING SAFETY REPORT, https://www.gm.com/content/dam/company/docs/us/en/gmcom/gmsafetyreport.pdf [https://perma.cc/WBK6-P6Y5].

[76] AV GUIDANCE 4.0, *supra* note 24, at 1.

[77] *See id.* (noting the document "outlines certain past and current Federal efforts, and compiles available key resources for innovators and entrepreneurs in the surface transportation AV domain").

DOT and NHTSA's commitment to voluntary standards and compliance for automated vehicles.[78]

E. Congressional Action (or Inaction) on Automated Vehicles: The SELF DRIVE Act and AV START Act

With NHTSA's statutory authority and regulatory tools more aligned with human-operated vehicles, the 115th Congress sought to advance legislation that balanced the need to test and deploy automated vehicles with public safety interests.[79] The result was a bill in each chamber of Congress.[80] In the House of Representatives, Representative Bob Latta introduced H.R. 3388, the SELF DRIVE Act, on July 25, 2017.[81] In the Senate, Senator John Thune introduced S. 1885, the AV START Act, on September 28, 2017.[82] In general, both bills preempt certain state and local laws, require NHTSA to conduct rulemaking, increase the number of vehicles eligible for exemption, and require safety-related submissions to NHTSA.[83] The bills also adopt the SAE terminology and definitions and target "highly automated vehicles," or those vehicles equipped with an SAE level 3–5 ADS.[84]

The bills contain provisions that preempt certain state and local laws and regulations as they relate to automated vehicles, but the preemption provisions in the SELF DRIVE Act are broader than those in the AV START Act.[85] The SELF DRIVE Act preempts all state and local laws and regulations pertaining to the "design, construction, or performance" of highly automated vehicles.[86]

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[78] *See id.* at 29 (noting, "[t]he U.S. Government will promote voluntary consensus standards as a mechanism to encourage increased investment and bring cost-effective innovation to the market more quickly").

[79] *See* Press Release, Sen. John Thune, Thune Introduces Bipartisan Autonomous Vehicle Legislation (Sept. 28, 2017), https://www.thune.senate.gov/public/index.cfm/2017/9/thune-introduces-bipartisan-autonomous-vehicle-legislation [https://perma.cc/5UPN-TEMT] (discussing the need for federal leadership and legislative changes to accommodate automated vehicles). For the status of automated vehicle legislation in the current 116th Congress, see *infra* notes 128–129 and accompanying text.

[80] *See* American Vision for Safer Transportation Through Advancement of Revolutionary Technologies Act, S. 1885, 115th Cong. (2017) (as reported by S. Comm. on Commerce, Sci., and Transp., Nov. 28, 2017) [hereinafter AV START Act] (serving as the Senate legislative vehicle); Safely Ensuring Lives Future Deployment and Research in Vehicle Evolution Act, H.R. 3388, 115th Cong. (2017) (as passed by House, Sept. 6, 2017) [hereinafter SELF DRIVE Act] (serving as the House legislative vehicle).

[81] Safely Ensuring Lives Future Deployment and Research In Vehicle Evolution Act, H.R. 3388, 115th Cong. (2017) (as introduced, July 25, 2017).

[82] Press Release, *supra* note 79.

[83] *See* AV START Act §§ 3, 4, 6, 9 (preempting certain laws, ordering rulemaking, increasing exemptions, and requiring submissions to NHTSA); SELF DRIVE Act §§ 3, 4, 6 (same).

[84] AV START Act §§ 2, 4, 8; SELF DRIVE Act § 13.

[85] *See* AV START Act § 3 (discussing state and local law preemption); SELF DRIVE Act § 3 (same).

[86] SELF DRIVE Act § 3.

The SELF DRIVE Act also contains a provision stating that, although nothing in the bill is to be construed as prohibiting states and localities from legislating or regulating in traditional areas—such as registration, safety and emissions inspections, and congestion management—these areas can be preempted if they act as an "unreasonable restriction on the design, construction, or performance of highly automated vehicles."[87] The AV START Act, however, preempts only those state and local laws and regulations that fall under nine subject areas listed in the bill.[88] The nine subject areas are: system safety, data recording, cybersecurity, human-machine interface, crashworthiness, capabilities, post-crash behavior, account for applicable laws, and automation function.[89] Thus, state laws or regulations that encroach unreasonably on design, construction, or performance—which may be open to a broad interpretation—could be preempted under the SELF DRIVE Act, whereas the AV START Act's preemption is limited to the subject areas listed above.[90]

Both bills also require NHTSA to conduct rulemaking to update FMVSS for automated vehicles, but take different approaches to the rulemaking process, with the rulemaking in the SELF DRIVE Act having a broader scope.[91] Within one year of enactment, the SELF DRIVE Act requires NHTSA to deliver a rulemaking and safety priority plan to "accommodate the development and deployment of highly automated vehicles" by updating FMVSS, issuing new FMVSS, and considering ranges for performance standards to test FMVSS.[92] The SELF DRIVE Act requires the first rulemaking process based on NHTSA's priority plan to commence within eighteen months of enactment.[93] By contrast, the rulemaking included in the AV START Act is much narrower because it only requires references to human drivers in existing FMVSS be updated rather than the creation of new FMVSS applicable to automated vehicles.[94] The AV START Act orders the Director of the John A. Volpe National Transportation Systems Center of the DOT ("Volpe Center") to review FMVSS for provisions that reference human drivers and then deliver a

[87] *Id.*

[88] AV START Act § 3.

[89] *Id.* § 9.

[90] *See id.* § 3 (listing subject areas that are preempted); SELF DRIVE Act § 3 (discussing state and local law preemption); *see also* AV GUIDANCE 3.0, *supra* note 2, at 18 (discussing the role of state and local governments in the proliferation of automated vehicles). NHTSA notes that states and localities have traditionally played the role of "licensing human drivers, registering motor vehicles, enacting and enforcing traffic laws, conducting safety inspections, and regulating motor vehicle insurance and liability" and that states will likely retain these roles with the adoption of automated vehicles. AV GUIDANCE 3.0, *supra* note 2, at 18.

[91] *See* AV START Act § 4 (ordering the commencement of rulemaking); SELF DRIVE Act § 4 (same).

[92] SELF DRIVE Act § 4.

[93] *Id.*

[94] *See* AV START Act § 4 (discussing the scope of rulemaking).

report within 180 days of enactment that recommends conforming references to an appropriate ADS in lieu of a human driver.[95] Within ninety days of the Volpe Center report, the AV START Act requires NHTSA to begin a rulemaking process to incorporate the report's recommendations into FMVSS.[96] If NHTSA does not complete rulemaking within one year of the Volpe Center report's submission, then the report's recommendations are automatically incorporated into FMVSS.[97] Therefore, although the scope of rulemaking in the AV START Act is narrower than the SELF DRIVE Act, it provides a faster approach to updating FMVSS as it relates to existing references to human drivers.[98]

Both the SELF DRIVE Act and AV START Act seek to expand NHTSA's authority to exempt a certain number of automated vehicles from compliance with FMVSS.[99] The SELF DRIVE Act allows NHTSA to grant exemptions for automated vehicles from FMVSS—currently capped at 2,500—at a rate of 25,000 vehicles in the first twelve-month period following enactment, 50,000 vehicles within the second twelve-month period, 100,000 vehicles within the third twelve-month period, and 100,000 vehicles in the fourth twelve-month period.[100] The SELF DRIVE Act permits a manufacturer to renew an exemption, but renewals must not exceed 100,000 vehicles in any twelve-month period.[101] The SELF DRIVE Act also increases the timeframe during which exemptions and renewals are valid from two years to four years.[102] The SELF DRIVE Act does not allow exemptions from FMVSS for crashworthiness to be granted until one year after NHTSA issues a rule requiring a safety assessment certification and the rulemaking and safety plan is complete.[103] The SELF DRIVE Act also requires a manufacturer to submit information to NHTSA if

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[95] *Id.* The Volpe Center was established within the DOT in 1970 to provide expertise across disciplines to address complex, multi-modal transportation issues. *About Us*, U.S. DEP'T OF TRANSP. VOLPE CTR., https://www.volpe.dot.gov/about-us [https://perma.cc/UB2Y-NP2H]. The Volpe Center already has experience and expertise in analyzing FMVSS as they relate to automated vehicles. *See* KIM ET AL., *supra* note 53, at ii (performing a review of FMVSS as they relate to automated vehicles).

[96] AV START Act § 4.

[97] *Id.*

[98] *See id.* (requiring the rulemaking process to be complete within eighteen months of enactment, otherwise the Volpe Center's recommendations will be incorporated into FMVSS); SELF DRIVE Act § 4 (requiring the rulemaking process to begin no later than eighteen months after enactment).

[99] AV START Act § 6; SELF DRIVE Act § 6.

[100] SELF DRIVE Act § 6.

[101] *Id.*

[102] *See* 49 U.S.C. § 30113 (2012) (establishing the current validity period for exemptions); SELF DRIVE Act § 6 (increasing the validity period for exemptions).

[103] SELF DRIVE Act § 6; *see infra* notes 111–113 and accompanying text (detailing the safety assessment certification). Crashworthiness standards are aimed at protecting the vehicle occupant. *Crashworthiness*, NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., https://www.nhtsa.gov/research-data/crashworthiness [https://perma.cc/3L88-W4NE]. The provision disallowing exemptions for crashworthiness standards does not apply to vehicles that are not designed to carry human occupants. SELF DRIVE Act § 6.

an exempted vehicle is involved in a crash and requires NHTSA to create a public database that includes information for all vehicles issued an exemption.[104]

The AV START Act allows NHTSA to grant exemptions for 15,000 vehicles in the first twelve-month period following enactment, 40,000 vehicles in the second twelve-month period, and 80,000 vehicles in the third twelve-month period and each twelve-month period thereafter.[105] If an exemption has been in place for four years, a manufacturer can petition NHTSA to expand the exemption beyond 80,000 vehicles in a twelve-month period.[106] The AV START Act requires NHTSA to grant or deny an exemption request within 180 days and allows for public comment on exemption requests.[107] Unlike the SELF DRIVE Act, the AV START Act contains a sunset clause that terminates a manufacturer's eligibility for an exemption from FMVSS for automated vehicles either ten years following enactment or on the date NHTSA issues a new standard for the exemption sought.[108] Both the SELF DRIVE Act and AV START Act retain the eligibility requirement that a new safety feature is at least as safe as the applicable FMVSS, or the exempted vehicle is at least as safe as a non-exempt vehicle overall.[109]

Both the SELF DRIVE Act and AV START Act require entities developing automated vehicles to make safety-related submissions to NHTSA.[110] The SELF DRIVE Act orders NHTSA, within twenty-four months of enactment, to issue a final rule that would outline safety-related areas for entities to address when developing automated vehicles.[111] The final rule must also contain a requirement that entities submit a safety assessment certification.[112] The safety assessment certification must include details on how a manufacturer addresses the safety areas identified in the final rule.[113] NHTSA is not permitted, however, to "condition deployment or testing of highly automated vehicles on review of safety assessment certifications."[114] In the interim period while the rulemak-

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[104] SELF DRIVE Act § 6.

[105] AV START Act § 6.

[106] *Id.*

[107] *Id.*

[108] *Id.*; *see* SELF DRIVE Act § 6 (lacking a sunset clause).

[109] *See* AV START Act § 6 (discussing eligibility for exemptions); SELF DRIVE Act § 6 (same). See 49 U.S.C. § 30113 to compare the effect of the amendments in the SELF DRIVE Act and AV START Act to the general exemption provisions.

[110] AV START Act § 9; SELF DRIVE Act § 4.

[111] SELF DRIVE Act § 4.

[112] *Id.*

[113] *Id.*

[114] *Id.*

ing process is underway, the SELF DRIVE Act requires submission of "safety assessment letters" to NHTSA.[115]

The AV START Act requires manufacturers to make similar safety-related submissions in a safety evaluation report.[116] The AV START Act lists nine subject areas that a safety evaluation report is required to address.[117] Each safety evaluation report requires a signature by an official representing the submitting entity to certify that "based on the official's knowledge, the report does not contain any untrue statement of a material fact."[118] The AV START Act also includes a civil penalty for the submission of false or misleading safety evaluation reports.[119] The submission of a safety evaluation report to NHTSA is required upon testing an automated vehicle or not later than ninety days before the sale or commercialization of an automated vehicle.[120] NHTSA must make the safety evaluation report public within sixty days of receipt.[121] Similar to the SELF DRIVE Act, NHTSA is not permitted to "condition the manufacture, testing, sale, offer for sale, or introduction into interstate commerce of a highly automated vehicle or automated driving system based on a review of a safety evaluation report."[122]

It initially appeared that these pieces of legislation had a strong chance of passage in the 115th Congress.[123] The SELF DRIVE Act passed the House of Representatives on September 6, 2017 by a unanimous voice vote, but stalled in the Senate.[124] The AV START Act, meanwhile, could not overcome the con-

[115] *Id.* The SELF DRIVE Act says "safety assessment letters shall be submitted to [NHTSA] as contemplated by [AV GUIDANCE 1.0], or any successor guidance issued on highly automated vehicles requiring a safety assessment letter." *Id.* Because the bill specifically refers to "safety assessment letters," a term used only in AV GUIDANCE 1.0, it is not entirely clear whether this language requires safety assessment letters conform to the requirements in AV GUIDANCE 1.0, or whether the Voluntary Safety Self-Assessment outlined in AV GUIDANCE 2.0 satisfies this requirement. *See id.* (requiring submission of a safety assessment letter); *see also supra* text accompanying note 24 (discussing the succession of guidance documents and noting that AV GUIDANCE 2.0 supersedes AV GUIDANCE 1.0).

[116] AV START Act § 9.

[117] *Id.* The nine areas are: (1) system safety, (2) data recording, (3) cybersecurity, (4) human-machine interface, (5) crashworthiness, (6) capabilities, (7) post-crash behavior, (8) account for applicable laws, and (9) automation function. *Id.*

[118] *Id.*

[119] *See id.* (adding the submission of a false or misleading safety evaluation report to the civil penalties provision in 49 U.S.C. § 30165(a)(4)); *see also* 49 U.S.C. § 30165(a)(4) (2012 & Supp. V 2017) (assessing "a civil penalty of not more than $5,000 per day" to "[a] person who knowingly and willfully submits materially false or misleading information to the Secretary" of Transportation).

[120] AV START Act § 9.

[121] *Id.*

[122] *Id.*; *see* SELF DRIVE Act § 4 (detailing the scope of NHTSA's authority).

[123] *See* Cecilia Kang, *Self-Driving Cars' Prospects Rise with Vote by House*, N.Y. TIMES, Sept. 7, 2017, at B4 (discussing prospects for passage).

[124] *Id.*

cerns of key Senators and was never brought to the floor for a vote.[125] Some legislators expressed apprehension about allowing unproven vehicles on the road with the general public.[126] Other observers suggested that instead of clearing the road for new regulations, the SELF DRIVE Act and AV START Act are giveaways to the automotive industry that do too much to entrench exemptions as a way forward at the expense of rulemaking to create new FMVSS.[127]

Currently, in the 116th Congress, the House Energy & Commerce Committee and the Senate Commerce, Science, and Transportation Committee are engaged in efforts to draft bipartisan automated vehicle legislation acceptable to both the Democrat controlled House of Representatives and the Republican controlled Senate.[128] A draft of potential bill language on certain topics—including advisory committees, testing, and exemptions—is circulating among stakeholders, but it is unclear how the draft compares to the SELF DRIVE Act and AV START Act and whether common ground between the House and Senate will be found.[129]

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[125] *See* Sam Mintz, *AV START Hits Dead End*, POLITICO (Dec. 20, 2018, 10:00 AM), https://www.politico.com/newsletters/morning-transportation/2018/12/20/av-start-hits-dead-end-461335 [https://perma.cc/G2XE-2GEY] (noting the bill is dead for the 115th Congress); Tony Romm, *A Bill to Put More Self-Driving Cars on U.S. Roads Is Stuck in the Senate*, RECODE (Jan. 18, 2018, 1:59 PM), https://www.recode.net/2018/1/18/16905964/self-driving-car-testing-roads-congress-senate [https://perma.cc/5JXA-G4K3] (describing disagreements among Senators).

[126] *See* Shaun Courtney, *Senate Won't Vote on Self-Driving Car Bill in 2017: Thune*, BLOOMBERG BNA (Dec. 20, 2017), https://bit.ly/2Rmv65G [https://perma.cc/3WDF-9HS9] (noting that, as the Senate's legislative calendar for 2017 came to an end, Senator Dianne Feinstein remained opposed to the bill). Senator Feinstein was quoted as saying "I'm strongly opposed to it . . . . I do not want untested autonomous vehicles on the freeways which are complicated, move fast and are loaded with huge trucks." *Id.*

[127] Joan Claybrook, *Don't Let Congress Put Dangerous Self-Driving Cars on the Road at the Cost of Human Lives*, USA TODAY (Aug, 7, 2018, 7:00 AM), https://www.usatoday.com/story/opinion/2018/08/07/congress-wants-accelerate-deadly-self-driving-car-technology-column/891085002/ [https://perma.cc/NZ2U-GSD3] (advocating against passage of the AV START Act). The author, a safety advocate and former NHTSA Administrator, wrote:

> I call on all U.S. senators to oppose the AV START Act unless vital improvements are added, such as eliminating massive exemptions from federal safety standards . . . . The legislation is not just a first step to regulating self-driving vehicles as its proponents claim. In fact, it deregulates safety for these vehicles. If this bill passes, the auto industry will fight to the death to prevent new legislation requiring commonsense safety rules.

Id.

[128] Greg Rogers, *Congress Drafts First Sections of New, Bipartisan Autonomous Vehicle Bill*, FORBES (Oct. 30, 2019, 11:53 AM), https://www.forbes.com/sites/gregrogers1/2019/10/30/congress-drafts-first-sections-of-new-bipartisan-autonomous-vehicle-bill/#1232f3c21043 [https://perma.cc/CFZ4-X32X].

[129] *See id.* ("House and Senate committee staff circulated draft legislative text for three sections of the bill that addressed federal advisory committees, AV testing expansions, and exemptions to allow for vehicles with novel designs. In an email to stakeholders, staff emphasized that this is just the first tranche of text, indicating more sections are soon to follow."). *Compare* Cat Zakrzewski, *The Tech-*

II. THE BALANCING TEST: PROMOTING INNOVATION AND ENSURING PUBLIC SAFETY

All regulatory schemes impose costs on the regulated entity or party.[130] From a policymaking perspective, the question of how, and at what stage of development, to regulate automated vehicles boils down to whether the potential costs of more regulation outweigh the benefits of the status quo, or even deregulation.[131] With the tremendous potential of automated vehicles, policymakers and regulators must balance the need for flexibility in research and development with the inherent growing pains and dangers that accompany the development of a machine so complex.[132] Unlike research done in a laboratory, automated vehicles are undergoing testing on public roads in ways that have the potential to cause property damage or personal injury.[133]

Policymakers and regulators are confronted with two objectives that, at times, conflict with one another: (1) promote the testing and deployment of automated vehicles, and (2) ensure public safely.[134] This Part discusses these objectives, applies them to NHTSA's current regulatory tools and proposals in Congress, and gives an overview of an alternative regulatory regime used for

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nology 202: Self-Driving Car Companies at CES Say: Safety First, WASH. POST (Jan. 9, 2019), https://www.washingtonpost.com/news/powerpost/paloma/the-technology-202/2019/01/09/the-technology-202-self-driving-car-companies-at-ces-say-safety-first/5c34e4261b326b66fc5a1be1/?noredirect=on&utm_term=.eeef1bee88ab [https://perma.cc/Y4NK-YTVE] (discussing prospects for automated vehicle legislation and noting that Rep. Jan Schakowsky, a co-sponsor of the SELF DRIVE Act, said the AV START Act "fell woefully short."), *with* Courtney, *supra* note 126 (noting that Senator John Thune, a co-sponsor of the AV START Act, estimated that the AV START Act could garner 70–75 votes in favor of passage in the Senate in the new Congress).

[130] *See* OFFICE OF MGMT. & BUDGET, 2017 DRAFT REPORT TO CONGRESS ON THE BENEFITS AND COSTS OF FEDERAL REGULATIONS AND AGENCY COMPLIANCE WITH THE UNFUNDED MANDATES REFORM ACT 2 (2018), https://www.whitehouse.gov/wp-content/uploads/2017/12/draft_2017_cost_benefit_report.pdf [https://perma.cc/F392-YTWE] (estimating the annual cost of major federal regulations as "between $78 and $115 billion"). Of course, regulations can also have benefits as well. *See id.* (estimating the annual benefits of major federal regulations as ranging from $287 to $911 billion).

[131] *See* AV GUIDANCE 3.0, *supra* note 2, at 19 (discussing regulatory choices facing states and noting, "[s]tates should consider reviewing and potentially modifying traffic laws and regulations that may be barriers to automated vehicles. For example, several States have following distance laws that prohibit trucks from following too closely to each other, effectively prohibiting automated truck platooning applications").

[132] *See* Alejandro Lazo, *Arizona, Site of Deadly Uber Crash, Pushed to Become Nation's Test Lab for Driverless Cars*, WALL ST. J. (Mar. 20, 2018, 10:33 PM), https://www.wsj.com/articles/arizona-site-of-deadly-uber-crash-pushed-to-become-nations-test-lab-for-driverless-cars-1521569259 [https://perma.cc/Y9SZ-2C8T] (discussing a fatality that arose during Arizona's campaign to become a testing ground for automated vehicles).

[133] *See* Wakabayashi, *supra* note 5 (describing a fatality in Arizona caused by an automated vehicle undergoing testing).

[134] *See* AV GUIDANCE 3.0, *supra* note 2, at iv (noting "U.S. DOT will lead efforts to address potential safety risks and advance the life-saving potential of automation," and declaring "[w]henever possible, the Department will support the development of voluntary, consensus-based technical standards and approaches that are flexible and adaptable over time").

the certification of aircraft.[135] Section A discusses the goal of encouraging automated vehicles and maximizing innovation.[136] Section B contrasts that goal with the objective of ensuring public safety.[137] Section C analyzes the objectives in relation to NHTSA's current regulatory tools.[138] Section D explores whether the SELF DRIVE Act and AV START Act strike a balance between the objectives.[139] Section E details the regulatory framework, known as type approval, used by the FAA to permit innovation while ensuring public safety.[140]

A. Objective One: Maximize Innovation

The development of automated vehicles promises to bring both economic benefits and broader societal benefits.[141] At the forefront of potential societal benefits is a reduction in the amount of traffic fatalities.[142] There were 37,133 fatalities on U.S. roadways in 2017, and approximately 1.35 million fatalities worldwide.[143] The introduction of automated vehicles in the United States can potentially cause traffic fatalities to fall from the second leading cause of death to the ninth leading cause of death and reduce the costs associated with traffic accidents by up to $190 billion each year.[144]

Moreover, automated vehicles may enhance mobility for disabled and elderly individuals.[145] The need for paratransit, or transportation for disabled

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[135] *See infra* notes 130–285 and accompanying text.

[136] *See infra* notes 141–163 and accompanying text.

[137] *See infra* notes 164–184 and accompanying text.

[138] *See infra* notes 185–223 and accompanying text.

[139] *See infra* notes 224–258 and accompanying text.

[140] *See infra* notes 259–285 and accompanying text.

[141] *See* AV GUIDANCE 3.0, *supra* note 2, at ii (describing automated vehicles as having the potential to enhance productivity, increase mobility, reduce crashes due to human error, and decrease motor vehicle fatality rates); Michele Bertoncello & Dominik Wee, *Ten Ways Autonomous Driving Could Redefine the Automotive World*, MCKINSEY & CO. (June 2015), https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/ten-ways-autonomous-driving-could-redefine-the-automotive-world [https://perma.cc/83K6-FPVS] (discussing benefits from increases in productivity and healthcare savings resulting from a decrease in motor vehicle injuries and fatalities).

[142] *See* Bertoncello & Wee, *supra* note 141 (discussing the potential decline in motor vehicle fatalities and resulting benefits).

[143] AV GUIDANCE 3.0, *supra* note 2, at 1 (U.S. statistics); *Road Traffic Injuries*, WORLD HEALTH ORG. (Dec. 7, 2018), https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries [https://perma.cc/GDA5-39Q6] (worldwide statistics). Worldwide, there are approximately 20–50 million non-fatal injuries per year caused by motor vehicle accidents. *Road Traffic Injuries*, *supra*.

[144] *See* Bertoncello & Wee, *supra* note 141 (looking toward a scenario in 2050 where automated vehicles are widely adopted and discussing the health care savings accompanying a reduction in traffic accidents and fatalities). "The overall annual cost of roadway crashes to the US economy was $212 billion in 2012. Taking that year as an example, advanced [ADS] and [automated vehicles] reducing accidents by up to 90 percent would have potentially saved about $190 billion." *Id.*

[145] *See* Kate Baggaley, *6 Surprising Ways Driverless Cars Will Change Our World*, NBC NEWS (Apr. 18, 2018, 2:11 PM), https://www.nbcnews.com/mach/science/6-surprising-ways-driverless-cars-will-change-our-world-ncna867061 [https://perma.cc/8A4F-5YVK] (discussing the potential for enhanced mobility for disabled and aged individuals).

individuals who cannot drive on their own, has continued to grow, even though the geographic reach of such services is constrained.[146] Automated vehicles could reduce labor costs associated with paratransit and mobility services for the elderly, while also expanding the geographic reach of such services in ways that provide enhanced mobility and independence.[147]

Widespread adoption of automated vehicles could also lead to significant economic benefits from the compound effects of changes in vehicle ownership, emissions, parking, housing, and productivity.[148] For example, individual vehicle ownership may fall out of favor with the rise of on-demand fleets of SAE level 4 automated vehicles that can provide point-to-point transportation.[149] Instead of owning a vehicle, an individual might purchase a subscription from an automated vehicle ridesharing operator for a predetermined number of rides or may pay on a ride-by-ride basis.[150] While an individually owned vehicle currently spends approximately ninety-five percent of its time parked, automated vehicles operating in an on-demand ridesharing network would only need to park in periods of low demand or for maintenance, refueling, and cleaning.[151] Consequently, the current space devoted to parking could be freed up significantly if individual car ownership is replaced by ridesharing.[152]

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[146] *See* Srikanth Saripalli, *Are Self-Driving Cars the Future of Mobility for Disabled People?*, THE CONVERSATION (Oct. 5, 2017, 8:55 PM), https://theconversation.com/are-self-driving-cars-the-future-of-mobility-for-disabled-people-84037 [https://perma.cc/X5PS-SHUN] (detailing obstacles disabled individuals encounter when accessing mobility).

[147] *See* Baggaley, *supra* note 145 (discussing the potential benefits of automated vehicles for elderly and disabled individuals); Saripalli, *supra* note 146 (discussing the potential benefits of automated vehicles for disabled individuals).

[148] *See* Baggaley, *supra* note 145 (discussing changes that could accompany wide adoption of automated vehicles); Bertoncello & Wee, *supra* note 141 (same); Dan Perry, *The Societal Impact of Self-Driving Cars*, MEDIUM (Nov. 27, 2017), https://medium.com/our-future/the-societal-impact-of-self-driving-cars-364644193a8a [https://perma.cc/6CGP-KCUJ?type=image] (same).

[149] *See* Perry, *supra* note 148 (noting that expenses attributed to car ownership may be diverted to business models for automated vehicles that do not involve individual ownership).

[150] *See id.* (describing a move away from individual car ownership). With U.S. auto loan balances of approximately $1.27 trillion, a reduction in debt associated with car ownership could also lead to increased spending power for consumers. *See* Press Release, Fed. Reserve Bank of N.Y., Total Household Debt Rises as 2018 Marks the Ninth Year of Annual Growth in New Auto Loans (Feb. 12, 2019), https://www.newyorkfed.org/newsevents/news/research/2019/20190212 [https://perma.cc/SE5Y-E9CA] (noting that auto loan debt at the end of the fourth quarter of 2018 was $1.27 trillion).

[151] *See* David Z. Morris, *Today's Cars Are Parked 95% of the Time*, FORTUNE (Mar. 13, 2016), http://fortune.com/2016/03/13/cars-parked-95-percent-of-time/ [https://perma.cc/4XKA-DF6P] (noting the time vehicles currently spend parked and the resulting benefits if automated vehicles free up parking spaces).

[152] *See* Bertoncello & Wee, *supra* note 141 (estimating that automated vehicles could liberate more than 5.7 billion square meters of space currently used for parking). Some urban planners observe that "because driverless vehicles will drop off passengers and move on, prime real estate now consumed by vast parking lots and unsightly garages could be freed up for more housing, parks, public plazas and open space . . . ." Katherine Shaver, *City Planners Eye Self-Driving Vehicles to Correct Mistakes of the 20th-Century Auto*, WASH. POST (July 20, 2019, 10:00 AM), https://www.washingtonpost.com/

The proliferation of automated vehicles available on-demand may also result in an exodus from the cities.[153] With the mind-numbing tedium of a hectic commute replaced by the comfort of being chauffeured to and from work in an automated vehicle, individuals might choose to lower their cost of living by settling further away from areas with high costs of living.[154] Moreover, during their commutes, individuals could be freed from focusing their attention on the roadway and use their time more productively.[155] Nevertheless, deurbanization due to automated vehicles may also have detrimental impacts, such as increased pollution and congestion.[156]

As a result of the potential societal and economic benefits of automated vehicles, policymakers and regulators are hesitant to erect regulatory roadblocks that may impede their development.[157] For some policymakers and regulators, maximizing innovation has become a primary objective.[158] Uber's decision to transition its automated vehicle testing operations from California to Arizona may be the best example of this phenomenon.[159] Uber was unwilling

transportation/2019/07/20/city-planners-eye-self-driving-vehicles-correct-mistakes-th-century-auto/ [https://perma.cc/9CA9-J4UY].

[153] *See* Perry, *supra* note 148 (noting automated vehicles may lead to a reduction in urbanization).

[154] *See id.* (discussing the convenience and reduction in commute times that may accompany automated vehicles).

[155] *See* Bertoncello & Wee, *supra* note 141 (estimating that automated vehicles "could free as much as 50 minutes a day for users, who will be able to spend traveling time working, relaxing, or accessing entertainment").

[156] *See* Shaver, *supra* note 152 ("[S]ome say driverless vehicles could also worsen [congestion and pollution], particularly if they're priced affordably enough to make them wildly popular and encourage solo driving. Another concern is the potential for what some planners have dubbed 'sprawl on steroids.' A two-hour commute becomes less onerous if travelers can nap, watch a movie or hold a business meeting rather than fume behind the wheel.").

[157] *See* AV GUIDANCE 3.0, *supra* note 2, at viii ("Automation technologies are new and rapidly evolving. The right approach to achieving safety improvements begins with a focus on removing unnecessary barriers and issuing voluntary guidance, rather than regulations that could stifle innovation.").

[158] *See* Ariz. Exec. Order No. 2015-09, (Aug. 25, 2015), https://azgovernor.gov/file/2660/download?token=nLkPLRi1 [https://perma.cc/WZ5V-7CTX] (declaring Arizona "believes that development of self-driving vehicle technology will promote economic growth, bring new jobs, provide research opportunities for the State's academic institutions and their students and faculty, and allow the State to host the emergence of new technologies" and that "the State has the view that the testing and operation of self-driving vehicles could produce transformational social benefits such as . . . a dramatic increase in pedestrian and passenger safety"); AV GUIDANCE 3.0, *supra* note 2, at viii (discussing the correct approach to safety as eliminating impediments to automated vehicles).

[159] *See* Dara Kerr, *Uber Snubs California, Moves Self-Driving Cars to Arizona*, CNET (Dec. 22, 2016, 4:20 PM) [hereinafter Kerr, *Uber Snubs California*], https://www.cnet.com/news/uber-snubs-california-moves-its-self-driving-cars-to-arizona/ [https://perma.cc/M4P4-2CB7] (detailing why Uber moved its automated vehicle testing operation to California). California law requires a testing permit, issued by the California Department of Motor Vehicles, to test automated vehicles on public roads. *See* CAL. VEH. CODE § 38750 (West 2017) (listing requirements for the application and approval process). Instead of applying for a permit, Uber began testing its automated vehicles on public roads in California, believing that it did not need a permit. Kerr, *Uber Snubs California*, *supra*; *see* Dara

to apply for an automated vehicle-testing permit in California and subsequently shifted its automated vehicle-testing program to Arizona, where the company was met with a warm reception by Governor Doug Ducey.[160] In contrast to California's comprehensive regulatory scheme for testing automated vehicles—that requires an application for testing be approved and testing data to be reported to the California Department of Motor Vehicles—Arizona has taken a more hands off approach to testing within its boundaries.[161] To test an automated vehicle in Arizona the state only requires that: (1) the vehicle be operated by an employee, contractor, or designee of the developer, (2) the operator seated in the vehicle have a valid driver's license, (3) the operator is able to take manual control of the vehicle when necessary, and (4) the developer submit proof of financial responsibility.[162] Policies that promote innovation, however, sometimes conflict with ensuring public safety.[163]

B. Objective Two: Ensure Public Safety

Although automated vehicles hold the promise of enhancing safety by reducing traffic accidents, they also pose new threats to the public.[164] These risks arise as a result of a number of issues, including unrefined technology, equipment malfunctions and failures, human error, and public opinion.[165] Automated

Kerr, *Uber: We Don't Need a Permit for Self-Driving Cars*, CNET (Dec. 14, 2016, 8:43 PM), https://www.cnet.com/news/uber-we-dont-need-a-permit-for-self-driving-cars/ [https://perma.cc/C72T-BCGS] (discussing Uber's reasoning in declining to apply for a permit and the California Department of Motor Vehicles' position). After attempts to encourage Uber to apply for a permit failed, the California Department of Motor Vehicles revoked the registrations of Uber's test vehicles, effectively ending the company's ability to operate automated vehicles on public roads in California. Kerr, *Uber Snubs California*, *supra*.

[160] Kerr, *Uber Snubs California*, *supra* note 159; Press Release, Gov. Doug Ducey, Governor Ducey Tells Uber 'CA May Not Want You, But AZ Does' (Dec. 22, 2016), https://azgovernor.gov/governor/news/2016/12/governor-ducey-tells-uber-ca-may-not-want-you-az-does [https://perma.cc/S9VU-42TK] ("Arizona welcomes Uber self-driving cars with open arms and wide open roads. While California puts the brakes on innovation and change with more bureaucracy and more regulation, Arizona is paving the way for new technology and new businesses. In 2015, I signed an executive order supporting the testing and operation of self-driving cars in Arizona with an emphasis on innovation, economic growth, and most importantly, public safety. This is about economic development, but it's also about changing the way we live and work. Arizona is proud to be open for business. California may not want you, but we do.").

[161] *Compare* CAL. CODE REGS. tit. 13, § 227.00–.54 (2019) (detailing the process and requirements for obtaining an automated vehicle testing permit in California), *with* Ariz. Exec. Order No. 2015-09, *supra* note 158 (listing four requirements for testing automated vehicles in Arizona).

[162] Ariz. Exec. Order No. 2015-09, *supra* note 158.

[163] *See* Scott Neuman, *Arizona Governor Helped Make State 'Wild West' for Driverless Cars*, NPR (Mar. 20, 2018 4:18 AM), https://www.npr.org/sections/thetwo-way/2018/03/20/595115055/arizona-governor-helped-make-state-wild-west-for-driverless-cars [https://perma.cc/LN6N-WLWP] (noting criticisms from safety advocates aimed at Arizona's approach to regulating automated vehicles).

[164] *See* AV GUIDANCE 3.0, *supra* note 2, at iv (noting "new safety risks" that may arise with the proliferation of automated vehicles).

[165] *See id.* (predicting fresh threats to safety may originate from automated vehicles).

vehicles must be able to function safely in extraordinarily complex environments where they encounter and interact with human operated vehicles, pedestrians, and other obstacles.[166] This level of safety requires a large amount of real world testing on public roads in order to ensure automated vehicles are ready for widespread deployment.[167] During the testing phase, policymakers, regulators, and developers need to assure the public that testing conducted on public roads is safe.[168]

Similarly, when automated vehicles are ready to deploy and be used by the public, policymakers and regulators need to assure users that the vehicles are safe.[169] Yet difficult questions arise with respect to approximately how safe automated vehicles need to be before they are deployed.[170] For example, if the safety level of a hypothetical automated vehicle is judged to be ten percent better than a vehicle operated by an average human driver, is that an acceptable level of risk to deploy the automated vehicle?[171] This hypothetical automated vehicle, if substituted for all human operated vehicles, would still injure and kill a large number of humans.[172] The notion of automated vehicles causing injury or death may not be palatable to either the public or policymakers even if overall injuries and fatalities would be less than they would have been in a

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[166] *See* Jesse Duneitz, *To Make Autonomous Vehicles Safe, We Have to Rethink "Autonomous" and "Safe,"* SCIENTIFIC AM. (Apr. 24, 2018), https://blogs.scientificamerican.com/observations/to-make-autonomous-vehicles-safe-we-have-to-rethink-autonomous-and-safe/ [https://perma.cc/U4CW-5TBQ] (discussing the multitude of scenarios than an automated vehicle must be programmed to detect and process).

[167] NIDHI KALRA & SUSAN M. PADDOCK, RAND CORP., DRIVING TO SAFETY: HOW MANY MILES OF DRIVING WOULD IT TAKE TO DEMONSTRATE AUTONOMOUS VEHICLE RELIABILITY? 1 (2016), https://www.rand.org/pubs/research_reports/RR1478.html [https://perma.cc/DDB2-HZP9] (observing that automated "vehicles would have to be driven hundreds of millions of miles and sometimes hundreds of billions of miles to demonstrate their reliability in terms of fatalities and injuries").

[168] *See* AV GUIDANCE 3.0, *supra* note 2, at 36 (explaining "[c]ollaboration is needed among manufacturers, technology developers, infrastructure owners and operators, and relevant government agencies to establish protocols that will help to advance safe operations in these testing environments").

[169] *See id.* at 26 (noting that Voluntary Safety Self Assessments provided to NHTSA are "intended to demonstrate to the public that entities are: considering the safety aspects of an ADS . . . and building public trust, acceptance, and confidence through transparent testing and deployment of ADS").

[170] *See* NIDHI KALRA & DAVID G. GROVES, RAND CORP., THE ENEMY OF GOOD: ESTIMATING THE COST OF WAITING FOR PERFECT AUTOMATED VEHICLES, at ix (2017), https://www.rand.org/pubs/research_reports/RR2150.html [https://perma.cc/5BNC-3VXX] (observing that the degree to which an automated vehicle needs to be safer than the average human driver may have large repercussions).

[171] *See id.* at ix–x (discussing findings that suggest widely adopting automated vehicles that are 10% safer than the average human driver would save more lives in the short run and long run than waiting for automated vehicles that are 75% or 90% safer than the average human driver).

[172] *Id.* at ix (observing that an automated vehicle that is marginally safer than the average human driver would still cause many crashes).

status quo scenario of purely human operated vehicles.[173] Other ethical issues also exist, such as whether automated vehicles need to be programmed with the ability to make moral decisions.[174]

The choices policymakers and regulators make regarding the balance between innovation and public safety may have already had real world consequences, as illustrated by Elaine Herzberg's death in Arizona.[175] Some cast blame for the accident on the state's relaxed approach to regulating automated vehicle testing.[176] In response to criticism over his state's approach, Governor Ducey noted that the overall potential of reducing traffic fatalities with automated vehicles should not be forgotten.[177] This accident nevertheless highlights the tightrope that policymakers and regulators must walk in balancing innovation and public safety.[178]

Public opinion is another critical area of which policymakers and regulators must be cognizant when considering options to satisfy the public safety objective of automated vehicle regulation.[179] For example, if fatalities such as the one resulting from the Uber accident in Arizona were to occur on a regular basis, public opinion might turn quickly against automated vehicles and the

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[173] See *id.* (noting that even if fatality rates are lower than human operated vehicles, "[t]his may not be acceptable to society, and some argue that the technology should be significantly safer or even nearly perfect before [automated vehicles] are allowed on the road").

[174] Laurel Wamsley, *Should Self-Driving Cars Have Ethics?*, NPR (Oct. 26, 2018, 4:36 PM), https://www.npr.org/2018/10/26/660775910/should-self-driving-cars-have-ethics [https://perma.cc/3W3E-T9YQ] (discussing whether an automated vehicle should be programmed to determine whether to protect pedestrians at the expense of vehicle occupants, or vice-versa, among other considerations, in the event of an emergency).

[175] *See* Wakabayashi, *supra* note 5 (discussing a fatality in Arizona caused by an automated vehicle undergoing testing).

[176] *See* Lazo, *supra* note 132 (noting "[c]ritics have said states such as Arizona are moving too quickly and not ensuring public safety"); Ryan Randazzo, *Fatal Uber Collision Highlights Secrecy of Self-Driving Tests in Arizona*, ARIZ. REPUBLIC (Mar. 29, 2018, 9:32 AM), https://www.azcentral.com/story/money/business/tech/2018/03/29/fatal-uber-collision-highlights-secrecy-self-driving-car-tests-arizona/466715002/ [https://perma.cc/6SM6-5U9L] (observing that, although Governor Ducey's executive order on automated vehicles "said testing would be allowed, it did not tell Arizonans where, when, who or how those tests would take place" and that the death of Elaine Herzberg "highlights the fact that Arizona's roads are an ongoing technology experiment and everyone on them is a participant—whether they know it or not").

[177] *See* Howard Fischer, *Debate Put Ducey on Defensive on Uber, Theranos*, ARIZ. CAPITOL TIMES (Sept. 26, 2018), https://azcapitoltimes.com/news/2018/09/26/debate-put-ducey-on-defensive-on-uber-theranos/ [https://perma.cc/UWY3-M6S3] (quoting Governor Ducey) ("We lose over 800 Arizonans a year on our highways due to human error from drivers . . . . What happened in that accident was tragic . . . [b]ut I want to see the 38,000 people that die in avoidable accidents across the United States, I want to see that problem solved.").

[178] *See* AV GUIDANCE 3.0, *supra* note 2, at ii (noting that "[a]long with potential benefits . . . automation brings new challenges that need to be addressed. The public has legitimate concerns about the safety, security, and privacy of automated technology.").

[179] *See* KALRA & GROVES, *supra* note 170, at 31 (discussing the effects of public opinion on the deployment of automated vehicles).

policymakers and regulators who reject increased regulation.[180] Perversely, such a scenario may actually lead to more fatalities through the delayed introduction of automated vehicles that are safer than the average human driver.[181] This risk is not unfounded, as one survey following the Uber accident in Arizona indicated that 73% of those surveyed were "afraid to ride" in an automated vehicle and 63% said they would "feel less safe sharing the road" with automated vehicles.[182] As a result, policymakers and regulators may need to look for solutions that build public trust and ward off the detrimental effects of a backlash in public opinion.[183] Such solutions could ensure that deployment of lifesaving technologies in the form of automated vehicles is not delayed.[184]

C. Whether NHTSA Has the Tools to Achieve the Objectives

Although NHTSA was created to regulate motor vehicles operated by humans, it still has tools at its disposal to regulate automated vehicles.[185] First, NHTSA's ability to conduct rulemaking to write new FMVSS for automated vehicles is clear.[186] Because the process for writing new FMVSS requires extensive research, rulemaking may achieve the public safety objective by setting minimum safety requirements that are grounded in hard data.[187] Moreover, the public comment process that accompanies rulemaking may reduce skepticism surrounding automated vehicles.[188] Rulemaking may also create more certainty for automated vehicle developers by stating specific standards that vehicles must meet to be considered roadworthy.[189]

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[180] *See id.* (observing that "a major backlash against a crash caused by even relatively safe [automated vehicles] could grind the industry to a halt").

[181] *See id.* (noting that a "major backlash" scenario could "result[] in . . . the greatest loss of life over time").

[182] Press Release, Am. Auto. Ass'n, AAA: American Trust in Autonomous Vehicles Slips (May 22, 2018), https://newsroom.aaa.com/2018/05/aaa-american-trust-autonomous-vehicles-slips/ [https://perma.cc/8U4W-BE5R].

[183] *See* KALRA & GROVES, *supra* note 170, at 31 (noting that "society . . . must balance the social response to [automated vehicle] crashes with the rate of [automated vehicle] crashes under different policy options").

[184] *See id.* (noting that a balanced approach may result in the greatest number of lives saved).

[185] *See* UNDERSTANDING NHTSA'S REGULATORY TOOLS, *supra* note 50, at 2 (discussing the regulatory tools available to NHTSA).

[186] *See id.* (listing rulemaking as one of the mechanisms the agency uses to regulate motor vehicles).

[187] *See* AV GUIDANCE 1.0, *supra* note 24, at 50 (qualifying that, although rulemaking is lengthy, its scope is also the widest and allows for lasting changes).

[188] *See id.* (observing that rulemaking allows for the most public participation in the outcome through the commenting process).

[189] *See id.* at 49 (noting designs that significantly differ from current motor vehicles may necessitate rulemaking if compliance with current standards is not feasible).

Rulemaking, however, is a slow and deliberate process that may take years to complete.[190] With the rapid iterative testing and development of automated vehicles, future inventions and technical solutions could make proposed FMVSS obsolete before they are even adopted.[191] Further, with all the technical know-how and data housed in the private entities developing the technology, it is not clear that NHTSA currently has the necessary expertise to develop FMVSS for automated vehicles.[192] Consequently, rulemaking risks creating barriers to innovation in the form of a process guided by uninformed regulators and the creation of new FMVSS that are not tailored to keep up with evolving technology.[193]

Another tool available to NHTSA is its ability to grant temporary exemptions from FMVSS in response to petitions from developers.[194] Exemptions can allow a developer to sidestep FMVSS that were clearly developed with human drivers in mind.[195] As a result, NHTSA's exemption authority could be a valuable tool to clear the way for innovation.[196] Nevertheless, because exemptions only pertain to current FMVSS, the scope of NHTSA's authority is limited.[197] Thus, although exemptions are a possible way around antiquated FMVSS, they do not provide a mechanism to further regulate the safety of exempted automated vehicles.[198]

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[190] *See* Soodoo, *supra* note 57 (noting that rulemaking of moderate complexity may take five years).

[191] *See* AV GUIDANCE 3.0, *supra* note 2, at 7 (observing that rulemaking is ill suited to the breakneck speed at which innovation is occurring in the automated vehicle space).

[192] *See* Alan Ohnsman, *Push for Self-Driving Car Rules Overlooks Lack of Federal Expertise in AI Tech*, FORBES (July 19, 2017, 7:49 PM), https://www.forbes.com/sites/alanohnsman/2017/07/19/push-for-self-driving-car-rules-overlooks-lack-of-federal-expertise-in-ai-tech/#6843d803cbf3 [https://perma.cc/ZE9K-P4ZL] (discussing NHTSA's lack of "software and computer science expertise needed to validate [the] technical claims" of entities' submissions through the Safety Assessment Letter process in AV GUIDANCE 1.0).

[193] *See* PRELIMINARY STATEMENT OF POLICY CONCERNING AUTOMATED VEHICLES, *supra* note 24, at 10 (observing that adopting regulations too soon may "run the risk of putting the brakes on the evolution toward increasingly better vehicle safety technologies").

[194] *See* UNDERSTANDING NHTSA'S REGULATORY TOOLS, *supra* note 50, at 9–10 (discussing exemptions).

[195] *See* Johana Bhuiyan, *General Motors Is Asking the U.S. Government to Let It Test Cars Without Steering Wheels in 2019*, RECODE (Jan. 12, 2018, 12:01 AM), https://www.recode.net/2018/1/12/16880570/general-motors-self-driving-cars-cruise-steering-wheel-nhtsa-fmvss [https://perma.cc/C5V2-TT2C] (discussing General Motors' exemption petition for an automated vehicle from the FMVSS that require a steering wheel or brake pedal).

[196] *See* AV GUIDANCE 3.0, *supra* note 2, at 8 (noting that "[t]he statutory provision authorizing NHTSA to grant exemptions from FMVSS provides sufficient flexibility to accommodate a wide array of automated operations, particularly for manufacturers seeking to engage in research, testing, and demonstration projects").

[197] *See* UNDERSTANDING NHTSA'S REGULATORY TOOLS, *supra* note 50, at 3 (describing exemptions as a safety valve from the typical requirement to comply with FMVSS).

[198] *See* LAURA FRAADE-BLANAR & NIDHI KALRA, RAND CORP., AUTONOMOUS VEHICLES AND FEDERAL SAFETY STANDARDS: AN EXEMPTION TO THE RULE? 4 (2017), https://www.rand.org/pubs/perspectives/PE258.html [https://perma.cc/CY4W-7K6N] (observing that FMVSS were not designed for automated vehicles).

Moreover, NHTSA's statutory authority to issue two-year exemptions from FMVSS is currently capped at 2,500 vehicles.[199] On the one hand, these requirements impose a volume and temporal ceiling that could arbitrarily inhibit the proliferation of automated vehicles and any corresponding economic and societal benefits.[200] On the other hand, these limitations may serve as a mechanism that protects public safety by limiting the introduction of exempted automated vehicles until more is known about their performance and overall safety.[201]

NHTSA is further limited because it may only grant exemptions for new safety features with a safety level at least equal to the applicable FMVSS or if the exempted vehicle is as safe as an existing non-exempt vehicle overall.[202] This standard may prove difficult for developers to meet because FMVSS were not written for automated vehicles and non-exempt vehicles are likely to still be human operated.[203] Thus, an equivalent safety level may be difficult to determine in the historical context of exemptions issued by NHTSA for vehicle systems designed to be operated by human drivers.[204] Although exemptions might still prove useful, they may not be granted at the speed necessary to keep up with innovative designs for automated vehicles.[205] Furthermore, at least historically, NHTSA has received few petitions for exemption for new safety technologies.[206]

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[199] *See* UNDERSTANDING NHTSA'S REGULATORY TOOLS, *supra* note 50, at 9 (discussing exemptions).

[200] *See* FRAADE-BLANAR & KALRA, *supra* note 198, at 2 (relating the desire of automated vehicle developers to increase the exemption ceiling).

[201] *See id.* (observing that the exemption provisions limit risk by imposing an annual cap on exempted vehicles).

[202] UNDERSTANDING NHTSA'S REGULATORY TOOLS, *supra* note 50, at 9. To show that a safety feature is at least equivalent to the applicable FMVSS, the manufacturer must provide an "analysis establishing that the level of safety or impact protection of the feature is equivalent to or exceeds the level of safety or impact protection established in the standard from which exemption is sought." *Id.* at 12. To show that a vehicle is at least as safe as a non-exempt vehicle overall, a manufacturer must, among other things, submit "[t]he results of any tests conducted on the vehicle demonstrating that its overall level of safety or impact protection exceeds that which is achieved by conformity to [FMVSS]." *Id.* at 14.

[203] *See* FRAADE-BLANAR & KALRA, *supra* note 198, at 3 (arguing that "it is not possible to compare the vehicle components of an [automated vehicle] with an FMVSS-compliant vehicle, while separately comparing the control components of an [automated vehicle] with human drivers: The two are completely integrated").

[204] *See id.* at 4 (observing that, in exemption petitions for automated vehicles, it will be difficult for NHTSA to use a quantifiable measurement to determine safety equivalence).

[205] *See* AV GUIDANCE 3.0, *supra* note 2, at 7–8 (discussing a proposal to speed up the exemption process); UNDERSTANDING NHTSA'S REGULATORY TOOLS, *supra* note 50, at 21 n.7 (noting exemption requests have typically taken years to process).

[206] FRAADE-BLANAR & KALRA, *supra* note 198, at 2 (noting the rarity of exemption requests, and observing that, "since 1994, there have been only eight requests on the basis of developing or evaluating new safety features" and that "NHTSA [typically] denied exemptions because the petition failed to show that the new safety feature provided a safety level equal to that of the FMVSS, that the exemption would facilitate testing, or both"). On January 11, 2018, NHTSA received a petition from General Motors for exemptions from sixteen FMVSS for an automated vehicle. *Petitions to NHTSA*, NAT'L

NHTSA also has the ability to issue interpretation letters in response to requests for interpretations of FMVSS.[207] Interpretation letters are typically more narrow agency actions than exemptions from FMVSS.[208] For example, Google submitted an interpretation request to NHTSA for a determination of whether an ADS could be deemed the "driver" and therefore allow its vehicle to be in compliance with various FMVSS.[209] NHTSA agreed that the ADS could be deemed the "driver" with respect to certain FMVSS but cautioned that Google might not be able to certify compliance with FMVSS that were "developed and designed to apply to a vehicle with a human driver."[210] NHTSA noted that Google may need to instead petition for exemptions or rulemaking.[211] As a result, although interpretation requests may provide automated vehicle developers an opportunity to bypass some FMVSS, they may not be a panacea to make use of innovative designs in a timely manner.[212]

NHTSA has also issued a series of guidance documents that give a sense of the agency's priorities and create a process for entities testing or deploying automated vehicles to submit information via a Voluntary Safety Self-Assessment.[213] Adherence to the principles in the guidance is voluntary, and thus the documents exemplify NHTSA's "flexible" approach to regulating automated

HIGHWAY TRAFFIC SAFETY ADMIN., https://www.nhtsa.gov/laws-regulations/petitions-nhtsa [https://perma.cc/T2ST-BEDR]. The petition includes a request for exemption from the FMVSS that require a steering wheel and brake pedal. Bhuiyan, *supra* note 195. As of December 14, 2019, the petition was still pending. *Petitions to NHTSA*, *supra*. NHTSA has requested public comment on the petition. General Motors, LLC—Receipt of Petition for Temporary Exemption from Various Requirements of the Safety Standards for an All-Electric Vehicle with an Automated Driving System, 84 Fed. Reg. 10,182 (Mar. 19, 2019) (noticed and requested). General Motors' petition is available at https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/gm_petition.pdf [https://perma.cc/NH7T-TNG8].

[207] *See* UNDERSTANDING NHTSA'S REGULATORY TOOLS, *supra* note 50, at 2 (discussing interpretation requests).

[208] *See id.* (explaining interpretation requests).

[209] *See* Letter from Chris Urmson, *supra* note 54, at 7–8 (discussing how references in FMVSS to the "driver" could be interpreted).

[210] *See* Letter from Paul A. Hemmersbaugh, Chief Counsel, NHTSA, to Chris Urmson, Dir., Self-Driving Car Project, Google, Inc. (Feb. 4, 2016), https://bit.ly/2O0LQ1x [https://perma.cc/M8LG-PB2U].

[211] *See id.* (advising Google that it could submit exemption requests, but that some of the issues raised would necessitate rulemaking).

[212] *See id.* (explaining the limited scope of interpretation requests).

[213] *See* AV GUIDANCE 3.0, *supra* note 2, at viii, 26 (discussing NHTSA's policy toward automated vehicles and reaffirming its commitment to the Voluntary Safety Self-Assessment); AV GUIDANCE 2.0, *supra* note 24, at 1, 16 (discussing NHTSA's policy toward automated vehicles and the Voluntary Safety Self-Assessment); AV GUIDANCE 1.0, *supra* note 24, at 6 (discussing NHTSA's policy toward automated vehicles). NHTSA and the DOT's stated priorities include: prioritizing safety, maintaining technological neutrality, modernizing regulations, "encourag[ing] a consistent regulatory and operational environment[,] . . . prepar[ing] proactively for automation[, and] . . . protect[ing] and enhanc[ing] the freedoms enjoyed by Americans." AV GUIDANCE 3.0, *supra* note 2, at iv–v.

vehicles.[214] The submissions of Voluntary Safety Self-Assessments are meant to augment this flexible approach by providing information to the agency and the public.[215] Because compliance is optional, NHTSA is not creating requirements for technologies that have not yet matured.[216] Further, by not requesting submission of a Voluntary Safety Self-Assessment prior to testing or deployment, NHTSA eases the introduction of automated vehicles onto public roads by eliminating the possibility of compliance-related delay.[217] Moreover, asking that Voluntary Safety Self-Assessments contain only "concise information" related to the developer's use of the guidance relieves the burden of providing complex information about the inner workings of the automated vehicles.[218]

The optionality of the guidance and the Voluntary Safety Self-Assessment, however, does little to ensure that automated vehicle developers will actually adhere to the guidance or make submissions, as evidenced by the disparity between the number of entities approved for testing in California and the number of Voluntary Safety Self-Assessments submitted to NHTSA.[219] If entities do not submit the Voluntary Safety Self-Assessment, then both NHTSA and the public are in the dark about who is testing automated vehicles, what the capability of the automated vehicles are, and what safety precautions are being taken.[220] Likewise, the generality of the instructions for the content of the Voluntary Safety Self-Assessment, coupled with the call for only "concise information," may result in submissions that do not provide the kind of data that NHTSA or the public need to make an informed opinion about the safety of the technology.[221]

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[214] AV GUIDANCE 3.0, *supra* note 2, at iii. NHTSA's flexible approach is evidenced by its goal to, "[w]herever possible[,] . . . partner with industry to develop voluntary consensus-based standards and [to] reserve nonprescriptive, performance-based regulations for when they are necessary." *Id.* at 41.

[215] *See id.* at 26 (discussing the role of Voluntary Safety Self-Assessments).

[216] *See id.* at iv (declaring the need for voluntary standards that are malleable rather than rigid).

[217] *See* AV GUIDANCE 2.0, *supra* note 24, at 16 (noting that, while NHTSA prefers a Voluntary Safety Self-Assessment be submitted before testing, it need not be).

[218] *Id.* (noting Voluntary Safety Self-Assessments should show how manufacturers are using the guidance and how they plan to address the safety elements). NHTSA also noted that the submission "should not serve as an exhaustive recount of every action the entity took to address a particular safety element." *Id.*

[219] *Compare Voluntary Safety Self-Assessment*, NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., https://www.nhtsa.gov/automated-driving-systems/voluntary-safety-self-assessment [https://perma.cc/E7JV-BCL3] (listing seventeen Voluntary Safety Self-Assessment submissions), *with Testing of Autonomous Vehicles with a Driver*, CAL. DEP'T OF MOTOR VEHICLES, *supra* note 3 (noting sixty-five entities have received permits to test automated vehicles on public roadways in California).

[220] *See* AV GUIDANCE 3.0, *supra* note 2, at 26 (discussing Voluntary Safety Self-Assessments as a means to increase public awareness).

[221] *See* AV GUIDANCE 2.0, *supra* note 24, at 16 (discussing the parameters of the information that should be included in a submission); Keith Laing, *Few Carmakers Submit Self-Driving Car Safety Reports*, DETROIT NEWS (Sept. 10, 2018, 1:51 PM), https://www.detroitnews.com/story/business/autos/mobility/2018/09/10/few-carmakers-submit-self-driving-safety-assessments/1076691002/ [https://perma.cc/VMR3-2GPT] (noting "[s]afety advocates say [Voluntary Safety Self-Assessments] that

Thus, it is not at all clear that NHTSA's optional guidance and Voluntary Safety Self-Assessment can keep the public safe or guard the technology against a backlash in public opinion.[222] The Voluntary Safety Self-Assessment lays bare the conflict that can occur in attempting to further one objective—maximizing innovation—at the expense of another—public safety.[223]

D. Whether the SELF DRIVE Act and AV START Act Achieve the Objectives

Both the SELF DRIVE Act and AV START Act were introduced to remove impediments for automated vehicles and safeguard the public.[224] The bills broadly attempt to achieve this goal by preempting certain state laws, ordering NHTSA to conduct rulemaking, increasing the number of exemptions available to manufacturers, and requiring certain submissions to NHTSA.[225]

First, the bills preempt state laws that impinge on the "design, construction, or performance" of automated vehicles.[226] Although the preemption provisions in the SELF DRIVE Act are slightly broader than the preemption provisions in the AV START Act, both bills appear to be aimed at heading off a rush of state-level legislation that has arisen in lieu of congressional action.[227] With NHTSA as the country's chief motor vehicle safety regulator, it could

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have been submitted so far . . . resemble slick marketing brochures instead of stringent regulatory filings").

[222] *See* Laing, *supra* note 221 (noting safety advocates want to make the submission of Voluntary Safety Self-Assessments mandatory).

[223] *See id.* (observing that Voluntary Safety Self-Assessments have not stemmed a decline in public opinion toward automated vehicles).

[224] *See* Press Release, *supra* note 79 (discussing reasons for introducing the AV START Act); Bob Latta & Jan Schakowsky, *The Only Way the US Can Safely Move Forward with Self-Driving Cars*, CNBC (Jun. 5, 2018, 11:13 AM), https://www.cnbc.com/2018/06/05/us-needs-to-pass-self-driving-car-legislation-now.html [https://perma.cc/6W33-U2B8] (advocating for passage of the SELF DRIVE Act).

[225] AV START Act §§ 3, 4, 6, 9; SELF DRIVE Act §§ 3, 4, 6.

[226] AV START Act § 3; SELF DRIVE Act § 3.

[227] *See* AV START Act § 3 (discussing the scope of state law preemption); SELF DRIVE Act § 3 (same); Kaveh Waddell & Kia Kokalitcheva, *States Are Sewing a Patchwork of AV Regulations*, AXIOS (Oct. 27, 2018), https://www.axios.com/states-are-sewing-a-patchquilt-to-regulate-av-f7577b90-966c-46ef-8ab2-b616e31ab3b0.html [https://perma.cc/P3SY-AMUZ?type=image] (noting "[a]utomakers worry that, without federal standards, they'll have to deal with a patchwork of state laws that would hamper a broader roll-out of [automated vehicles]"). Twenty-nine states have enacted legislation related to automated vehicles and governors in eleven states have signed executive orders pertaining to automated vehicles. *Autonomous Vehicles: Self-Driving Vehicles Enacted Legislation*, NAT'L CONFERENCE OF ST. LEGISLATURES (Oct. 9, 2019), http://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx [https://perma.cc/HG4C-XJT8]. The states that have enacted legislation include: Alabama, Arkansas, California, Colorado, Connecticut, Florida, Georgia, Illinois, Indiana, Kentucky, Louisiana, Maine, Michigan, Mississippi, Nebraska, Nevada, New York, North Carolina, North Dakota, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, Utah, Vermont, Virginia, Washington, and Wisconsin, as well as the District of Columbia. *Id.*

make sense to ensure that a patchwork of differing standards for automated vehicles does not develop at the state level.[228] Alleviating the specter of state-by-state regulation may also support innovation by allowing for a single national compliance framework that gives developers more certainty and might not compromise public safety, so long as NHTSA develops a robust framework to replace existing state level oversight.[229]

Second, both bills require NHTSA to conduct rulemaking to update FMVSS.[230] The rulemaking process required by the SELF DRIVE Act is broad in scope because it requires the creation of new FMVSS.[231] Rulemaking would not begin until between twelve and eighteen months after enactment, and the process itself could take five years or more to complete.[232] The AV START Act's rulemaking scope is narrower because it only requires an update to existing FMVSS.[233] It requires the Volpe Center to review FMVSS for references to human drivers and create a report within 180 days of enactment.[234] Rulemaking is required to begin within ninety days thereafter.[235] If the rulemaking is not complete within one year of the Volpe Center report's submission, then the report's recommendations are automatically incorporated into revised FMVSS.[236] Thus, although the AV START Act's rulemaking process is likely to be significantly faster, its scope is also narrower.[237]

The results for each approach appear to be mixed in relation to the objectives.[238] The SELF DRIVE Act orders a rulemaking that has the potential to create new FMVSS for automated vehicles that, if premature, may hinder innovation.[239] At the same time, this approach to rulemaking could lead to more certainty for those concerned about public safety and for manufacturers who

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[228] *See* AV GUIDANCE 1.0, *supra* note 24, at 7 (noting that, in creating a Model State Policy, "the shared objective is to ensure the establishment of a consistent national framework rather than a patchwork of incompatible laws"). For an argument that state-by-state regulation of automated vehicles should be maintained and expanded, see Madeline Roe, *Who's Driving That Car?: An Analysis of Regulatory and Potential Liability Frameworks for Driverless Cars*, 60 B.C. L. REV. 315, 342–44 (2019).

[229] *See* AV GUIDANCE 1.0, *supra* note 24, at 37 (discussing federal and state regulatory responsibilities and recommending states allow NHTSA to regulate performance-related areas).

[230] AV START Act § 4; SELF DRIVE Act § 4.

[231] *See* SELF DRIVE Act § 4 (discussing the scope of rulemaking).

[232] *See id.* (discussing the timeframe for rulemaking); Soodoo, *supra* note 57 (noting the typical time it takes NHTSA to complete rulemaking).

[233] *See* AV START Act § 4 (limiting the breadth of rulemaking to references to human drivers in FMVSS).

[234] *Id.*

[235] *Id.*

[236] *Id.*

[237] *See id.* (noting the timeframe and scope for rulemaking); SELF DRIVE Act § 4 (same).

[238] *See* AV START Act § 4 (discussing rulemaking); SELF DRIVE Act § 4 (same).

[239] *See* SELF DRIVE Act § 4 (ordering rulemaking that could include promulgation of new FMVSS).

would have on point FMVSS to engineer their vehicles to meet.[240] The SELF DRIVE Act runs the risk, however, that the standards will already be outdated by the time the rulemaking is complete due to advances in technology.[241] The AV START Act's rulemaking, meanwhile, is limited to only correcting and conforming references in existing FMVSS related to human drivers and thus is faster with a lighter touch than the SELF DRIVE Act's approach.[242] The downside, however, is that the AV START Act does not result in the public safety assurances that rulemaking of a broader scope might create.[243]

Third, both bills modify the exemption process and raise the number of vehicles that a manufacturer may petition for an exemption.[244] By raising the cap on exempted vehicles from the current ceiling of 2,500, the SELF DRIVE Act and AV START Act allow for the proliferation of tens of thousands more exempted vehicles on the roadways than current law.[245] This has the potential to greatly increase the rate of automated vehicle testing.[246] Conversely, merely exempting more vehicles from FMVSS that stand in the way of certain automated vehicle designs does not guarantee, without new standards, that the exempted automated vehicles can safely navigate the roadways.[247] Both bills, however, preserve the requirement that either a new safety feature must be at least as safe as the applicable FMVSS or the overall vehicle must have a safety level equivalent to that of a non-exempt vehicle.[248] A manufacturer may have difficulty satisfying this requirement because it is not clear how NHTSA will measure an equivalent level of safety and what data NHTSA would require for such a finding.[249] Thus, although exemptions may serve as a helpful interim step for the testing and deployment of automated vehicles, they may not be successful in ensuring public safety.[250]

Fourth, both bills require automated vehicle developers to submit information to NHTSA, similar to the information NHTSA requested in the Volun-

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[240] *See id.* (defining the scope of rulemaking).

[241] *See* Soodoo, *supra* note 57 (explaining that rulemaking ordinarily takes five years).

[242] *See* AV START Act § 4 (discussing the scope of rulemaking); SELF DRIVE Act § 4 (same).

[243] *See* AV START Act § 4 (noting that rulemaking is limited to references to human drivers in FMVSS).

[244] AV START Act § 6; SELF DRIVE Act § 6.

[245] *See* AV START Act § 6 (increasing the number of exemptions); SELF DRIVE Act § 6 (same).

[246] *See* AV START Act § 6 (raising the cap on exemptions); SELF DRIVE Act § 6 (same).

[247] *See* FRAADE-BLANAR & KALRA, *supra* note 198, at 4 (noting that current FMVSS were not written for automated vehicles).

[248] *See* AV START Act § 6 (discussing exemptions); SELF DRIVE Act § 6 (listing requirements for an exemption). The AV START Act preserves the current requirements for an exemption. AV START Act § 6; *see also* 49 U.S.C. § 30113 (2012) (listing current requirements for an exemption).

[249] *See* FRAADE-BLANAR & KALRA, *supra* note 198, at 4 (discussing the difficulties in judging equivalent safety).

[250] *See* UNDERSTANDING NHTSA'S REGULATORY TOOLS, *supra* note 50, at 3 (noting the limited scope of exemptions).

tary Safety Self-Assessment.[251] The SELF DRIVE Act's safety assessment certification gives NHTSA latitude in conducting a rulemaking to determine what the submission should include.[252] The AV START Act takes a different approach by laying out the various subject areas that a safety evaluation report must address.[253] The AV START Act also includes provisions addressed at accountability, such as requiring a signature from a representative of the submitting entity and introducing civil penalties for false or misleading safety evaluation reports.[254] Nevertheless, both bills include language to the effect that NHTSA may not condition testing or deployment of automated vehicles on review of the submissions, which raises questions about how NHTSA can navigate situations where the agency feels it needs more information before it is satisfied with the safety level of a vehicle.[255]

Although both bills are aimed at the public safety objective, the AV START Act, with its requirement of a signature and civil penalty provisions, appears to require more accountability by entities submitting information.[256] If the public knows that entities face consequences for submitting false information, public confidence in the submission process may increase and reduce public demands for more stringent regulatory actions.[257] Conversely, these accountability provisions, coupled with mandatory reporting, may chill innovation and move testing off of public roadways or to other less regulated jurisdictions.[258]

E. An Alternative Method for Self-Certification: The FAA's Type Approval Process

Manufacturers of new motor vehicles in the United States must attest compliance with applicable FMVSS through self-certification.[259] An alterna-

[251] AV START Act § 9; SELF DRIVE Act § 4; *see* AV GUIDANCE 2.0, *supra* note 24, at 16 (discussing the contents of the Voluntary Safety Self-Assessment).

[252] *See* SELF DRIVE Act § 4 (discussing the scope of rulemaking for the safety assessment certification).

[253] *See* AV START Act § 9 (listing the subject areas that need to be addressed in a safety evaluation report); *see also supra* text accompanying note 117 (listing the subject areas).

[254] *See* AV START Act § 9 (discussing signature requirements and civil penalties).

[255] *See id.* (referring to NHTSA's review authority); SELF DRIVE Act § 4 (same).

[256] *See* AV START Act § 9 (including signature requirements and civil penalties); SELF DRIVE Act § 4 (lacking signature requirements and civil penalties).

[257] *See* Laing, *supra* note 221 (discussing the current Voluntary Safety Self-Assessment program and noting, "the paperwork already voluntarily submitted does little to reassure the driving public that vigorous testing is being done").

[258] *See id.* (quoting Deputy NHTSA Administrator Heidi King as saying "[k]eeping an open mind to technology that is still developing is why NHTSA has adopted a voluntary approach to safety disclosures" and "[w]e believe that a voluntary approach is appropriate at this point in the development of the emerging technology because a need to regulate hasn't been demonstrated").

[259] *See* 49 C.F.R. § 567.4 (discussing self-certification requirements).

tive to self-certification is a regulatory framework called type approval.[260] Type approval is a process under which a manufacturer of a product must get preapproval from a regulator before offering the product for sale.[261] Type approval, or "type certification," is used by the FAA in the United States to regulate new aircraft.[262]

Unlike self-certification, where NHTSA is not actively involved in the design, testing, and introduction of a motor vehicle, the FAA is actively involved in each phase throughout the type certification process.[263] As a result, the FAA and the applicant seeking type certification have a close working relationship throughout the process.[264] The FAA type certification process for aircraft is divided into five phases: conceptual design, requirements definition, compliance planning, implementation, and post-certification.[265]

The conceptual design phase begins when an applicant decides to seek type certification for an aircraft.[266] Thereafter, an applicant may receive pre-project guidance from the FAA on technical questions and hold a familiarization meeting to bring the agency up to speed on the design of the applicant's aircraft.[267] The conceptual design phase concludes with the applicant's submission of a certification plan.[268] Among the items the certification plan must address are: (1) the design of the aircraft, (2) a plan for compliance with applica-

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[260] *See* BILL CANIS & RICHARD K. LATTANZIO, CONG. RESEARCH SERV., R43399, U.S. AND EU MOTOR VEHICLE STANDARDS: ISSUES FOR TRANSATLANTIC TRADE NEGOTIATIONS 10 (2014), https://www.hsdl.org/?view&did=751039 [https://perma.cc/6RUY-LHG7] (noting Europe uses type approval for the regulation of motor vehicles).

[261] *See FAQ—Type Approval of Vehicles*, EUROPEAN COMM'N, http://ec.europa.eu/growth/sectors/automotive/technical-harmonisation/faq-auto_en [https://perma.cc/6WBD-6W4G] (detailing the type approval process for motor vehicles in Europe).

[262] *See* Type Certification, FAA Order No. 8110.4C 13 (Mar. 28, 2007), faa.gov/documentLibrary/media/Order/FAA_Order_8110_4C_Chg_6.pdf (describing the type certification process).

[263] *See id.* (discussing the scope of type certification).

[264] *See* AEROSPACE INDUS. ASS'N ET AL., THE FAA AND INDUSTRY GUIDE TO PRODUCT CERTIFICATION 13 (3d ed. 2017), https://www.faa.gov/aircraft/air_cert/design_approvals/media/cpi_guide.pdf [https://perma.cc/EN2J-68YZ] (charting the roles of the FAA and the applicant). In light of concerns arising from two crashes involving Boeing 737 MAX aircraft, discussed *infra* Part III, some "[l]awmakers have criticized the [FAA] for having a cozy a relationship with Boeing and handing over too much of the certification tasks to the manufacturer." Leslie Josephs, *FAA Plans New Safety Division as Post-Boeing Max Scrutiny Ramps Up*, CNBC (Dec. 11, 2019, 7:57 AM), https://www.cnbc.com/2019/12/11/faa-plans-new-safety-division-as-post-boeing-max-scrutiny-ramps-up.html [https://perma.cc/PWP3-CZAN].

[265] *See* AEROSPACE INDUS. ASS'N ET AL., *supra* note 264, at 12 (discussing the phases of certification).

[266] *See* Type Certification, *supra* note 262, at 20 (detailing the conceptual design phase). This phase may include a process orientation where the applicant meets with a representative from the Aircraft Certification Office to learn the procedures and requirements for type certification. *Id.*

[267] *See id.* (detailing the subtasks of the conceptual design phase). The subtasks are: process orientation, pre-project guidance, familiarization briefing, and certification plan. *Id.*

[268] *See id.* at 21 (discussing certification plans). All applicants must submit a certification plan and ensure the plan is up to date throughout the process. *Id.*

ble regulations and how compliance will be shown, (3) the documentation that will demonstrate compliance, (4) where the aircraft will operate and how it will be maintained, (5) whether exemptions from airworthiness standards are needed, and (6) if there are special conditions, such as novel or unusual design features.[269] In the requirements definition phase, the applicant submits an application for type certification.[270] The FAA creates a certification project plan to coordinate the schedule and resources needed from the agency.[271] When both the application for type certification and the certification project plan are complete, the applicant and the FAA jointly develop a project-specific certification plan to coordinate activities between the parties and establish timelines and goals.[272] This process is followed by the establishment of a certification basis where applicable airworthiness standards that the aircraft must meet are identified.[273]

In the compliance planning phase, the FAA certification team decides where to focus its attention.[274] If rulemaking, exemptions, or special conditions are needed for compliance, these are areas to which the FAA will be attentive.[275] Additionally, the FAA will focus on critical safety areas that require complex means of compliance.[276] At this time, the project-specific certification plan should be complete, indicating that the FAA is confident that effective implementation of the plan would result in compliance.[277]

The implementation phase puts the project-specific certification plan into action and consists of compliance data generation activities, compliance substantiation activities, and compliance finding activities.[278] Compliance data genera-

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[269] *See id.* at 21–22 (noting the essential components of a certification plan). A type certification plan for a complex project need not have all the information if the information is not yet known. *Id.* at 21.

[270] *See id.* at 22 (discussing the requirements definition phase). A project manager is selected to represent the Aircraft Certification Office and coordinates the selection of a certification team. *See id.* at 23–24 (detailing the role of a project manager).

[271] *See id.* at 29 (explaining the certification project plan). The certification project plan is "a living document . . . used [internally] to coordinate schedules, responsibilities, and personnel resources between the accountable directorate and project Aircraft Certification Office." *Id.* at 6.

[272] *See id.* at 30 (discussing the project-specific certification plan). "The [project specific certification plan] combines information from the applicant's certification plan and the FAA's [certification project plan] with additional project details to support an effective certification project. It is also the depository for milestones, performance measures, and information unique to the certification project." *Id.*

[273] *See id.* (discussing the certification basis). As a part of determining the certification basis, the inquiry may also explore whether different avenues for compliance are necessary, such as exemptions or special conditions. *Id.* at 31.

[274] *See id.* at 37 (detailing the compliance planning phase).

[275] *See id.* (explaining the FAA's role in the compliance planning phase).

[276] *See id.* (discussing the compliance planning phase). The FAA also takes the level of sophistication and experience of the applicant into consideration when determining where to focus its resources. *Id.* Likewise, the FAA will delegate compliance responsibilities to the applicant and establish oversight criteria in areas where it has trust and confidence in the applicant. *Id.*

[277] *See id.* at 39 (discussing the project-specific certification plan).

[278] *See id.* at 41 (detailing the implementation phase).

tion activities include conformity inspections to confirm that the prototype aircraft is manufactured in accordance with the design specifications and schematics.[279] Compliance substantiation activities involve the applicant submitting compliance and flight test data reports to demonstrate that the data show the aircraft is compliant with applicable regulations.[280] Compliance finding activities comprise FAA review of the compliance data and test results, inspections to check conformity, and flight certification tests with FAA personnel to verify test data and ensure compliance.[281] This is followed by the creation and determination of maintenance requirements, instructions for continued airworthiness, flight testing to confirm function and reliability, and the development of the aircraft flight manual.[282] If these steps result in the FAA finding compliance, the aircraft is type certificated and an airworthiness certificate is issued.[283]

Post-certification activities include the preparation of a certification summary report and continued airworthiness activities to ensure that, over the aircraft's lifetime, the aircraft's level of safety does not degrade.[284] The FAA may also conduct a special certification review if an event or subsequent finding indicates a potential safety problem.[285]

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[279] *See id.* at 43 (discussing the implementation phase). This phase also includes a variety of other inspections and engineering tests, as well as the grant of an experimental airworthiness certificate and the performance of test flights. *See id.* at 44–46 (listing inspection requirements and discussing the process to obtain an experimental airworthiness certificate). Among other reasons, experimental airworthiness certificates are "issued to operate an aircraft that does not have a type certificate . . . and is in a condition for safe operation" in order to demonstrate compliance with applicable regulations. *Experimental Category,* FED. AVIATION ADMIN., https://www.faa.gov/aircraft/air_cert/airworthiness_certification/sp_awcert/experiment/ [https://perma.cc/D4W3-ENBV].

[280] *See* Type Certification, *supra* note 262, at 47–49 (discussing compliance substantiation activities).

[281] *See id.* at 50–52 (detailing compliance finding activities).

[282] *See id.* at 54–56 (discussing the final stages of the implementation phase).

[283] *See id.* at 56–57 (discussing the process for issuing type certification). The FAA issues two types of airworthiness certificates: a Standard Airworthiness Certificate and a Special Airworthiness Certificate. *Airworthiness Certification,* FED. AVIATION ADMIN., https://www.faa.gov/aircraft/air_cert/airworthiness_certification/aw_overview/ [https://perma.cc/EML9-MYVH]. A Standard Airworthiness Certificate, or FAA Form 8100-2, is issued for aircraft categorized as: normal, utility, acrobatic, commuter, transport, manned free balloons, and special classes. *Standard Airworthiness Certificate,* FED. AVIATION ADMIN., https://www.faa.gov/aircraft/air_cert/airworthiness_certification/std_awcert/ [https://perma.cc/8Z5R-Z3CQ]. A Special Airworthiness Certificate, or FAA Form 8130-7, is issued for aircraft that are used for restricted categories such as agriculture or surveying, experimental uses, or for aircraft that are primarily operated for pleasure seeking and personal use. *Special Airworthiness Certificate*, FED. AVIATION ADMIN., https://www.faa.gov/aircraft/air_cert/airworthiness_certification/sp_awcert/ [https://perma.cc/Q5YY-KUBG].

[284] *See* Type Certification, *supra* note 262, at 58 (discussing the post-certification phase).

[285] *See id.* at 59 (discussing the special certification review process). The special certification review "[t]horoughly explore[s] every significant aspect and ramification of the potential safety problem in question" and concludes with a "[c]onsider[ation of] the adequacy of the applicable regulations and policy material." *Id.*

III. TYPE APPROVAL: AN ALTERNATIVE WAY FORWARD FOR REGULATING AUTOMATED VEHICLES

This Part explores type approval as utilized by the FAA and analyzes whether its application as a tool to regulate automated vehicles would achieve an appropriate balance between maximizing innovation and ensuring public safety.[286] Notwithstanding recent events explored in more detail below, type approval presents an attractive alternative to the current model of self-certification for regulating automated vehicles.[287] In particular, the FAA type certification process represents a generally respected regulatory framework evidenced by the fact that, since 2009, U.S.-based airlines carried over seven billion passengers and incurred only one passenger fatality.[288]

Before discussing type approval as it relates to automated vehicles, it is instructive to detail the circumstances surrounding recent crashes overseas of Boeing 737 MAX aircraft that have called into question the effectiveness of the FAA's type certification process.[289] In October 2018, a Boeing 737 MAX 8 aircraft, operated by Lion Air, crashed shortly after takeoff in Indonesia, killing all 189 people on board.[290] In March 2019, a second Boeing 737 MAX 8, operated by Ethiopian Airlines, crashed shortly after takeoff from Addis Ababa and killed all 157 people on board.[291] Investigations into the similarities between the two crashes led investigators to conclude that a malfunction with an automated system, designed to force the nose of the aircraft down to prevent a stall, caused the crashes by putting the planes into "uncontrollable nose dives."[292] This brought immediate attention to the type certification process for

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[286] *See infra* notes 286–334 and accompanying text.

[287] *See* AV GUIDANCE 1.0, *supra* note 24, at 72 (analyzing different proposals to regulate automated vehicles).

[288] *See* Michael Laris, *'It Appeared That We Had Time': How the FAA Missed a Chance to Save Jennifer Riordan*, WASH. POST (Dec. 2, 2019, 7:58 PM), https://www.washingtonpost.com/local/trafficandcommuting/it-appeared-that-we-had-time-how-the-faa-missed-a-chance-to-save-jennifer-riordan/2019/12/02/671d48c2-ef81-11e9-89eb-ec56cd414732_story.html [https://perma.cc/4Q2N-9M8X] ("[O]ver the past decade U.S. airlines have carried 7 billion passengers around the country with just one fatality."); *Accidents Involving Passenger Fatalities: U. S. Airlines (Part 121) 1982 – Present*, NAT'L TRANS. SAFETY BD., https://www.ntsb.gov/investigations/data/Pages/paxfatal.aspx [https://perma.cc/THX3-GNS8] (noting a February 12, 2009, Colgan Air crash that resulted in passenger fatalities on a U.S. airline).

[289] David Schaper, *Safety Experts Slam Boeing and FAA for Design and Approval of 737 Max Jets*, NPR (Oct. 11, 2019, 8:35 PM), https://www.npr.org/2019/10/11/769609684/safety-experts-slam-boeing-and-faa-for-design-and-approval-of-737-max-jets [https://perma.cc/D2ZD-R3CQ].

[290] James Glanz et al., *After a Lion Air 737 Max Crashed in October, Questions About the Plane Arose*, N.Y. TIMES (Feb. 3, 2019), https://www.nytimes.com/2019/02/03/world/asia/lion-air-plane-crash-pilots.html [https://perma.cc/M4MF-CB7C].

[291] Hadra Ahmed et al., *Ethiopian Airlines Plane Is the 2nd Boeing Max 8 to Crash in Months*, N.Y. TIMES (Mar. 10, 2019), https://www.nytimes.com/2019/03/10/world/africa/ethiopian-airlines-plane-crash.html?action=click&module=Intentional&pgtype=Article [https://perma.cc/J32Q-QANQ].

[292] Schaper, *supra* note 289.

the 737 MAX and, in particular, the automated anti-stall system.[293] Reports indicate a series of missteps contributed to the crash, including: (1) a design flaw in the automated anti-stall system, (2) that the FAA delegated evaluation of the system's safety to Boeing, and (3) that pilots were not instructed on how to override the automated anti-stall system.[294] The FAA in particular is undergoing scrutiny of its resources, the competence of its personnel to certify exceedingly complex aircraft systems, its close relationships with manufacturers, and policies that permit the agency to delegate certification tasks to manufacturers.[295]

Criticisms of the FAA, however, do not necessitate the conclusion that the concept of type approval is flawed, but rather that the FAA failed to adequately conduct a robust and thorough type certification process for the Boeing 737 MAX.[296] Further, the fact that Boeing was delegated authority to certify the safety of its automated anti-stall system, and that this critical system failed so dramatically, actually buttresses the notion that self-certification for automated vehicle systems is not enough to guarantee public safety.[297] If anything, the

[293] *See id.* ("A new report from a group of international aviation safety experts sharply criticizes both Boeing and the Federal Aviation Administration for the way the 737 Max airplane was developed and certified to fly . . . . Investigators link both crashes to a new automated flight control system on the plane known as MCAS, which acted on faulty data from a single angle of attack sensor . . . .").

[294] *See* Dominic Gates, *Flawed Analysis, Failed Oversight: How Boeing, FAA Certified the Suspect 737 MAX Flight Control System*, SEATTLE TIMES (Mar. 17, 2019), https://www.seattletimes.com/business/boeing-aerospace/failed-certification-faa-missed-safety-issues-in-the-737-max-system-implicated-in-the-lion-air-crash/ [https://perma.cc/K3FN-MQNV] (discussing certification of the 737 MAX). One of Boeing's goals in designing the 737 MAX was to ensure that pilots of earlier generation 737 aircraft did not need to undergo retraining in order to fly the 737 MAX. *See* Glanz, *supra* note 290. Although the automated anti-stall feature was not installed on earlier iterations of the 737, the FAA agreed with Boeing that pilots of the 737 MAX did not need to be informed of the change. *Id.* European aviation authorities originally thought that the feature would require pilots to undergo retraining, but ended up siding with the FAA and Boeing. *Id.* In contrast, Brazilian aviation authorities required pilots to be retrained in order to be familiar with the feature. *Id.*

[295] *See* Schaper, *supra* note 289 (discussing criticisms of the FAA).

[296] *See id.* (noting that "Boeing told the FAA the [anti-stall] system existed in a broad framework, but the company did not fully explain what the [anti-stall] systems would do nor how forcefully it would push the nose of the plane down" and quoting a report on the FAA's actions that found "[t]he information and discussions about [the anti-stall system] were so fragmented and were delivered to disconnected groups" and that it "was difficult (for the FAA) to recognize the impacts and implications of this system").

[297] David Gelles & Natalie Kitroeff, *Boeing and F.A.A. Faulted in Damning Report on 737 Max Certification*, N.Y. TIMES (Oct. 11, 2019), https://www.nytimes.com/2019/10/11/business/boeing-737-max.html [https://perma.cc/6EVD-WBBV] (detailing the findings of a multi-agency task force in which the authors criticized the FAA's reliance "on Boeing employees to vouch for the safety of the [737] Max" and indicated they "believed that if F.A.A. technical staff had been fully aware of the details of [the anti-stall system], the agency would probably have required additional scrutiny of the system that might have identified its flaws"). In particular, the report on the FAA's shortcomings noted that automated systems are making the certification process more complex. *Id.* According to Christopher Hart, former chairman of the National Transportation Safety Board, "[a]s automation becomes more and more complex, pilots are less likely to fully understand it and more likely to have

Boeing 737 MAX crashes show that the FAA has to be more involved in the type certification process, not less.[298] As noted above, and except for the recent 737 MAX crashes, the type certification process has historically resulted in a high level of safety for aircraft that are very complex machines.[299] Moreover, type certification, if executed correctly, requires much of an applicant.[300] For example, one particularly technologically advanced aircraft, Boeing's 787 Dreamliner, took eight years to receive type certification from the FAA.[301]

Still, a lengthy process may risk creating a bureaucratic morass for entities seeking to develop automated vehicles that is no more efficient than rulemaking.[302] Moreover, self-certification has been the norm for the automotive industry in the United States for decades.[303] A switch to type approval would mark a departure from current regulatory norms and add another regulatory layer of complexity to the status quo for entities seeking to develop automated vehicles.[304] Additionally, because automated vehicles are an emerging technology that requires specialized knowledge and technical skills, NHTSA may not be able to marshal the resources or engineering expertise needed to support a type approval structure, which was a crucial flaw in the FAA's evaluation of the Boeing 737 MAX.[305] Indeed, NHTSA has rejected type approval as a means to regulate automated vehicles.[306]

Many U.S.-based automakers, however, already sell vehicles in Europe, where type approval for safety is the norm.[307] Furthermore, although self-

problems and more likely to encounter scenarios in real operations that they haven't seen even in a simulator." *Id.*

[298] *See id.* (reporting that, "[t]o address [certification process] shortcomings, [a report by multiple agencies and jurisdictions] recommends that the F.A.A. update the certification process to allow the agency to be more involved early on").

[299] *See supra* note 288 and accompanying text discussing safety statistics.

[300] *See supra* notes 260–285 and accompanying text discussing type certification.

[301] *See* Ghim-Lay Yeo, *787 Wins Certification from FAA and EASA*, FLIGHTGLOBAL (Aug. 26, 2011), https://www.flightglobal.com/news/articles/787-wins-certification-from-faa-and-easa-361346/ [https://perma.cc/7WUT-A55Z] (noting Boeing applied for type certification on March 28, 2003, and received type certification on August 26, 2011).

[302] *See* AV GUIDANCE 3.0, *supra* note 2, at 7 (noting NHTSA does not favor type approval).

[303] *See* 49 U.S.C. § 30115 (2012) (listing self-certification requirements).

[304] *See* AV GUIDANCE 3.0, *supra* note 2, at 7 (discussing why NHTSA does not favor type approval).

[305] *See* Ohnsman, *supra* note 192 (arguing NHTSA lacks the technical capability to properly analyze a Safety Assessment Letter); Schaper, *supra* note 289 (noting the FAA "lack[ed] sufficient personnel with the expertise needed to fully evaluate . . . complex systems").

[306] *See* AV GUIDANCE 3.0, *supra* note 2, at 7 (discussing NHTSA's stance on type approval). NHTSA noted that self-certification, as opposed to type approval, "more appropriately balances and promotes safety and innovation." *Id.*

[307] *See* CANIS & LATTANZIO, *supra* note 260, at 10 (noting Europe uses type approval for the regulation of motor vehicles as opposed to self-certification). The European Commission describes type approval in the EU as thus:

certification is used in the United States for motor vehicle safety, type approval is used to determine compliance with emissions regulations.[308] The U.S. Environmental Protection Agency (EPA) sets emissions standards and conducts testing of motor vehicles to ascertain compliance before they may be sold in the United States.[309] The EPA process resembles the type approval system in Europe for vehicle safety.[310] Accordingly, automakers based in the United States already have experience with type approval.[311]

Moreover, type approval need not supplant self-certification entirely.[312] For example, self-certification could be preserved for vehicle hardware not critical to the operation of the ADS, and type approval instituted for the ADS and ADS-critical hardware.[313] Under this framework, self-certification would

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> The manufacturer makes available about a dozen or more pre-production cars that are equal to the final product. These prototypes are used to test compliance with EU safety rules (installation of lights, braking performance, stability control, crash tests with dummies), noise and emissions limits as well as production requirements (of individual parts and components, such as seats or steering wheel airbags). If all relevant requirements are met, the national authority delivers an EU vehicle type approval to the manufacturer authorising the sale of the vehicle type in the EU. . . . Every vehicle produced is then accompanied by a certificate of conformity, which is like the car's birth certificate, in which the manufacturer certifies that the vehicle corresponds to the approved type. On the basis of this document, the vehicle can be registered anywhere in Europe.

FAQ - Type Approval of Vehicles, *supra* note 261.

[308] *See* CANIS & LATTANZIO, *supra* note 260, at 14 (discussing emissions compliance for motor vehicles in the United States).

[309] *See id.* (discussing the U.S. Environmental Protection Agency's (EPA) process for certifying vehicles). The EPA has a three-step compliance strategy for light duty vehicle emissions. *Id.* The emissions of the subject vehicle are measured prior to production, on the assembly line, and after final production to ensure the vehicle remains compliant for a number of years. *See id.* (listing steps for certification). Vehicles are tested in a laboratory on a dynamometer (basically, a treadmill for cars), according to normal driving behavior. *See id.* (discussing the EPA's testing procedures). EPA's testing procedures and its type approval process, however, are not foolproof. *See* Andrea Peterson & Brian Fung, *The Tech Behind How Volkswagen Tricked Emissions Tests*, WASH. POST (Sept. 22, 2015, 12:37 PM), https://www.washingtonpost.com/news/the-switch/wp/2015/09/22/the-tech-behind-how-volkswagen-tricked-emissions-tests/?utm_term=.9460a048a5cc [https://perma.cc/Z4D4-QWW4] (detailing how Volkswagen programmed its diesel powered vehicles to detect that they were operating on a dynamometer and undergoing testing in order to activate auxiliary emission control devices (also known as defeat devices) that allowed the vehicles to pass the emissions test).

[310] *See* CANIS & LATTANZIO, *supra* note 260, at 14 (discussing the U.S. emissions certification process as it compares to the self-certification process for safety).

[311] *See, e.g.*, Ford Motor Co., Annual Report (Form 10-K) (Feb. 8, 2018) (noting Ford does business in Europe).

[312] *See* AV GUIDANCE 1.0, *supra* note 24, at 74–75 (discussing a hybrid self-certification/type approval process).

[313] *See id.* at 74 (describing the contours of a hybrid self-certification/type approval process). For example, the Pipeline and Hazardous Materials Safety Administration (PHMSA) utilizes a hybrid self-certification/pre-market approval process. *Id.* PHMSA uses self-certification for the "classification, containment, and commercial transportation of hazardous materials" and uses pre-market approval to sanction "certain types of transportation of hazardous materials." *Id.*

be retained for all systems and components that are not essential to the operation of the ADS, such as seat belts and airbags.[314] Type approval, meanwhile, would be implemented for the software that acts as the brain of the ADS and the sensors, lasers, cameras and other hardware that the ADS uses to operate the vehicle.[315] Because software operating an ADS is extremely complex and critical to safety—similar to the automated anti-stall system in the Boeing 737 MAX—it is essential that it undergo at least some review by regulators to determine its capabilities.[316] Relying on representations by manufacturers of the vehicle's safety level—as evidenced by the FAA's reliance on Boeing's statements that its anti-stall system was safe—is not enough to guarantee public safety.[317]

Further, there are ways the FAA type certification process could be modified to better serve automated vehicle developers.[318] Although FAA type certification takes years, the process could be winnowed down by focusing exclusively on the implementation phase where the manufacturer shows compliance.[319] This would maximize innovation, to the extent possible, by involving the regulator at a later stage of design and after significant testing and proving occur.[320] Likewise, the standards developers need to meet in order to gain type approval could be less technical, more performance-based, and tailored to the specific operational design domain.[321] Consequently, NHTSA could focus on

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[314] *See id.* at 75 (positing the framework for a hybrid self-certification/type approval process).

[315] *See id.* (discussing the outlines of a hybrid self-certification/type approval process).

[316] *See* Gelles & Kitroeff, *supra* note 297 (positing that if regulators knew more about the automated anti-stall system in the Boeing 737 MAX, they may have been able to determine the system was flawed).

[317] *See id.* (noting "Boeing did not adequately explain to federal regulators how a crucial new [anti-stall] system on the plane worked" and that the FAA "relied heavily on Boeing employees to vouch for the safety of the [737] Max").

[318] *See* AV GUIDANCE 1.0, *supra* note 24, at 73 (noting differences between products regulated by the FAA and NHTSA). Differences identified are that the FAA only interacts with a small number of manufacturers and that the automotive industry produces vehicles "on a model-year basis [which] might create challenges . . . due to potential delays in the beginning of production of vehicle models caused by the length of the approval process." *Id.*

[319] *See* Type Certification, *supra* note 262, at 41 (detailing the implementation phase). In this scenario, NHTSA would focus on areas in the implementation phase for FAA type certification: compliance data generation activities, compliance substantiation activities, and compliance finding activities. *See id.* (noting the subtasks of the implementation phase). For example, during compliance data generation activities, NHTSA would determine whether the subject automated vehicle meets its design specifications. *See id.* at 43 (discussing compliance data generation activities). Compliance substantiation activities would involve NHTSA analyzing test data provided by the developer to determine compliance. *See id.* at 47–49 (detailing compliance substantiation activities). Finally, compliance finding activities would include on-road testing to evaluate performance and substantiate the test data. *See id.* at 50–52 (discussing compliance finding activities).

[320] *See* AV GUIDANCE 1.0, *supra* note 24, at 73 (arguing an FAA style type approval process would require a lengthy timeframe).

[321] *See* AV GUIDANCE 4.0, *supra* note 24, at 5 (discussing the need for regulations "that are as performance-based and non-prescriptive as possible and do not discriminate against American tech-

how the automated vehicle performs on the road in its operational design domain as opposed to on paper.[322] The result would be a type approval process that more resembles a driving test rather than an intrusive look into the design process.[323] If NHTSA is lacking in resources or expertise, specialized third-parties could be brought in to conduct the testing and evaluation on behalf of NHTSA, or certain tasks could be delegated to developers in a manner similar to the FAA's type certification process, as long as those tasks are not critical to overall safety.[324] Type approval also need not be adopted immediately and could be phased in to allow time for the technology to mature and for rulemaking on appropriate standards to be finalized.[325] Deadlines for type approval decisions contingent on the applicant satisfactorily providing all the necessary information could similarly be instituted to lessen the possibility of delays in approval.[326]

Finally, although type approval may interrupt innovation, it would have safety benefits.[327] The close relationship between the entity developing the automated vehicle and the regulator allows for more transparency and scrutiny, assuming the regulator is properly resourced.[328] Rather than relying on self-certification from the manufacturer, type approval allows the regulator to determine whether the automated vehicle is compliant with regulations before it operates on public roadways.[329] If the public knows that automated vehicles are not permitted on roadways without regulatory approval, type approval may

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nologies, products, or services"); AV GUIDANCE 3.0, *supra* note 2, at 7 (discussing performance-based standards in the context of new FMVSS for automated vehicles).

[322] *See* Type Certification, *supra* note 262, at 52 (discussing compliance finding activities and noting the FAA conducts flight tests to verify data submitted by the applicant).

[323] *See* AV GUIDANCE 3.0, *supra* note 2, at 7 (discussing test methods that could allow for more flexible validation of safety).

[324] *See* AV GUIDANCE 1.0, *supra* note 24, at 74 (noting NHTSA can use third parties as part of a hybrid self-certification/type approval process); Type Certification, *supra* note 262, at 37 (discussing when the FAA delegates compliance finding responsibility). In the wake of the crashes involving the Boeing 737 MAX, the practice of delegating regulatory authority to aircraft manufacturers during the type certification process is receiving criticism. *See* Thomas Kaplan, *After Boeing Crashes, Sharp Questions About Industry Regulating Itself*, N.Y. TIMES (Mar. 26, 2019), https://www.nytimes.com/2019/03/26/us/politics/boeing-faa.html [https://perma.cc/PHJ9-BFDU] (discussing the history and scope of the FAA's delegation authority and scrutiny of the practice). The FAA delegated the responsibility for the safety analysis of the automated anti-stall system involved in both 737 MAX crashes to Boeing. Gates, *supra* note 294.

[325] *See* AV GUIDANCE 1.0, *supra* note 24, at 73 (noting that objective standards take time to be developed).

[326] *See id.* (discussing delays that could arise with type approval).

[327] *See id.* at 72 (observing that type approval may increase safety).

[328] *See id.* (discussing the type approval process). Of course, it can be problematic if the regulator and manufacturer have too close a relationship, as evidenced by the certification process for the Boeing 737 MAX. *See* Schaper, *supra* note 289 (detailing the relationship between the FAA and Boeing).

[329] *See* AV GUIDANCE 1.0, *supra* note 24, at 72 (noting that type approval is used to manage risk and verify safety).

increase public confidence in the technology.[330] A robust type approval process could also prevent the kinds of accidents, such as the Uber crash in Arizona, that undermine public confidence and put the entire future of automated vehicles at risk of a public backlash.[331] Aside from serious mistakes made in the type certification of the Boeing 737 MAX, type approval presents the best path forward for automated vehicles because, unlike self-certification, it has the potential to provide public safety assurances while still allowing for innovation.[332] Unfortunately, however, instituting type approval for automated vehicles would require congressional action.[333] Although it appears unlikely Congress has the appetite to adopt type approval for automated vehicles in the near term, this could change if current regulatory tools and legislative proposals prove inadequate to ensure public safety in the long term.[334]

CONCLUSION

Automated vehicles are coming. The key questions for policymakers, regulators, designers, manufacturers, and the general public moving forward are whether current regulatory schemes designed for a different era can keep pace with the technology, and whether policymakers can augment or adapt those schemes to further innovation and keep the public safe. Type approval, if instituted in a deliberate, thoughtful, and coordinated way with input from policymakers, regulators, developers, and other stakeholders, is a better alternative than the current scheme to ensure that innovation in the automated vehicles space does not come at the expense of public safety.

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[330] *See* KALRA & GROVES, *supra* note 170, at 31 (discussing the effects of public opinion on the deployment of automated vehicles); AV GUIDANCE 1.0, *supra* note 24, at 72 (noting the prospect of increased public confidence in automated vehicles if the government approves the vehicle's safety aspects).

[331] AV GUIDANCE 1.0, *supra* note 24, at 72 (observing that a type approval process would prohibit the introduction of an automated vehicle until approved by NHTSA).

[332] *See id.* at 72–73 (discussing the benefits of type approval).

[333] *Id.* at 75.

[334] *See* AV START Act (preserving the self-certification system); SELF DRIVE Act (same); UNDERSTANDING NHTSA'S REGULATORY TOOLS, *supra* note 50, at 2 (discussing the regulatory tools available to NHTSA).