

MOBILITY INDUSTRY INSIGHTS

Researched and written by Michael L. Sena

June 2026 - Volume 01, Issue 07

In *Mobility Industry Insights* we will investigate and debate the issues that affect how people and goods are transported, how governments attempt to enable and restrict transport, how consumers decide which transport options they will use, and the methods being used to make mobility safer, more convenient, and more affordable for all. We will discuss and debate the issues, presenting multiple perspectives, and will solicit views from a variety of sources.



The ziggurat at Ur was built during the reign of King Ur-Nammu (2112–2095 B.C.).

Enabling Driverless Mobility to Work for Riders Requires the Right Laws for the Right Reasons

One group says we'll never have driverless vehicles on the roads unless governments agree on the rules for their operation. Another group says we'll never have driverless vehicles on the roads unless governments stop trying to regulate them and let consumers decide whether they fill a gap in transportation and producers decide how to build them. Haven't we learned the difference between enabling and regulating during the four thousand years since we began writing down laws?

ABRIDGEMENT

MAKING LAWS IS a complicated matter. What is their purpose; who has the right to make them; who shall enforce them; what are the consequences of not obeying them? The word 'law' comes from the Middle English *laue*, from Old English *lagu* meaning "ordinance, rule prescribed by authority, regulation; district governed by the same laws;" also sometimes "right, legal privilege," from Old Norse *lagu* "law," collective plural of lag "layer, measure, stroke," literally "something laid down, that which is fixed or set."¹

Before the first law was written down, which happened around 2100 B.C., rules for how social order within communities was maintained were passed on orally by leaders and elders. An example is Egyptian law which dates back to 3000 B.C. and is based on the concept of Ma'at. It established the ethical and moral principles for how Egyptians were expected to act "with honor and truth in matters that involve family, the community, the nation, the environment, and the gods". Its purpose was to avoid chaos. Egyptian kings were the "Lord of Ma'at", and it was they who prescribed what laws covered. The Code of Ur-Nammu is said to be the first written law code. Ur-Nammu was a Sumerian king who set a reed stylus to clay around 2100 BC and invented the concept of written justice. "Unlike previous rulers who governed through royal decree and personal whim, Ur-Nammu understood something profound: a kingdom built on predictable, written laws would be stronger than one built on the shifting sands of royal mood."²

Avoid chaos, shifting sands, and mood swings. Clear laws make for a strong nation. The U.S. has not wanted to go down the same path as the European Union, which has regulated itself into a technological corner, where decades of over-regulating the old continent's economy has left businesses there unable to compete with American—and now Chinese—firms.³ But the U.S. cannot decide if it is the country of Maynard Keynes, who advocated government intervention, or the country of Milton Friedman's monetarism, leaving things to the market, which will work things out in the long run. Maybe. Quoting Keynes, "In the long run, we're all dead."



¹ <https://www.etymonline.com/word/law>

² <https://history-uncovered.com/articles/ur-nammu-the-king-who-wrote-the-worlds-first-laws-on-clay>

³ Charlemagne: The road to economic serfdom. *The Economist* April 25th 2026.

Driverless vehicle law-making is missing the objective function and therefore the point

THE FIRST EVER National Automated Vehicle (AV) Safety Forum was held in Washington, DC on the 10th of March 2026. It was organized by the U.S. Department of Transportation (DOT) National Highway Traffic Safety Administration (NHTSA).⁴ The Forum was billed as “a public meeting to provide updates and insights into ongoing and upcoming vehicle automation activities”. Secretary of Transportation Sean P. Duffy used the Forum to announce that the Federal Government would reduce regulations for “autonomous vehicles” (bad habits die hard, and continuing to use the term ‘autonomous’ is a bad habit; at least the name of the forum used a better alternative, but ‘driverless’ is best). DOT’s reasons for doing this were first and foremost to win the driverless technology race against China, America’s principal competitor, and secondly, to help usher in a “golden age” of transportation. In Secretary Duffy’s view, this means safer transportation, not gilded street cars. DOT is primarily a regulator, he said, and if the regulations are too strict, innovation can be held back. If they are too lenient, safety can be compromised. So, DOT is doing its best to get the level of regulation “just right” – not too much and not too little – by staying between these two extremes and finding a good balance.

Note: DOT does not make the laws. That is up to Congress. DOT makes the rules for how the laws that Congress makes regarding all modes of transportation will be carried out. See sidebar.

Jonathan Morrison, Administrator of NHTSA, followed Duffy to the podium with a more detailed explanation of how the government is going to move forward on new regulations that are specifically intended to encourage driverless vehicle innovation. Importantly, he expanded on the advantages of driverless vehicles beyond national interests and safety, specifically stating that vehicles without human drivers will unlock benefits for those who are left behind because they cannot drive and do not have access to other transportation alternatives, in part by being more affordable. This is, of course, the main message that I, along with Alain L. Kornhauser, co-author with me of [The Real Case for Driverless Mobility](#),⁵ have been delivering for the past dozen or so years. It was good to finally hear this goal for driverless vehicles being stated by the government transportation authorities. Administrator Morrison said that three pillars would underpin NHTSA’s initiatives to encourage driverless vehicles:

- Prioritize safety of on-going driverless operations on public roads;
- Remove unnecessary regulatory barriers; and
- Move to commercial operations to allow the public to experience the safety benefits.

Laws versus Regulations
*“While the words ‘law’ and ‘regulation’ are often used interchangeably, they can refer to very different things. **Laws** are the products of written statutes, passed by either the U.S. Congress or state legislatures (Parliaments or other legislative bodies in other countries). The legislatures create bills that, when passed by a vote, become statutory law. **Regulations** are standards and rules adopted by administrative agencies that govern how laws will be enforced. Like laws, regulations are codified and published so that parties are on notice regarding what is and isn’t legal. And regulations often have the same force as laws, since, without them, regulatory agencies wouldn’t be able to enforce laws.”*

*Christopher Coble, Esq.
What’s the Difference Between
Laws and Regulations?
FindLaw (March 21, 2019)*

⁴ Agenda and links to the speakers and panels. (<https://www.nhtsa.gov/events/av-public-meeting-2026>)

⁵ Sena, Michael, Kornhauser, Alain. *The Real Case for Driverless Mobility*. Elsevier (January 2024).



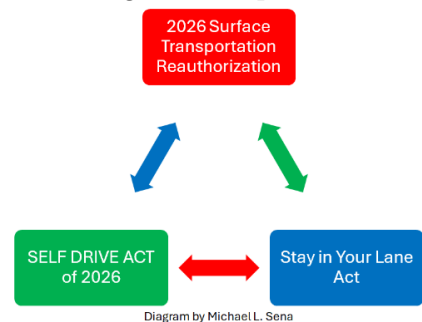
In spite of mentioning affordability, it is not among these three pillars. And in spite of saying that NHTSA would seek a balance with regulation, it still offers no way to measure **loss/cost** or **reward/utility**. In other words, there is still no objective function beyond a goal to increase safety, because NHTSA is in the highway traffic safety business, not the mobility support business.⁶ Hold this thought while we look at where we are right now.

Proof of the pudding is in the eating


At the present time, with regard to driverless vehicles in the U.S., there are no federal laws or regulations guiding or supporting them except one very important one: all vehicles must have driver controls unless the vehicles are for test purposes and are given an exception by NHTSA to operate up to 2500 vehicles. Driverless vehicle developers are using available state laws to operate commercially in a growing number of markets. Thirty-four states, led by California, have enacted their own legislation to allow or control driverless vehicles, and their laws are not compatible with each other. In the meantime, China drives forward. Waymo, the current leader in the competition to deliver driverless driving, boldly moves ahead with Chinese car maker Zeeker to scale up from its India-owned Jaguar vehicles. (Zeeker is a subsidiary of Chinese Geely, which also owns Volvo Cars.) In the absence of national leadership during the past ten years, driverless vehicle developers have moved fast to establish a reality which DOT and NHTSA are now (finally?) attempting to get under control.

So, how does the government see the way forward to snatch victory from the jaws of defeat? U.S. DOT and NHTSA currently have three ways to achieve their dual objectives of beating China in the technology race and realizing their dream of a golden age of transportation, and each of these ways requires that legislation passes muster in both houses of Congress. At present, there are two competing legislative proposals, one from the Democratic side of the aisle in the Senate, called **Stay in Your Lane Act**, and the other from the Republican side of the House of Representatives, called **SELF DRIVE Act of 2026**. The third way is through the modification of existing legislation when that legislation expires. The existing legislation is the **Infrastructure Investment and Jobs Act**, also known as the **Bipartisan Infrastructure Law (BIL) - H.R.3684**, which is a United States federal statute enacted by the 117th United States Congress and signed into law by

President Joe Biden on November 15, 2021. **H.R.3684** is set to expire on the 30th of September 2026. A proposal for a successor



⁶ <https://www.google.com/search?q=what+is+an+%22objective+function%22%3F&ie=UTF-8&oe=UTF-8&hl=sv-se&client=safari>



highway bill, called the **2026 Surface Transportation Reauthorization (STRA)**, is under development. If the Reauthorization is passed, the bill instructs DOT and NHTSA to finalize the rules for its implementation by the 30th of September 2027.

Let's look first at the two legislative proposals. Differing views on how much regulation would be enough is exemplified in the two competing proposals for U.S. legislation to amend Title 49, United States Code⁷ regarding "the authority of NHTSA over vehicles with automated driving systems (ADS) to provide safety measures for such vehicles, and for other purposes".⁸ In December 2025, Senators Edward Markey (D-Massachusetts) and Richard Blumenthal (D-Connecticut) introduced *S.3536 Stay in Your Lane Act*. In February 2026, Representative Robert E. Latta (R-Ohio) introduced *H.R.7390 SELF DRIVE Act of 2026*.


Each act's title signals the principal intention of the proposed legislation. The Senate proposal from the Democrats is short (slightly more than four pages) and simple. It states that each manufacturer of an automated driving system (It actually uses the term "Driving Automation System", but the authors will probably get it right in the final text of the proposed bill) shall ensure that the automated driving system does not operate outside of its operational design domain, and that it should operate "safely" inside its ODD. If passed, manufacturers of automated driving systems will have to define the ODDs for their systems, submit them to NHTSA, and make them available on a publicly accessible website maintained by the manufacturer. Operating "safely" within the ODD means that the operation of the system will present "no more than an inconsequential risk".

The House of Representatives' proposal is long (twenty-nine pages), just like its full title: *Safely Ensuring Lives Future Deployment and Research In Vehicle Evolution Act of 2026*. (How many beers did it take to come up with that acronym?) If you remove the last six pages of this proposed act, it reads like a summary of the WP.29 Proposal for a new United Nations Global Technical Regulation (GTR) of Automated Driving Systems (ADS).⁹ The last six pages must be what has triggered the preference for it by the system developers and their acolytes, in particular the clause **Federal Preemption for Automated Driving Systems and ADS-equipped Vehicles**. This states: "Except as provided in subparagraph (B), a State, or political subdivision of a State, may not maintain, enforce, prescribe, or continue in effect any law, rule, regulation, requirement, standard, or other provision having the force and effect of law of the State or political subdivision of the State that prohibits a manufacturer from selling or offering an ADS-equipped vehicle

⁷ The United States Code, formally The Code of Laws of the United States of America, is the official codification of the general and permanent federal statutes of the United States.

⁸ Title 49 of the United States Code is a positive law title of the United States Code with the heading "Transportation". It was enacted into law on October 17, 1978, and finalized on July 5, 1994.

⁹ See the March 2026 issue of [Mobility Industry Insights](#) - Merging Silos: Building and Testing Automated Driving Systems for Driverless Driving.



if the vehicle meets the requirements of H.R.7390, or requires manufacturers of ADS systems and ADS-equipped vehicles to report information to the State or subdivision of the State.”¹⁰

Getting the states out of the federal operational design domain


Removing any doubt that the federal government is responsible for defining the safe operation of vehicles on all roads in every state appears to be the main reason for H.R.7390. If one reads the proposed bill carefully, it is clear that it covers the purpose of the proposal by Senators Markey and Blumenthal, which is that an ADS should only work within a defined ODD. California is the state that has assumed the right to control ADS in ways that would be eliminated if H.R.7390 is passed. So, this proposed bill can be viewed as a once-and-for-all attempt by the federal government to stop California from establishing policies that other states might adopt and thereby establish a de facto national regulation, as it has done with vehicle emissions and health and safety warnings. As if to reinforce its determination to keep its exemption authority status over the federal government, California recently approved new regulations that strengthen its oversight and enforcement of what they continue to refer to as “autonomous vehicles” by extending their regulations to freight and transit vehicles.¹¹

California moved into the ADS regulation space in order to fill a vacuum left by many years of NHTSA’s total lack of action. With scores of California-based companies wanting to test their driverless systems there, especially Waymo, both its Division of Motor Vehicles and city governments established laws and regulations for how both federal and state laws should be met. DOT with NHTSA says it is now intending to shoulder the responsibility which Title 49 assigns to it, not to the states, so it is time for California to abrogate its own laws and regulations on the subject—and get back in its rightful lane.

Congress has been trying to pass the SELF DRIVE Act since 2017. It failed in 2017 and again in 2021. Why did it fail? Ideological differences between the parties is only part of the reason. Anti-car, transit-and-train-only advocates have had no interest in cooperating with any group on a transportation alternative that would take money and bandwidth from their causes. However, now the Republicans feel that the third time is the charm, and until the votes are counted in November, the party has majorities in both Houses of Congress. The bill’s addition of a specific Federal Motor Vehicle Safety Standard (FMVSS) for Automated Driving System-equipped vehicles includes a requirement for “safety cases” which demonstrate that a manufacturer’s ADS meets safety requirements. This has been borrowed from the Federal Aviation

¹⁰ Subparagraph (B) says that a state can make a law that is identical with H.R. 7390.

¹¹ April 28, 2026 – “New autonomous vehicle (AV) regulations were approved today covering both light-duty and heavy-duty vehicles. The regulations comprehensively update the department’s AV rules, enhancing safety requirements, oversight and enforcement, while opening the California market for testing and deployment of larger AVs in freight and transit.”



Administration's certification process.¹² As the referenced Upstream article explains, when the Federal Aviation Administration (which, like NHTSA, is part of the Department of Transportation) evaluates aircraft systems, it studies the documentation supplied by a manufacturer that describes how the aircraft's automated systems behave under various conditions. However, there are major differences between the highly regulated and controlled airspace in which aircraft operate and the complex and unpredictable environments in which motorized road vehicles operate, where they share the roads with human drivers, pedestrians, cyclists, and all manner of non-humans. Aviation also has a very robust and integrated cybersecurity framework with DO-326A and DO-356A standards built into the certification process. There is a cybersecurity management standard, UNR 155, developed by WP.29, but NHTSA has not yet adopted it.

Putting the money on the third way – Reauthorization of BIL

Simple is not always better, and the **Stay in Your Lane** proposal has some bones but no meat. It is unlikely to go anywhere. While the time may be right for a full-fledged, single national legislative foundation for automated driving systems, the **SELF DRIVE Act** is going to have difficulty putting enough votes together to see it through both houses of Congress. Transit-heads have not changed their colors, and they exist in both parties. Also, the insurance industry is lining up support to oppose it. Insurance operates at the state not the national level in the U.S., and the industry appears to be uncertain that the federal government would share data with insurance companies in the same way as states are doing. The states that have established their own guidelines are not going to lay down their weapons without a fight, and their representatives in Congress represent them, not federal agencies. Where the automobile companies stand on the issue is definitely not clear. Honda has come out as a supporter of the **SELF DRIVE Act**, but there is no groundswell among the other companies.

Can the **Bipartisan Infrastructure Law (BIL) - H.R.3684** reauthorization offer a better path to getting something rather than nothing? SELF DRIVE could easily be incorporated into the Reauthorization. However, because the Biden BIL was 'bipartisan', it was a compromise. Then the new administration came in and began paring it back because it violated new executive orders against 'sustainability' and 'diversity, equity, inclusion, and accessibility' clauses in government contracts. Fixing the bill's problems and adding the SELF DRIVE Act content at the same time may be one gulp too far to swallow. It seems that no one believes Congress will pass a Reauthorization bill in September 2026. It is more likely Congress will provide enough funding to keep it going for a year or so while parties negotiate on what it should and should not include.

¹² Tisdale, Jennifer. The SELF DRIVE Act Returns: Why Congress Is Taking Another Shot at AV Regulation. Upstream (March 1, 2026).



On the 18th of May, the House of Representatives Committee on Transportation and Infrastructure released a proposal for bipartisan legislation titled the **BUILD America 250 Act**, with the long title **Building Unrivaled Infrastructure and Long-term Development for America’s 250th Act** (more beers).¹³ It is related to the eventual 2026 Surface Transportation Reauthorization Act, but it is not the Reauthorization. The BUILD 250 Act concentrates on investments in roads, bridges, transit, and rail, while the 2026 STRA is intended to renew federal funding for surface transportation programs in general. In the BUILD 250 proposal, under Title V – Motor Carriers, Subtitle E – Safe Integration of Autonomous Commercial Motor Vehicles (“autonomous again!), there is a highly condensed version of the SELF DRIVE Act. However, it is only for commercial vehicles. Nevertheless, it shows how the SELF DRIVE Act might be incorporated into the Reauthorization act and include both commercial and private automobiles.

This is definitely not the time for more cooks in the kitchen

I believe we could gather together a quorum of individuals actively working with all aspects of driverless vehicles to agree that we do not need more states creating laws and regulations that try to do more to preempt the authority of the federal government as defined in Title 49. And yet, they keep coming. The latest is proposed legislation (S-1677) by New Jersey State Senators Andrew Zwicker and Gordon Johnson to establish a three-year “pilot program” for testing automated driving systems in the state. It would be run by a nine-member task force led by the NJ Motor Vehicle Commission. During the three-year period, according to the proposed legislation, Section d, there can be no vehicles performing the full dynamic driving task. It states:

- d. *An autonomous vehicle tester shall not operate a fully autonomous vehicle in the State unless:*
 - (1) *the operator is:*
 - (a) *seated in the driver's seat of the fully autonomous vehicle;*
 - (b) *monitoring the operation of the fully autonomous vehicle;*
 - (c) *capable of taking immediate manual control of the fully autonomous vehicle;*
 - (d) *an employee, independent contractor, or other person designated and trained by the autonomous vehicle tester concerning the capabilities and limitations of the fully autonomous vehicle;*


In March, Minnesota stopped a similar bill as the one proposed in New Jersey when a proposal bill did not make it out of committee. Rep. Bjorn Olson, R-Fairmont, said, “...the bill’s conditions would prevent autonomous vehicles from ever coming to Minnesota, explaining the task force, study and further regulations would deter companies from wanting to set up in Minnesota,”

What’s the point of this? California, Nevada, Texas, Georgia, Mississippi among other states, allow vehicles to perform the dynamic driving task with no one sitting in the driver’s seat. What does New Jersey believe it will learn by testing driverless driving with a backup driver sitting in the driver’s seat? One thing it will not accomplish is to get Waymo to test there.

Is Rome burning while Congress fiddles?

Are we really in a hurry to put federal, state-spanning legislation in place for driverless vehicles? Is chaos reigning, and, if so, is it

¹³ https://transportation.house.gov/uploadedfiles/build_america_250_act_bill_text.pdf



really that bad? Waymo is charging punters for rides while it logs the results of its driverless driving operations. Waymo is far from a going concern, but it's getting paid to conduct tests. It moves from state to state, meticulously mapping its ODD, and then sticking to the area it has mapped. Waymo says it already meets the requirements of the **Stay in Your Lane Act**, and even though all of the papers claiming it is light years better than mere humans are written by Waymo employees, there are surely grains of truth in them.¹⁴ Others, like Tesla, are getting into the act. Tesla has not yet pulled the driver in its Texas tests, but it has set a date for when it will do so: early 2027. If the main objective of legislation is for DOT and NHTSA to reassert Constitutional federal rights and remove the states from assuming power it has no right to assume, then why not just concentrate on that and leave the rest as it is? There are laws that have to be followed by low volume vehicle manufacturers (SVMs) testing or even selling fewer than 2500 vehicles annually, and it is NHTSA that is responsible for overseeing the permits for them. There is no need to increase the number of driverless vehicles to a number over the current 2500 limit, especially not up to 90,000 as suggested in the SELF DRIVE Act.

How did the airline industry move from driving by the seat of the pilot's pants to driving by wire? According to a 2023 Deloitte Insights report, it was not just safety that was the impetus. "The airline industry transitioned from traditional pilot-driven operations to aviation systems that rely on technology and automation in order to: 1) increase the capacity of their planes; 2) reduce operational costs; and 3) and meet enhanced safety standards."¹⁵ It was not just safety, and if it had been just safety, today's airline industry would not be ferrying college kids from one weekend party to another in the world capitals, or selling weekend shopping packages to New York or Dubai from places all around the world. Without reasons 1 and 2, the likelihood that the airlines would have made the investments necessary to fully automate their aircraft is zero, and if they were forced to do so, we would probably be taking trains, buses, and ships instead of flying, and there would be no Ryanairs.

What changed when flying was automated were the certification requirements used by the airline manufacturers to test their systems. Pre-fly-by-wire (FBW) standards were developed for mechanical and hydraulic systems. These had to be supplemented with requirements for electronic system reliability, cybersecurity, and software validation. In a similar way, the FMVSS in the U.S. and Type Approval in the EU and other countries will need to be supplemented. There were no certification requirements for increasing capacity or reducing operational costs, just like there will not be any such requirements in the FMVSS or Type Approval processes. The planes had to be able to take off, stay in the air, and land. If the FBW systems didn't work, or if faults were detected

¹⁴ https://www.michaellsena.com/wp-content/uploads/2023/12/The-Dispatcher_January_2024_Lead.pdf

¹⁵ Technology Trends in the Airline Industry. 2023 Airline Trends. Deloitte Insights. (2023)

once they were implemented, the planes were recalled, just like cars are recalled.

Calls for improved safety on the highways are disingenuous

Claiming that all those 40,000 people who die each year on U.S. roads will be saved if only Congress passes legislation that properly regulates driverless vehicles is simply a red herring. I was sent a copy of such an article recently. I filed it with all of the others that say that a robot will not commit what they claim is the main cause of those deaths: human error. According to reports from both the National Traffic Safety Institute and NHTSA, 67-75% of deaths in traffic are caused by deliberate stupidity on the part of drivers. ('Deliberate Stupidity' is my term.) Speeding (29%), driving under the influence of alcohol and drugs (30-32%), and texting while driving (8-14%) are not human error; they are stupidity. There is a big difference. Even if we combine some of the causes (e.g. drunk drivers speeding and texting at the same time), we are well over half of accident causes. Then add one of the more effective ways to avoid death by vehicle accident, buckling up one's seatbelt. Half of all passengers of motor vehicles who die in car crashes were not wearing their seat belt. **I am not making this up.**¹⁶ We can cut deaths by more than half—if only we could write proper regulations for laws that are currently on the books AND make sure those regulations are enforced by ensuring that the enforcing parties are adequately funded.

A carnumdrum we can't get our heads around


For the same reason legislative bodies have problems keeping drunks out of cars, making sure cars are not driven over the speed limits, making sure people don't text while they are driving, and making it impossible to drive their cars unless their seat belts are fastened—problems that could be fixed with technology that is a whole lot simpler than replacing the human driver with a robot—those legislative bodies will have difficulty making the laws that can be used by regulating entities, like NHTSA, to achieve their objectives by turning over the driving task to robots. That difficulty will continue as long as safety is the only objective function being used to justify pushing out humans and adding a pile of technology to replace him or her.

It was much easier for commercial aircraft automation.

The safety-related purposes and justifications for using automation in aircraft were improving operational safety by reducing pilot workload, minimizing the risk of human error, enhancing decision-making in emergency situations, helping ensure consistent operational parameters, reducing fatigue-induced errors in judgment, and enhancing aircraft performance in difficult weather conditions.¹⁷ Automation began to be introduced in aircraft in the 1960s, with FBW systems introduced commercially in 1988. Fatal

¹⁶ <https://www.nhtsa.gov/press-releases/click-it-ticket-seat-belts>

¹⁷ https://www.bing.com/search?pglt=161&q=what+was+the+justification+of+using+automation+in+aircraft&cvid=4c12efe881374bef9715925722b3497a&gs_lcrp=EgRIZGdlKgYIABBFgDkyBggAEEUYOTIHCAEQ6wcYQNIB-CTEyMDA4ajBqN6gCALACAA&FORM=ANNTA1&PC=LCTS&source=chrome.ob



airline accidents per million commercial miles fell from 6.6 to 2.8 between 1970 and 1983, rose to 3.9 in 1988, and have fallen since then to 0.5. How much of this decline is due to automation of the flying task and how much is due to better fail-safe engineering of the aircraft, improvements in air traffic control, better design of airports, increased rigor in aircraft maintenance? I'm certain the information is there for someone who has the time to dig it out. My guess is that the reduction in deaths, the safety-related component of the total objective function for all commercial aircraft interventions, is a result of all of these improvements.

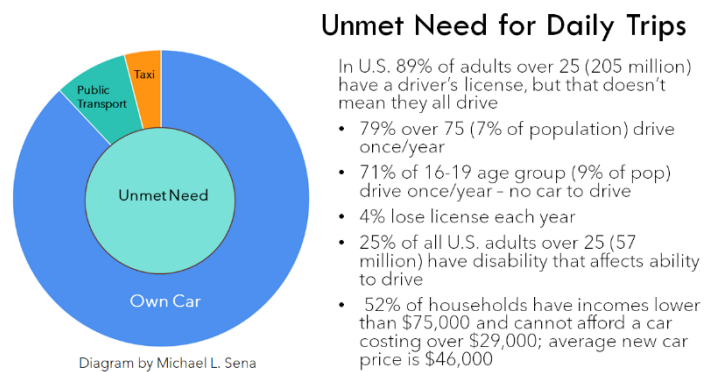
Automobile manufacturers have been attacking safety — and winning the battle — for half a century. Seat belts, air bags, and crumple zones did the heavy lifting beginning in the '70s; advanced driver assistance systems with steering angle sensors, automatic cruise control, emergency braking assist, night vision, lane change assist, along with the international standards that provide the requirements and testing methods, continued to do the job of reducing deaths even while the number of miles driven increased. Perhaps, if Waymo allowed independent tests with its data, which would mean there would be less bias in the results, it is possible that there could be a more reliable safety component for measuring the true safety benefits of driverless automation compared to a vehicle with a sober, attentive, and responsible human driver. Perhaps, if we wait for the standardization of requirements by WP.29 to be completed (see footnote 9), there would be the means for proving the safety case. Right now, rather than chaos it feels like there is a sense of hysteria among politicians and self-proclaimed traffic safety pundits who want to look like they are doing something even though they are not sure of what to do or why they are doing it.

Note: In 2014, the Society of Automotive Engineers (SAE) prepared the first of what they termed a 'taxonomy' for levels of driving automation. SAE has updated it on a regular basis. It is not a standard. It is a categorization of increasing levels of mechanical and computer control of the dynamic driving tasks which both enhance and replace the active engagement of a driver. By definition, the 'driver' is human. A fully automated vehicle is one in which the dynamic driving task is performed by the vehicle's automated driving system (ADS) without the intervention of a driver. Moving down through the levels, a driver must take over when the vehicle's ADS reaches its limits. At the lowest level, there is no ADS performing any functions. One of the major problems with what is written by individuals who are not familiar with the automotive industry is their confusion between advanced driver assistance systems (ADAS) and ADS. ADAS are technologies which are incorporated into vehicles to assist drivers in the driving task, in some cases taking over when a task that should have been performed by the driver was not performed. Automatic Braking Systems are such an ADAS. ADAS technologies, including sensors of all types, are the foundation for Automated Driving Systems. But to claim, as many journalists do, that most accidents with ADS vehicles in which the full Dynamic Driving Task is being performed by the ADS are caused by failures of the ADAS, and reference Tesla's Full Self-Driving (Supervised) as the principle example, exhibit a complete

misunderstanding of how these systems and ADS-equipped vehicles work. An accident with a Tesla in FSD (Supervised) mode is not caused by an ADAS, unless the ADAS actually fails. It is caused by: 1) the driver not supervising and taking control when the ADS fails; and 2) the implementation of FSD (Supervised) by Tesla not being sufficiently robust to re-engage the driver who removed himself/herself voluntarily from the driving task and placed himself/herself in the supervising position. There are standards developed by WP.29 for doing this, but they are not part of FMVSS, and Tesla has not voluntarily implemented them. To put it in simple terms, FSD (Supervised) is an SAE Level 4+ system (high driving automation that operates anywhere) without the guardrails necessary for operating at that level. The FSD (Supervised)-equipped vehicle requires that there is a driver in the driver's seat, and that driver keeps his or her eyes on the road. If it detects that the driver's attention has wandered for more than three seconds, it warns the driver. After the third warning, FSD is turned off. But, and this is a big but, the Tesla FSD does not have the methods to re-engage the driver when it is performing the full dynamic driving task and it decides it cannot continue. That is why it tells its drivers that they are always supposed to be supervising.

Where laws and regulations should be focused

There are other compelling reasons than safety for fully automating the driving task, just as there were other compelling non-safety reasons for automating the plane piloting task. As with the airline industry, one reason to automate vehicles that carry people is to increase the capacity of the ride delivery vehicles by changing how rides are delivered. Capacity increase is necessary to give rides to people who need them because they cannot afford to own or drive a car, are not physically or mentally able to drive, or have had their right to drive a car revoked, and whose mobility needs are not met by other alternatives, such as public transport. The individuals whose needs are not being met are latent demand waiting for a suitable mobility solution. Their number is much larger than politicians of any color or stripes are willing to acknowledge, as shown in my diagram below.¹⁸



The other compelling reason for driverless vehicles is to reduce operational costs of delivering those rides. Shared ride-delivering vehicles without the cost of the driver accomplishes both. A bus ride in New York City costs the rider, on average, \$2.90. The cost of

¹⁸ Sena and Kornhauser. The Real Case for Driverless Mobility. (pp. 209-210)



Objective Function

"An objective function is a mathematical formula that defines the goal of an optimization problem. It measures how "good" a solution is by returning a single numerical value that either needs to be maximized (such as profit or model accuracy) or minimized (such as cost or prediction error).

Core Concepts

Goal: Represents what the model or algorithm is trying to achieve (maximize or minimize).

Variables: The parameters or decisions you can adjust to change the outcome.

Constraints: Real-world limitations or boundary rules (e.g., budget, time, or physical limits).

Types of Objectives

- *Functions/Loss / Cost Functions: Used when you want to minimize error or distance. Examples include Mean Squared Error (MSE) in machine learning.*
- *Reward / Utility Functions: Used when you want to maximize a positive outcome. Examples include maximizing revenue or production output."*
DataCamp (<https://www.data-camp.com/tutorial/objective-function>)

delivering that ride is four times what the transit authority receives in the farebox.¹⁹ Taxes and subsidies make up the difference. Payroll expenses are 60% of the total NYC Transit budget of \$19 billion, and drivers take 66% of that, which is \$7.8 billion. So, what the rider pays for a ride covers one-half of what it costs to employ the driver. The other half of the budget is used to keep the buses and subways running. New York City has one of the most extensive public transit systems in the U.S., but it still cannot meet the travel needs of all of the city's residents. Only 45% of households owned a car in 2020, but between 1970 and 2020, the number of vehicle-owning households with two or more cars increased from 191,000 to 433,000, and the total number of vehicles owned by residents increased from 1.42 million to 2.06 million. One very telling statistic is that the average income of non-car owners in New York City is one-half that of car owners, \$45,000 versus \$90,000.²⁰

Move outside of New York City to any other city or region in the country and the numbers who are served by transit are fewer, the costs for delivering transit rides are higher, and the need to own a car in order to get to where one needs to go are greater. This is where driverless technology should initially be focused because the benefits are the greatest and they are measurable. But, so far, no one is measuring. Unfortunately, unlike the aircraft industry in which the plane builders followed the lead of the companies that bought their planes in order to make a business out of giving people rides in them, the business model for cars is based on putting individual drivers in the driver seats.²¹ Automation of the airplanes allowed the planes to be flown by two flightdeck crew, rather than three-to-five that had been required up to the 1980s. It is headed toward zero flightdeck crew with full automation. Loading up cars with the technology needed to put the driver into the passenger seat adds thousands of any currency you want to count in while requiring a totally new mindset for the eventual consumer who purchases the vehicles. The answer to this carnumdrum is not to give up the car market in favor of the commercial vehicle market, as Aurora has done. That has its own life. The answer is to expand the objective function so that all the benefits are on the table, and so that any legislation that is passed is doing a job that needs to get done.

The objective function for automated driving systems

An objective function is a mathematical formula that defines the goal of an optimization problem. It measures how "good" a solution is by returning a single numerical value that either needs to be maximized (such as profit or model accuracy) or minimized (such as cost or prediction error). So far, all efforts to justify driverless vehicles have been attempting to solve for a single variable, which is the number of crashes compared to the number of miles driven.

¹⁹ <https://www.mta.info/budget#p346796>

²⁰ <https://www.hunterurban.org/wp-content/uploads/2024/06/Car-Light-NYC-Infographics-May-2024.pdf>

²¹ Fleet sales to corporations, rental car companies, utilities, and government agencies provide automakers with ways to sell large volumes of their inventories.



U.S. Department of Transportation

Mission:

- Advance safety
- Move people and goods
- Build big and beautiful infrastructure

Vision: Usher in a Golden Age of transportation for the United States.*

Agencies

- *Advanced Research Projects Agency-Infrastructure (ARPA-I)*
- *Federal Aviation Administration (FAA)*
- *Federal Highway Administration (FHWA)*
- *Federal Motor Carrier Safety Administration (FMCSA)*
- *Federal Railroad Administration (FRA)*
- *Federal Transit Administration (FTA)*
- *Great Lakes St. Lawrence Seaway Development Corporation (GLS)*
- *Maritime Administration (MARAD)*
- ***National Highway Traffic Safety Administration (NHTSA)***
- *Office of Inspector General (OIG)*
- *Office of the Secretary of Transportation (OST), which includes the agencies below, among others*
 - *John A. Volpe National Transportation Systems Center*
 - *Bureau of Transportation Statistics (BTS)*
- *Pipeline and Hazardous Materials Safety Administration (PHMSA)*

**The Department's Mission and Vision were updated by the new Secretary of Transportation, Sean P. Duffy, after he was appointed to his post by President Donald J. Trump. To be clear, DOT does not move people and goods, and it does not build infrastructure, big and beautiful or small and unassuming. It plans, regulates and funds states, municipalities and transit authorities to do those jobs.*

Waymo has been trying to convince anyone who will listen that its Waymo Driver is way mo' safe compared to a human driver, but it has defined the input to its safety function in a way that puts the total result in doubt.

An objective function for driverless ride delivery would combine the economic and social benefits of the reduction in the number of accidents, fatal or otherwise, with the total value of meeting the latent demand for rides that could be given with shared ride-delivering vehicles minus the costs of delivering those rides without the cost of the driver compared to what it would cost with a driver.

If NHTSA or any other government agency were in the mobility supporting business, they might have put this objective function together years ago and steered all driverless vehicle development toward meeting this need. But neither NHTSA nor any other government organization is in the mobility supporting business, and the organization that was in a business that needed driverless vehicles, namely the war supporting business managed by DARPA, got what they needed twenty years ago and haven't been heard from again.

NHTSA is in the transportation safety supporting business, not the mobility supporting business. There is no government department or agency within DOT or any other department that is in the mobility supporting business. Therefore, any laws that are passed that will require NHTSA or any other group within the Department of Transportation to create regulations to see that those laws are followed will have to focus on what NHTSA and those agencies do, not what they don't do. That is why the **Stay in Your Lane Act** and the **SELF DRIVE Act of 2026**, both still proposals, address only safety. That is also why they have trouble getting passed, because not enough congressmen and congresswomen believe driverless vehicles are really needed to enhance safety, and there are not enough businesses writing letters to their congresspeople telling them they should see to it that they get driverless vehicles on the roads.

If Congress wants to do something really useful, it should pass two laws, one making it obligatory for NHTSA to adopt WP.29 regulations in general, and driverless vehicle regulations in particular, and incorporate them in its FMVSS, and a second law that establishes a Mobility for All supporting administration, just like it passed a law on the 31st of December 1970 establishing NHTSA, a transportation safety supporting administration. The law should charge the new administration with defining the objective function for Mobility for All as its first order of business. Then, the new administration should do its job as the federal planning, regulatory, and funding agency to provide guidance and grants to State programs for making Mobility for All work. I, for one, am confident that the real case for driverless vehicles will be a critical part of enabling mobility to work for all riders.



About Michael L. Sena

Through my writing, speaking and client work, I have attempted to bring clarity to an often-opaque world of highly automated and connected vehicles. I have not just studied the technologies and analyzed the services. I have developed and implemented them and have worked to shape visions and followed through to delivering them. What drives me – why do what I do – is my desire to move the industry forward: to see accident statistics fall because of safety improvements related to advanced driver assistance systems; to see congestion on all roads reduced because of better traffic information and improved route selection; to see global emissions from transport eliminated because of designing the most fuel-efficient vehicles; and to see everyone who needs a ride get one.

I try to put vehicles into their context. It is not just roads; it is communities, large and small. Vehicles are tools, and people use these tools to make their lives and the lives of their family members easier, more enjoyable, and safer. Businesses and services use these tools to deliver what people need. Transport is intertwined with the environment in which it operates, and the two must be developed in concert.



Michael L. Sena

Editor

SUNDBYVÄGEN 38

SE-64551 STRÄNGNÄS

SWEDEN

PHONE: +46 733 961 341

E-MAIL: ml.sena@mlscab.se

www.michaellsena.com