

# MOBILITY INDUSTRY INSIGHTS

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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.

## ***Should governments do any more for robot-driven cars than they did for human-driven cars? If so, what?***

*Governments can err, Presidents do make mistakes, but the immortal Dante tells us that divine justice weighs the sins of the cold-blooded and the sins of the warm-hearted in different scales. Better the occasional faults of a Government that lives in a spirit of charity than the constant omission of a Government frozen in the ice of its own indifference.*

Franklin Delano Roosevelt<sup>1</sup>

*Still one more thing, fellow citizens, a wise and frugal Government, which shall restrain men from injuring one another, which shall leave them otherwise free to regulate their own pursuits of industry and improvement, and shall not take from the mouth of labor the bread it has earned. This is the sum of good government, and this is necessary to close the circle of our felicities.*

Thomas Jefferson

From Jefferson's first inauguration address 4 March 1801<sup>2</sup>

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### ABRIDGEMENT

JEFFERSON WANTED A rights-based government of limited proportions, lest it intrude on the freedoms of its citizens to "regulate their own pursuits". Roosevelt occupied the other end of the spectrum of opinion on the role of the central government, believing that it should take care of its citizens, and when in doubt, do more not less. If we spent the time, we could find similar quotes by politicians in every country on the Planet, even though in some countries (North Korea comes to mind) it might not be politic to voice them.

In the principal automotive market countries, China, United States, and Japan, and in the consolidated market of the European Union comprised of twenty-seven member countries and several associated non-member countries, including the UK, Norway, and Switzerland, there are significant efforts being made to develop robot-driven cars which can be operated without the active engagement of a human driver. Waymo, the main U.S. developer of driverless vehicle software and hardware, says it is doing it to make cars safer, and that is the U.S. government line as well. Japan says the country needs driverless cars because there will not be enough human drivers in the not-too-distant future. China's government and its companies want to be the world leader in everything, and driverless cars are no exception. Europe? "Reduce traffic congestion, emissions and traffic fatalities while enhancing accessibility," it says. Get those pesky, error-prone humans out of the picture and the future is rosy.

It does not seem to have occurred to anyone but the Japanese that there might be something they could do with the driving environment to help the process along. Read why.



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<sup>1</sup> The Four Freedoms, delivered 6 January 1941

<sup>2</sup> Thomas Jefferson (2011). "Jefferson on Freedom: Wisdom, Advice, and Hints on Freedom, Democracy, and the American Way", p.65, Skyhorse Publishing, Inc.

## Enable, champion, finance, co-develop

WHAT IS THE proper role of government in fostering social and technological developments in their countries? Herbert Hoover said, “The sole function of government is to bring about a condition of affairs favorable to the beneficial development of private enterprise.” This would suggest that he would do more than Jefferson but less than Roosevelt. Ronald Reagan said, “Government’s first duty is to protect the people, not run their lives.” He was never very clear about how far that protection should extend. Alexander Hamilton asked, “Why has government been instituted at all? Because the passions of man will not conform to the dictates of reason and justice without constraint.” Hamilton could have been a little less passionate himself; he would have lived longer if he hadn’t offended Aaron Burr, who challenged him to a duel and was a better shot. Ayn Rand summed up the libertarian view of government and its role in business thusly: “Government ‘help’ to business is just as disastrous as government persecution...the only way a government can be of service to national prosperity is by keeping its hands off.” And finally, Bertrand Russell, philosopher, logician, and perpetual peace activist, claimed, “There is no nonsense so errant that it cannot be made the creed of the vast majority by adequate governmental action.”

*“Government’s view of the economy could be summed up in a few short phrases: If it moves, tax it. If it keeps moving, regulate it. And if it stops moving, subsidize it.”*

Ronald Reagan

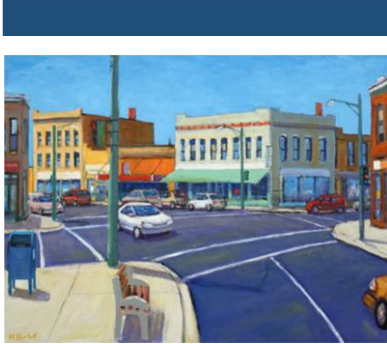
Remarks to state chairs of National White House Conference on Small Business, 15 August 1986

I wonder what Hoover would have said about competing with state-backed and state-owned private enterprise, Reagan about protecting people from artificial general intelligent agents, Hamilton about the passions of robots, and Rand about businesses, not just governments, keeping their hands out of people’s private lives. Russell had it right about pushing battery electric vehicles: if you make them free, people will flock to buy them.

Today, global technology competition among the five main economic and political blocks, the United States, China, the European Union, Japan, and India, has settled on the interrelated narratives of artificial intelligence and driverless mobility.<sup>3</sup> There are other narratives, such as quantum computing, next generation communications, genetic engineering, cybersecurity and ransomware prevention, data privacy, and supply chain resilience, which capture significant amounts of investment capital for research and development, as do future energy generation techniques, methods for reducing global warming, and systems for delivering lethal force. But AI, and especially artificial general intelligence (AGI), and driverless mobility have focused our minds because they have the potential to deliver barrier-shattering solutions to most of the other fields.

The five economic and political blocks have different approaches to ensuring that businesses in their countries and regions are not left behind in the competitive dust by the other countries and

<sup>3</sup> WorldData.info. The world’s largest economies by gross domestic product. <https://www.worlddata.info/largest-economies.php>



Remove the road markings, traffic signals, and the modern mailbox and replace the automobiles with horses and wagons, and this could be a scene from the middle of the 19th century. (Painting by Mark Horton, Groveland Gallery.)

regions. Each of these countries and regions is committed in varying degrees to both artificial intelligence and driverless mobility. What are they doing? What are the chances for their approaches to succeed. What could they be doing differently so that all the citizens of the world can share in the success and not just those citizens living in the winning country in a zero-sum game of winner takes all? I will try to shed some light on each of these questions.

#### *What did governments do for human-driven vehicles, actually?*

The motorized vehicle driving environments we have today are either adaptations of non-motorized driving environments or have been built for motorized transport during the past one hundred years. Most of the world's cities were built well before there were cars and trucks. Think about that for a moment. By the end of the 1920s, a sufficient quantity of motorized transport vehicles had been sold, and the number of owners and drivers of these vehicles was large enough to create the political and economic incentives necessary for both the public and private sectors to invest in a transport infrastructure suitable to the special requirements of motorized vehicles.<sup>4</sup> There were two types of driving environments, those in built-up areas in cities and towns, and those in the rural areas between towns. In the early days, it was in the cities and towns where most of the driving was taking place due to the simple facts that roads and the supporting infrastructure for automobiles were inadequate outside of the cities, and most people, except for the very wealthy and farmers, still lived relatively close to where they worked, worshiped, and conducted commerce, that is, in the cities and towns.

The driving environments inside the cities and towns were initially further developments of the rights-of-way used for horse-drawn vehicles and horse-borne riders. They were adapted as overlays on these older roads so the roads could be used by humans driving motorized vehicles that would interact 1) with humans driving other motorized vehicles and vehicles that were not motorized (e.g., horse-drawn vehicles and bicycles), and 2) with humans not in or on other vehicles, in particular, pedestrians walking in the immediate vicinity of roads. Roads started to be paved, traffic lanes and pedestrian crossing were demarcated with paint, stop signs, parking restriction signs, and eventually traffic signals were added. But there was not much difference between the streetscape during the time of horses and buggies and the same streetscape with cars, trucks, and buses, except for the absence of manure.

Humans were expected to control their vehicles in order to avoid collisions with other vehicles, pedestrians, and objects in the vicinity of the rights-of-way. How humans were expected to control their vehicles was codified in legal instruments related to road traffic beginning in 1909 with the *Convention with Respect to the*

<sup>4</sup> The American Automobile Association published its 1929 World Motor Census and stated that on 1 January 1929 there were exactly 31,929,952 cars and trucks in the world, most of which were in the United States. <https://trove.nla.gov.au/newspaper/article/275759935>



This is a photo of a street in the Roman city of Pompeii, built on a site of a settlement that had existed since the 8th century BC. It was in 79 AD that the city was buried in four-to-six meters of volcanic ash from the eruption of Mount Vesuvius. Did the term 'cross walks' evolve from the similar sounding 'cross rocks'?

*International Circulation of Motor Vehicles*.<sup>5</sup> This was followed in 1926 with the first *International Conventions on Motor Traffic and Road Traffic (Paris)*, and the *United Nations Geneva Convention on Road Traffic of 1949*.<sup>6</sup> Today, laws and regulations in most countries are either based directly on the *1968 Vienna Convention on Road Traffic and Road Signs and Signals*, or reference this *Convention* in their own laws. Eventually, beginning in the 1950s, large-scale demolition and reconstruction of cities, large and small, occurred to accommodate more modern buildings and higher density commercial centers, as well as to facilitate better access to selected parts of cities by introducing freeways and their interchanges.

In those places that were built after motorized vehicles became the principal method of transporting people and goods, the driving environments could have been designed using standards specifically created for optimizing both the driving task and the safe interaction between vehicles and pedestrians without having to adapt to existing rights-of-way and the street-sidewalk-building paradigm inherited from four-to-eight thousand years of human settlement construction. For example, on-street parking could have been prohibited, as it is in most of Tokyo. Barriers between roadways and sidewalks, like the ones used on underground platforms in Tokyo and other cities, could have been made mandatory, with designated drop-off locations and parking in these areas heavily policed. Only right turns could have been permitted because left-hand turns result in over 20% of all car accidents and one-quarter of all accidents involving pedestrians.<sup>7</sup> This is definitely possible. UPS drivers are given routes that include all right turns in order to avoid the dangerous turns into oncoming traffic.<sup>8</sup> Night driving could have been banned or severely restricted since 40% of fatal car accidents occur at night.

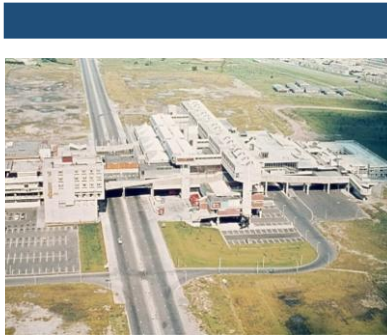
Unfortunately, few broke with the old model, and when they tried, they usually compromised pedestrian security and convenience, vehicular accessibility and safety, or both. The photo of **Pompeii** in the sidebar shows a street that has been uncovered from the volcanic ash. It was buried for almost two thousand years. It has all the features of a well-designed streetscape, and more. Sidewalks border a single-laned stone-paved street. The steppingstones allowed pedestrians to cross from one sidewalk to another without having to place their feet in the water rushing down the right-of-way from aqueduct water channeled into the streets to clean them from manure and urine from horses, mules, and oxen, and human waste thrown in (Pompeii did not have a 'modern' underground sewage system like Rome). The steppingstones were positioned to

<sup>5</sup> Convention with Respect to the International Circulation of Motor Vehicles, signed at Paris, October 11, 1909. The United States was not a signatory.

<sup>6</sup> UNECE, WP.1/GE.3/2022.7. Historical background of the Conventions related to road traffic and road traffic safety. (<https://unece.org/sites/default/files/2022-09/Presentation%205.pdf>)

<sup>7</sup> Crash Factors in Intersection-Related Crashes: an On-Scene Perspective. U.S. Department of Transportation. National Highway Transportation Safety Administration (NHTSA). September 2010.

<sup>8</sup> Why UPS drivers don't turn left and you probably shouldn't either. (<https://theconversation.com/why-ups-drivers-dont-turn-left-and-you-probably-shouldnt-either-71432>)



View of Cumbernauld, Scotland City Center. The city is about 20 kilometers northeast of Glasgow.

allow the lighter, two-wheeled carts called a *cisium* or *birota*, or a larger four-wheeled wagon called a *plaustrum* or *raeda*, to pass through the cross rocks. What we see in Pompeii is a view that can be seen in cities and towns in most parts of the world today, only Pompeii was better.<sup>9</sup>

Those who were thinking about how the built environment should adapt to motorized transport during the early part of the 20th century so that cars could move fast and people outside of cars could remain safe decided that there were two options. One was to put roads in the air, like they had put the railroad tracks for trains, and the other was to elevate people off the ground in what one of the most prominent built form designers, Le Corbusier, called ‘radiant cities’, in which the street would disappear and the “dwelling unit” would occupy a slot in a skyscraper, leaving the ground free. The former resulted in hideous intrusions in cities, like the West Side Highway in Manhattan along the Hudson River completed in the 1930s, and the latter led to entire centers of cities raised up above the plain, like the one in Cumbernauld, Scotland, built in the 1960s. Cumbernauld was officially designated as one of Britain’s New Towns in 1955. It served as a model for Thamesmead in London, made famous as the backdrop to the dystopian movie *Clockwork Orange*.

The driving environments we have today are far from perfect. According to the United Nation’s World Health Organization, approximately 1.2 million people die every year in road traffic crashes, and between twenty and fifty million people receive non-fatal injuries.<sup>10</sup> More than one-half of those who die in vehicular crashes are pedestrians, cyclists, and motorcyclists. Road traffic injuries are the leading cause of death for children and young adults aged 5-29 years. The majority of vehicle-related fatal accidents occur in those areas where the motorized driving environments were overlaid on the former horse-drawn driving environments:<sup>11</sup>

- Intersections
- Urban roads (59%)
- Residential roads within five miles from home
- Rural roads (41%)
- The fifth most dangerous is relatively : parking lots



A modern-day high-speed driving environment.

Over the past one hundred years, improvements have been made to driving environments that were built after motorized transport appeared in order to reduce risks of accidents. Medians have been added to opposing lanes of traffic and barriers or guardrails have been inserted in the medians; at-grade cross traffic has been eliminated and interchanges have been added to control access; pedestrians, bicycles, and slow-moving traffic have been prohibited on high-speed roadways; rumble strips have been installed in the road edge to alert drivers that they are drifting off the roadway;

<sup>9</sup> For a detailed discussion of the history and development of sidewalks, see the December 2022 and March 2023 issues of *The Dispatcher* (<https://www.michaellsena.com/the-dispatcher-newsletter-2/>).

<sup>10</sup> United Nations World Health Organization. (13 December 2023). Road traffic injuries.

<sup>11</sup> National Highway Traffic Safety Administration (NHTSA) Fatality Analysis and Reporting System (FARS). July 26, 2024.



*This is suggestion for how to reconfigure our urban streets by a company called Walker Consultants. It is a minefield for pedestrians sharing the side of the street with bikers. Is it really enjoyable dining in the middle of the street, even if all the cars have muzzles on their gas pipes? Are there only deliveries to the side of the street without a bus lane?*

breakaway sign posts have replaced rigid posts; guard rail ends have been angled away from the roadway and buried; exit lanes have been added to allow vehicles to slow down before the turnoff; and collapsible crash barriers have been added at bridge heads and bifurcations.

In combination with improved vehicle design safety, all of these expressway driving environment modifications have contributed to the significant reduction in traffic deaths in the United States between the peak in 1972, when there were approximately 55,000 traffic-related deaths, and 2014 when the number of deaths had been reduced to 35,000. Interstates and freeways that have been specifically designed to improve safety account for the lowest numbers of deaths (14%) compared to arterial roads, collector roads, and local roads in rural areas. For urban areas, interstates and freeways running through them account for almost double the number of deaths compared to those same roads in rural areas, mainly due to higher speeds and a higher level of congestion, but the death rate is still about one-third that of arterial roads.<sup>12</sup>

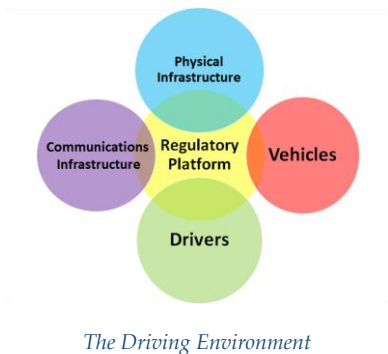
#### *Will it be 21<sup>st</sup> century vehicles on 18<sup>th</sup> century roads?*

Now, we are in the process of moving into the next phase of vehicular development with two types of vehicles, those with advanced driver assistance systems (ADAS) incorporated into human-driven vehicles, and those with automated driving systems in which there is no human driver present in the driving position (i.e., driverless vehicles, also called automated vehicles, or autonomous vehicles). It appears that those who should be thinking about how the driving environments could be changed are counting on the ADAS and driverless cars performing better than humans so that all of the dangerous situations will be handled by the vehicles' sensors and intelligent algorithms, and the elimination of human misbehavior in the form of drinking or taking drugs while driving, driving while fatigued, being distracted, speeding, running red lights and stop signs will take care of the majority of the other causes of accidents.

We are doing what was done one hundred years ago when motor power replaced horsepower, letting the drivers work out the best way to use what was already available, and then gradually making changes when new roads were built. In the case of the driverless vehicles, the 'drivers' are the algorithms controlling the driving task, and they should learn by doing, either in simulation mode in a virtual driving environment, or on a real road.

#### *It's the whole value chain, not just one link*

Vehicles in any form are one part of the picture, but not the whole picture. We need to look at the entire driving environment picture (see left) when we evaluate what governments are doing to enable, champion, finance, or co-develop robot-driven cars, not just the cars, and especially not just the AI component of the cars.



<sup>12</sup> NHTSA. Op. cit. and Insurance Institute for Highway Safety (IIHS). Fatality Facts 2022: Urban/rural comparison. June 2024.

Two of the top four home appliances companies are Chinese.

The top steel producer is Chinese, and it produces twice as much steel as the second largest producer.

Five of the top ten aluminum producers are Chinese, and they produce twice as much as aluminum as the other five combined.

China has the largest train manufacturing company, twice as large as the second largest company.



Tiangong Ultra is in the orange running shirt. The men in green are handlers, not runners. TU was developed by the Beijing Humanoid Robot Innovation Center. It needed three battery changes during the “race”, which affected his time. A few months ago, it took TU eight hours to compete the course. Such an improvement in a human runner would send up hundreds of red flags among the drug testing officials.

## Drivers, start your engines

### *The People’s Republic of China*


WE KNOW CHINA’S business development playbook by heart. The People’s Republic of China is a serious competitor in every single area of technology. It has a space station. (You knew that, right?) It collects rock samples from the Moon and even shares them with western scientists. It has its own global navigation satellite system (BeiDou). It has not made a secret of how it approaches a product market that it has identified as being of significant strategic interest to its future. Whether it is steel or aluminum production, home appliances, solar panels, high-speed locomotives, or battery electric vehicles, the Chinese Communist Party is the ultimate authority in deciding where investments will be made. It considers the entire value chain for a product, from sourcing and refining the raw materials, through design, development, purchasing or creating joint ventures for the intellectual property incorporated into the product, manufacturing, sales, and overall logistics. It provides direct investments and indirect investments through the provincial and city governments.

A public relations gimmick on the 19<sup>th</sup> of April of this year exemplifies China’s approach to its successful attempts to make its industries the best in the world in everything. It was a half-marathon co-organized by Beijing municipal government bureaus. *The Beijing Yizhuang Half Marathon and Humanoid Robot Half Marathon* pitted 1,200 human runners against 21 robot teams from private companies and state-backed projects, including industry leaders Unitree and X-Humanoid. Humans and robots raced on separate tracks on the 21.1-kilometer course. The men’s winner finished in 1 hour 2 minutes and 36 seconds, and the women’s winner in 1:11:07. Tiangong Ultra, the leading robot, completed the course in 2:40:27 with three stops for battery changes. Three of the robots didn’t make it to the starting line, and most of them didn’t finish. If this sounds like the first DARPA Grand Challenge held on the 13<sup>th</sup> of March 2004 in the Mojave Desert in the United States, it should. That is when the U.S. was still the biggest market for automobiles, an American company, GM, was still the world leader in vehicle production, and no one was taking China as a serious competitor for anything.<sup>13</sup> Twenty short years; another world.

In 2015, the China State Council announced **Made in China 2025**. This was a guideline and a plan that, among other things, established the foundation for the implementation of autonomous (driverless) vehicles<sup>14</sup> during the following decade. In 2020, the National Development and Reform Commission (NDRC), the Ministry of Industry and Information Technology (MIIT), and nine other ministries put into effect *The Innovative Development Strategy of Intelligent Vehicles (IDSIV)*. This strategy led to the acceleration of the development of advanced autonomous driving. It proposed that by 2025, there would be large-scale production of SAE

<sup>13</sup> GM lost the lead to Toyota in 2008.

<sup>14</sup> Most of the documents for China use the term ‘autonomous’ for driverless vehicles.



Level 3 vehicles and the market launch of SAE L4 vehicles in selected operational design domains. It also proposed that there should be a long-term evolution of LTE-V2X with 5G and dictated that a comprehensive set of Chinese standards should be established. By 2035, the *IDSIV* should be complete.

Also in 2020, the China State Council issued the New Energy Vehicle Industrial Development Plan (2021-2035) which proposed the goal of “developing highly autonomous vehicles to achieve commercial application in limited areas and specific scenarios by 2025, and to achieve large-scale application by 2035.”<sup>15</sup>

The Communist Party’s 14<sup>th</sup> Five-Year Plan for 2021-2025 National Economic and Social Development and Long-term Objectives for 2035, published in March 2021 included targets for “autonomous driving and intelligent mobility”. In July of that year, MIIT and other ministries issued the Good Practice for the Administration of Road Tests and Demonstrative Application of Intelligent and Connected Vehicles (ICVs) (*I guess these titles are shorter with Chinese characters*). This was intended to establish requirements and regulate autonomous driving tests. In 2022, the PRC Ministry of Transport issued its Safety Service Guide for Autonomous Vehicle Transport as a Draft for Comment. This was intended to foster commercialization of autonomous driving technology.

By the end of 2021, local governments had created in excess of twenty ICV test zones in cities, including Beijing, Shenzhen, and Chongqing, and had designated more than 3,500 kilometers of roads for use in autonomous vehicle testing. Pilot tests included the testing of market access, data security, accident handling, and the design of specifications in these tests. Shenzhen created the first law in China to ensure end-to-end regulatory coverage during the testing of autonomous driving with a specification for how to determine responsibility for traffic accidents.

China is currently running autonomous driving tests in sixteen cities, and there are 2,300 driverless vehicles delivering taxi services. This compares with around 700 Waymo vehicles operating in four U.S. cities. Although there are references in many of the articles about the integration of these tests with improvements to the driving environments, it seems they refer to ITS and not STI: Intelligent Transportation Systems and not Safe Transportation Infrastructure. I have found no mention of changes to the physical driving environment. Nevertheless, the steps that China has taken, including the investments by both private companies and the government, and the enabling regulations that have been put in place, clearly indicate that China fully intends to do exactly the same thing with driverless vehicles as it has done with all the other industrial developments it has made over the past twenty-five years, namely, wipe out the competition.

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<sup>15</sup> See <https://theicct.org/sites/default/files/publications/China-new-vehicle-industrial-dev-plan-jun2021.pdf>

### *The United States of America*

THE UNITED STATES once built the ‘bomb’ and went to the moon. However, it has not always been very united when it comes to making decisions about investments that affect all of its citizens, except when there has been an external threat, real and imminent (for example, during World War II when it was believed that Germany was developing an atomic bomb), or a bogeyman (such as during the Cold War when the Soviet Union represented an existential threat and the race to land humans on the Moon was viewed as a way to meet that threat). Unlike China, it does not develop five-year or ten-year plans with goals that its government agencies and businesses are expected to achieve, and it does not set aside money to finance the achievement of these goals.

*The Manhattan Project to build the atomic bomb (\$2 billion cost/\$27 billion in today’s money), the Apollo Program to land American astronauts on the moon (\$28 billion cost/\$280 billion today), and the Interstate Highway System, which was billed as a national defense effort (\$114 billion cost/\$618 billion today), were exceptions to the way the U.S. government conducts its business.*

What the U.S. government has done during the past eighty years is issue contracts to private companies for building defense systems and provide research funding to both public/state and private universities and research institutes for the development of whatever the government believes are of strategic importance. One example is the U.S. Global Positioning System, which is owned and operated by the Department of Defense. It has been funded by federal tax revenues (\$5 billion cost/\$11 billion today – *seems cheap*). Another example is the Internet, which was originally created as ARPANET and began as a research project funded by the Defense Department’s Advanced Research Project Agency in 1969. The goal of ARPANET was to develop a robust computer network that could function after a nuclear attack.

Without the Internet, there would be no Alphabet, Meta, or Amazon, and Apple would have probably been absorbed into HP or Dell long ago or simply disappeared. So, score a couple for the U.S. Government. Without the DARPA challenges starting in 2004, driverless vehicle development in the U.S. would have had to wait for a kick-start from Japan, Europe, or eventually China. DARPA awarded prize money (a miserly few million in total) to the winning teams who were able to complete the prescribed courses. The last of those was in 2007. What has the federal government, or any state or local governments done since then to move the driverless vehicle industry forward? Precious little.

*It will be the same driving environment that met the Model Ts*

Nothing has been done in the U.S. to prepare the driving environments for driverless vehicles. As I said earlier, when cars replaced horses and wagons in cities, we paved the roads to accommodate rubber wheels, rather than leaving the dirt that was kinder to horses’ hooves, painted lines on the roads and at crosswalks, and we added traffic lights. So far, there are no indications that the U.S., at any level of government, is doing anything to make it easier for robotic drivers to do their job either inside cities, on rural roads, or on limited access highways.

What the U.S. is doing in a limited way is making it possible to test driverless vehicles. In certain states, including California, Arizona,

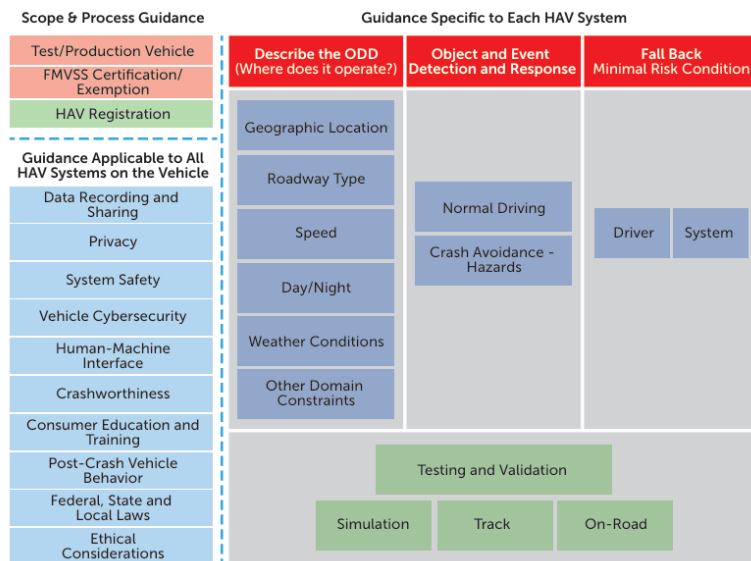


*Waymo is out there on the same streets as every other vehicle using the roads, mixing it up with no special rights or privileges, but with more obligations to the state and federal authorities*

and Texas, the departments of motor vehicles have exempted driverless vehicles from any requirements that make specific reference to having a human driver controlling the vehicle at all times. California has a four-step process. First, a company applies for an AV testing permit to the CA DMV. The permit is valid for a car with a safety driver. When the tests show that the car can be driven without any problems, the company applies for a driverless permit. When the DMV judges that the performance is ‘safe enough’, it allows the company to apply for a non-commercial operational permit. When tests show that it can operate in driverless mode within the requirements of an operational framework, the company applies to the CPUC for an operational commercial permit. This is what Waymo has obtained (and Cruise had before it was closed by its owner, GM). The only metrics for testing are safety-related, and there are no requirements that the jurisdiction in which the tests are performed must fulfil.

At the federal level, the Department of Transportation and NHTSA have been following the policies of whoever is leading the Executive Branch of the government. In September 2016, during the last months of Barack Obama’s second and last term as President, DOT Secretary, Anthony Foxx, issued the *Federal Automated Vehicles Policy*. The authors of this policy document clearly intended to

Figure I: Framework for Vehicle Performance Guidance



make a concerted attempt to insert the federal government into the driverless vehicle development process, to enable their successful progress while not moving into championing, financing, or co-developing. It defined a framework for vehicle performance guidance that was intended to provide the outline for new or modified Federal Motor Vehicle Safety Standards (FMVSS). The Policy document also outlined a set of steps the states could take so that federal and state initiatives would be coordinated so that confusion and unnecessary bureaucracy could be avoided. This framework is shown below.

“DOT supports an environment where innovation can thrive and the American public can be excited and confident about the future of transportation.”

Elaine Chao, U.S. Secretary of Transportation, 2018

Two months after the 2016 Policy was issued, Donald Trump was elected President, and all activities on automated and driverless vehicles were paused for four years. There was a document issued in October 2018 by Secretary of Transportation Elaine Chao called *Preparing for the Future of Transportation: Automated Vehicles 3.0*. It was basically an update of the 2016 Policy document with better graphics. It can be summed up by a caption on one of its final illustrations showing a line of trucks on an illustration of a connected highway (See sidebar.)

As soon as the Biden administration took over in January 2021, NHTSA geared up to insert itself in the process that had been kept running by the states, particularly California, during the Trump years. It issued its *Standing General Order on Crash Reporting in June 2021 (SGO)*. The SGO requires “manufacturers and operators to report to the agency certain crashes involving vehicles equipped with automated driving systems or SAE Level 2 advanced driver assistance systems. The General Order allows NHTSA to obtain timely and transparent notification of real-world crashes associated with ADS and Level 2 ADAS vehicles from manufacturers and operators. With these data, NHTSA can respond to crashes that raise safety concerns about ADS and Level 2 ADAS technologies through further investigation and enforcement”.<sup>16</sup>

NHTSA refers to the SAE Level 2 advanced driver assistance systems which provide both speed and steering input when the driver assistance system is engaged but require the human driver to remain fully engaged in the driving task at all times. These are systems that are already on the road and available to customers. In the second part of the SGO, it refers to or SAE Levels 3-5 automated driving systems (ADS), which were not then, and still are not today, available to the public for sale, except the Level 3 system from Mercedes-Benz which has been approved for sale in California and Nevada. This SGO guideline is the sum total of what the federal government did with driverless vehicles during the period from January 2021 to January 2022.

On the 24<sup>th</sup> of April 2025, the new Department of Transportation Secretary Sean P. Duffy issued what was called the *New Automated Vehicle Framework* as part of its Innovation Agenda. It says it is going to do what the 2016 *Federal Automated Vehicles Policy* said it was going to do, prioritize safety, remove unnecessary regulatory barriers, and make it easier for American manufacturers to compete on equal ground as foreign companies. One significant change in the *New AV Framework* is intended to protect “confidential business information”. It removes the requirement on testing companies to divulge information on whether the car was operating in conditions it was or was not designed to operate in, a description of the circumstances of the crash, and the version of the self-driving software that was in use. Elon Musk, has been complaining about these requirements

<sup>16</sup> See <https://www.nhtsa.gov/sites/nhtsa.gov/files/2022-06/ADS-SGO-Report-June-2022.pdf>

2023 U.S. Code  
Title 49 - Transportation  
Subtitle VI - Motor Vehicle and  
Driver Programs  
Part A - General  
Chapter 301 - Motor Vehicle  
Safety  
Subchapter II - Standards and  
Compliance  
Sec. 30114 - Special exemptions

from the time they were issued. Tesla obtained a permit from the California DMV to test with a driver, the first level of permitting in the state, but always reported zero miles of testing.

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*In the Secretary Duffy press release, there is a baffling statement which is either meant to be intentionally obfuscating or is simply an indication that the current Secretary has been misinformed. It states that the "New Framework is expanding the Automated Vehicle Exemption Program (AVEP) to now include domestically produced vehicles, because the AVEP was previously open only to imported AVs".*

*THERE HAS NEVER BEEN AN AUTOMATED VEHICLE EXEMPTION PROGRAM ADMINISTERED BY NHTSA. There has been an exemption process for vehicles, domestic or foreign, which do not meet FMVSS regulations to operate them on U.S. roadways FOR TEST PURPOSES in order to save the manufacturer the cost and trouble of creating a vehicle that is FMVSS-compliant while they are testing the parts of the vehicle that need to be made compliant or testing sub-systems that will be included in vehicles eventually sold in the U.S.. (See sidebar) The exemption also applies to low-volume manufacturers. It is not the systems which are exempted but the vehicles in which the systems operate. If a foreign manufacturer has a FMVSS-compliant vehicle and wants to test anything, it does not need an exemption, unless it wants to test something that is not allowed, like a car without a steering wheel or pedals. Then it needs to do exactly what both foreign and domestic car manufacturers are doing in California, Texas, Arizona, obtaining approval from the state DMVs.*

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#### [The European Union](#)

THE EUROPEAN MOTOR vehicle industry, including the vehicle manufacturers, their suppliers, and the motor vehicle testing and approvals organizations are working hard to keep up with the U.S. and China. The EU Commission is in a rut of its own making. The Commission's lead on this topic is a career politician from Finland, Henna Virkkunen, who has been at the EC for only a few months after taking over for Margrethe Vestager (who is best known for bludgeoning American IT giants). Virkkunen said that the EC's policy would include better access to data for AI developers, make it easier for developers to follow all of the EU's regulations, and create an AI-gigafactory to drive development forward. This has all the makings of a bureaucratic marshland.

With driverless vehicles, which the Commission has filed under Cooperative Intelligent Transport Systems/Cooperative, Connected and Automated Vehicles (the *Declaration of Amsterdam in 2016*)<sup>17</sup>/Automated Driving Systems, it has decided to organize its approach around the type approval process for motor vehicles that is in effect in EU countries and other countries, including Japan and South Korea, but not the U.S. and China. In 2020, the UN World Forum for Harmonization of Vehicle Regulations (WP.29) finalized and adopted Regulation 157 on Automated Lane Keeping Systems (ALKS) for low-speed highway applications. It provided a set of standardized technical specifications for conditional

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<sup>17</sup> "With the Declaration of Amsterdam on connected and automated driving, member states, the European Commission and private sector have agreed on joint goals and joint actions to facilitate the introduction of connected and automated driving on Europe's roads. This should prevent a patchwork of rules and regulations arising within the EU, which would be an obstacle to both manufacturers and road users."



automated driving, and this has been incorporated into the Type Approval regulations. Germany has made it part of its country driving regulations, and it is expected that the rest of the EU countries and partners will follow. In 2022 a proposal for high-speed highway and lane changing was submitted, and this will be incorporated into Type Approval regulations.

The problem is that the European Commission wants to fiddle with how driverless systems are developed by forcing developers to comply with all of its strategies on communications, climate change policy, safety, sustainable mobility, smart mobility, legal frameworks, and more. There is no apparent consideration for the driving environments or the business cases for driverless vehicles and how the regulations will affect or be affected by these considerations. There have been numerous multi-country, multi-partner projects funded by the EC that demonstrate driverless vehicle functionality, but there is nothing on the scale of what is occurring in the U.S. and in China. The Commission is laying additional layers on top of the Type Approval requirements that may not apply to all driverless vehicles, such as vehicle-to-vehicle communications, and it is putting itself in the position of making decisions that could either be made by the system developers or the countries where the vehicles are operating.

#### Japan

JAPAN IS NO stranger to world-beating inventions. Nintendo, Sony Walkman, and the Prius hybrid electric vehicle are among a long list of such inventions. Its companies and government agencies have been extremely important partners in the field of automotive-related technologies, starting with navigation systems in the early 1990s to advanced driver assistance systems today. While it has been less vocal than either the U.S. or China about what it is doing in the field of autonomous vehicles (AV), its companies and its government agencies have not been idle. Here is how one source sums up its approach:


*“Japan’s strategy for AVs is characterized by a comprehensive commitment to technological advancement, large-scale infrastructure investments, and progressive legislation, all aimed at addressing immediate challenges such as an aging population, driver shortages, and the need for safer transportation networks.”*

*“Japan’s strategy for AVs is characterized by a comprehensive commitment to technological advancement, large-scale infrastructure investments, and progressive legislation, all aimed at addressing immediate challenges such as an aging population, driver shortages, and the need for safer transportation networks. This approach underscores Japan’s dedication to deploying AV solutions on an expedited timeline, particularly for cargo transport and public transit.”<sup>18</sup>*

Of all the countries or regions working on driverless vehicles, this is the most succinct and clear description of what is being done and why. Japan needs driverless vehicles to solve a major problem: it has an aging population which is also diminishing in numbers, and it will not have enough people to do the jobs that need to be done.

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<sup>18</sup> <https://www.globalfleet.com/en/technology-and-innovation/asia-pacific/analysis/lanes-laws-japans-fast-tracking-driverless-future?t%5B1%5D=Smart%20Mobility&t%5B2%5D=Autonomous&curl=1>



Japan's authorities have recognized that there is a real potential for conflicts between vehicles with and without drivers, and it is therefore creating roadways and lanes on which the driverless vehicles will operate. So, while companies are developing the driverless technologies, the government is providing the roads on which the technology will be both tested and put into operation.

Concerning the AV technology, Japanese companies have decided to work on two parallel tracks on creating the AV ecosystems. One track will be followed by smaller companies that do not have the resources to design and develop their own operating systems. A Japanese company called Tier IV has developed Autoware, what they say is the "world's first open-source operating system for autonomous driving".<sup>19</sup> Tier IV collaborates with companies around Autoware to help them customize the basic platform for their own applications.

The other track is being followed by larger companies, like Toyota, who, in partnership with Nippon Telegraph and Telephone (NTT), have committed to invest \$3.2 billion in developing AI-powered AV technology which will be focused on safety and accident prevention. This effort is beginning this year with a deployment set for 2028. Nissan has been testing its driverless technology in its headquarters city of Yokohama and expects to have a fully driverless vehicles operating there and in other Japanese cities by 2030.

Toyota and Nissan vehicles will soon be joined by Jaguar I-Pace cars adapted for use by Waymo. Waymo announced in late December 2024 that it was partnering with the Japanese taxi company Nihon Kotsu and with the taxi app developer Go to bring its vehicles to Tokyo. They will be operating with a Nihon Kotsu driver behind the wheel. Waymo's software will be learning how to drive on the left side of the road while it operates in one of the world's most densely populated urban environments. Waymo will find that its customers are different from those in the U.S., not quite so forgiving of sub-standard service of any kind.


#### *India*

*INDIA HOLDS GREAT* promise for the automotive industry, including contributing to the development of driverless vehicle technology. That promise will not be fulfilled in the near term for the simple reason that the driving environment in India is, in a word, chaotic. In addition, there are an insufficient number of men and women who are trained to work in the companies and organizations that would develop automated vehicle solutions. Arindam Lahiri, CEO of India's Automotive Skills Development Council (ASDC)<sup>20</sup> put it this way:

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<sup>19</sup> <https://tier4.jp/en/>

<sup>20</sup> Currently, there is a mismatch in India in certain areas between the skills that the automotive industry requires and those possessed by the youth in country. ASDC has been established to bridge the gap. It is promoted by the Automobile industry through Society of Indian Automobile Manufacturers (SIAM), Automotive Component Manufacturers Association (ACMA) and Federation of Automobile Dealers Association (FADA) and Government of India represented by Department of Heavy Industry and National Skill Development Corporation (NSDC).



*“While the development of AVs is progressing rapidly around the world, there are unique challenges that need to be addressed before they can become a reality in India. Here are a few challenges:*

- *Infrastructure: The major challenge is the country’s intracity road infrastructure, especially state owned, which are poorly maintained and lack of proper signage and road markings.*
- *Driving Behaviour: Indian driving culture is known for its unpredictability and the tendency of drivers to ignore traffic laws, and there are a wide range of behaviours across very large population.*
- *Technology: AVs requires advanced technology, which will make them expensive and difficult to maintain. This will limit the adoption of AVs among India’s large low-income populations.*
- *Rule-Regulation: India’s current laws and regulations are not designed to handle the complexities of autonomous vehicles, and it will take time for new policies that can govern the use of this technology on Indian roads to be created.*
- *Accident Liability: Indian accident insurance laws are not designed to handle the complexity of assigning responsibility for the cause of accidents.”<sup>21</sup>*

It is refreshing to read an honest and self-critical statement like the one above. While the problems may not be as severe in the U.S., China, or Europe, every country could write something similar. They should be addressing each of these areas in concert with promoting any form of advanced driver systems.

#### **Where the countries and regions stand on their support for robot-driven cars**


The central governments of China and Japan are working together with local authorities and companies to enable and champion the development and introduction of driverless vehicles in their countries. China goes further by providing financial support to both private companies and state-owned companies for all of the stages in the value chain, from raw material sourcing, component sourcing and manufacturing, intellectual property acquisition, customer subsidies, and tax benefits. Japan also coordinates national policies with its private companies to establish the necessary infrastructure for testing and eventual introduction of the systems.

European countries that are part of the EU or that coordinate their policies with the EU are following a regulation-based roadmap for an eventual introduction of vehicles that have driverless capabilities. There is no single policy governing just driverless vehicles because the EU has wrapped automated vehicle systems into a larger bundle with cooperative connectivity (i.e. vehicle-to-everything communication). It is basing its roadmap for automated vehicle roll-out on the UNECE framework for standardization, so vehicle systems that fall outside of this framework will remain in testing until they do conform.

The United States has no coordinated policy to either champion, finance, or co-develop driverless vehicles. Its Standing General

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<sup>21</sup> <https://electronicsera.in/state-of-autonomous-vehicles-in-india-current-progress-and-future-outlook/>



Order is as close as it gets to enabling development. What is happening in the U.S. is the result of private companies obtaining investments for system development and testing, and state and local governments providing permits for testing systems that are not allowed by the Federal Motor Vehicle Safety Standards issued by the country's Department of Transportation. In spite of the lack of a policy, developments have progressed for Waymo, the company whose parent, Alphabet, has invested the most and been most patient and supportive of Waymo's progress.


Only Japan has made a point of emphasizing its efforts to adapt Japan's driving environment to driverless vehicles, but it is likely that China will be doing this as well, particularly on its expressway network. There are no indications that such efforts are being made by any level of government in the U.S., principally because such efforts would cost money, and there is no evident threat that driverless vehicles will help to avert or defeat that would cause the government purse strings to be loosened.

#### *What should the governments of the world be doing*

Driverless system developers may bristle at the thought of being subject to special regulations while they are trying hard to "fit in" to the normal flow of traffic and show that their algorithms make them better drivers than humans. Based on what we have learned thus far from the tests that have been made with driverless vehicles, there are situations in which they are not better, such as in work areas or accident scenes, and there are other situations in which they exhibit behavior that humans consider uncharacteristic and which cause human drivers to have difficulty reacting, especially hard braking, in cross traffic turns, and when interacting with large trucks and buses. Special regulations would help to make driving safer for both the riders in the driverless vehicles and the drivers and riders in human-driven vehicles.

One of the most common accidents that occurs with driverless vehicles is the driverless vehicle being rear-ended due to sudden stopping. Placing a warning sign on the back of driverless vehicles with a "No Driver Onboard - Please keep your distance" warning would help to reduce those accidents. It might be obvious to most drivers in San Francisco that they are behind a Waymo vehicle because of all the sensors bulging out on top and on the sides, but there is always a chance that a visitor from Idaho shows up and has no idea that he is following a driverless car.

While it is not possible to prevent humans from parking or standing in places that are clearly marked as No Parking or No Standing, it is possible to program a driverless vehicle to totally avoid parking or standing where it is not allowed. Waymo admits that it has chosen not to do this for the convenience of the riders, but that is not an excuse for human-driven vehicles, and it should definitely not be a practice allowed for driverless vehicles. There could be a regulation that vehicles allowed on the streets of a city must certify that the vehicles are programmed to follow all of the city's traffic



regulations. That seems obvious, but perhaps the programmers working for Waymo decide which laws they follow and those which they ignore. Maybe the programmers should be certified.<sup>22</sup>

In addition, a city that has the intention of allowing driverless vehicles should first pass regulations regulating itself. First, it must ensure that driverless vehicles have places where they can safely pick up and drop off passengers, and that these locations are not used by human-drivers, both passenger cars and delivery vehicles, as convenient open spaces for parking or standing. Learn from the chaotic introduction of electric scooters when they were welcomed by city transportation departments as micromobility supplements to public transport and a substitute for cars only to find out that they had multiple problems of their own which required regulation.

Second, transport authorities should separate driverless vehicles from human-driven vehicles at accident sites and road maintenance locations, and provide clear directions for the driverless vehicles to follow. Third, there might need to be regulations restricting when driverless vehicles can be on the roads, at least initially. Accidents are more common at dusk and dawn when lighting conditions can confuse sensors, and during heavy rains and snow.

There are a number of other measures that could be taken which would make urban roads safer for both human-driven and driverless vehicles, such as eliminating all left turns, strictly enforcing pedestrian crossings to intersections, strictly enforcing the stopping and yielding of bicycles and scooters at intersections, strictly enforcing one-way travel by all two- and four-wheeled vehicles—with no exceptions for bicycles or scooters.

If you truly believe that there is a place at the table of humanity for driverless vehicles, then work toward preparing the table setting for it. That's what civilized people do for any new guest.



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<sup>22</sup> Bunkley, Nick. *Waymo robotaxis racked up \$65,000 in San Francisco parking tickets last year.* AUTOMOTIVE NEWS. (March 26, 2025).

### *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.



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