

# 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.

## Henry Ford's Vision

*"I will build a motor car for the great multitude. It will be large enough for the family, but small enough for the individual to run and care for. It will be constructed of the best materials, by the best men to be hired, after the simplest designs that modern engineering can devise. But it will be so low in price that no man making a good salary will be unable to own one – and enjoy with his family the blessing of hours of pleasure in God's great open spaces."*

*The words of Henry Ford in his book, My Life and Work: Ford, Henry; Crowther, Samuel (1922), My Life and Work, Garden City, New York, USA: Garden City Publishing Company, Inc.*

## ***In silos without windows: That's where driverless mobility research and development is done***

*"Reducing the messiness of reality to a limited number of fixed drawers helps bureaucrats keep order, but it comes at the expense of truth."*

Yuval Noah Harari

### ABRIDGEMENT

AT THE BEGINNING of the 20<sup>th</sup> century, people were not asking for cars. They were asking for a way to travel that did not require them to own and care for a horse. They were asking for a way to travel that allowed them to cover distances farther than they could walk in a day without having to provide their own motor power. They were asking for the possibility to travel where and when they desired, rather than according to a schedule devised by someone else. They were asking for a way to travel that they could master both physically and mentally. They were asking for a way to travel which they could afford.

The first cars met some, but not all, of those requirements. It was not until close to the end of the second decade of the 20<sup>th</sup> century that a relatively affordable and relatively easily driven vehicle was available in the form of the Ford Model T. Today's cars are still doing all of things asked of them over a century ago for people who can afford them and are physically and mentally able to drive them.

Well into the third decade of the 21<sup>st</sup> century, people are not asking for driverless cars. They are asking for a way to travel in their cars that is safer than it is today, when a large number of people both in and outside of cars are killed and injured in car-related accidents. They are asking for a way to travel that is less stressful than it is today, with that stress caused by increases in traffic congestion and the increased complexity of roadways built to carry ever larger numbers of ever larger sizes of vehicles. They are asking for a way to travel that is more inclusive by being both more affordable and able to be used by individuals who cannot drive themselves.

To repeat, no one is asking for driverless cars. The military is asking for vehicles that can deliver payloads without risking the lives of drivers, like guided missiles and unmanned aerial vehicles (aka 'drones') can. Farmers are asking for vehicles that can plow, seed, prune, and pick as a substitute for humans who can no longer be found to do these jobs. Mining companies are asking for vehicles that can perform hazardous tasks that put human drivers at high risk, requiring both high pay and high insurance premiums.

The absence of a compelling vision, like the one behind Henry Ford's Model T, is the main reason there is ambivalence about the entire idea of passenger vehicles that drive themselves. Such a vision will not be found in a single silo, but in many of them. Reality is messy, but it is in that mess where real answers are found.



## Vehicle engineering is the means not the end

RESEARCH ON DRIVERLESS vehicle engineering mirrors the structure of the academic world, which is divided into different faculties and departments (i.e., silos). Yuval Noah Harari, in his book [Nexus: A Brief History of Information Networks from the Stone Age to AI](#), explains how this division occurred for the same reason that specialization occurred in government and business, for the sake of bureaucratic order, to be able to solve the information retrieval problem by dividing the world into drawers and knowing which document goes into which drawer.<sup>1</sup> An unfortunate consequence of the bureaucratic approach, explains Harari, is that instead of focusing on understanding the world as it is, bureaucracy is often busy imposing a new and artificial order on the world and then forcing the world to fit into the categories represented by the drawers. In an attempt to reduce messiness and create order, truth suffers.

The word 'bureaucracy' comes from the French *bureaucratie*, which was formed by combining *bureau* ('desk') and *cratie*, a suffix denoting 'a kind of government'. Rule by writing desk.



*Imagine if all the world's flora and fauna were placed in individual bureau drawers, each with a label giving the name of the drawer's contents. With the bees, ants, worms, birds, and squirrels in their own drawers, trees and plants would not last very long, and neither would the bees, ants, worms, birds, and squirrels.*

He uses the example of one bureaucrat given the task of increasing industrial production and another bureaucrat given the job of combatting pollution. The first ignores environmental consequences and the second ignores economic consequences. When a third bureaucracy is established to control both, it is ignored by the other two bureaucracies. Universities are divided into faculties and departments, such as mathematics, history, biology, physics, sociology, politics, art, computer science, and so on. Students must choose which of these disciplines they will follow in order to earn an academic degree, and they may continue to pursue higher degrees in their chosen field. The higher they go, the more they specialize until they obtain sufficient qualifications to enter the faculties in which they have specialized as teachers.

In order to climb the academic ladder, explains Harari, academics need to publish. Publish or perish is the rule. Your work must be published in peer-reviewed journals, and the journals are divided by disciplines. Every discipline has its own jargon, rules for citations, and expectations for what should be in an article, and if you do not follow the rules of the journals, your peers will not recommend your work for publication and you do not get to keep your job. There are no rewards for attempting to cross subject lines. You are rewarded for staying in your lane in a race around a track with others running in the same race, not for throwing a discus while pole vaulting.

Universities were not always the centers of research, and the educated elite dabbled in everything. Universities have existed for over a thousand years, but they did not become centers of research until the turn of the 19<sup>th</sup> century.<sup>2</sup> They were teaching institutions;

<sup>1</sup> The word 'bureaucracy' comes from the French *bureaucratie*, which was formed by combining *bureau* ('desk') and *cratie*, a suffix denoting 'a kind of government'. Rule by writing desk.

<sup>2</sup> Most references which list the oldest universities has the University of Bologna as the oldest. It was founded in 1180 A.D. as a place for teaching outside of ecclesiastical schools. The Muslim world offers its University of Al-Qarawiyyin in Fez, Morocco as

their primary reason for existing was to produce priests, lawyers, and doctors, so they taught theology, law, and medicine. A fourth subject area was called philosophy. It was a catch-all which then included the arts and sciences. During the Age of Enlightenment, beginning in the 17<sup>th</sup> and reaching its peak in the 18<sup>th</sup> century, research occurred in connection with institutions like the British Royal Society,<sup>3</sup> the French *Academie des sciences*, and the Swedish *Kungliga Vetenskapsakademien*. The latter was founded by six Swedish scientists, including Carl von Linné, the inventor of the naming system for the biology bureau drawers. Anyone who was teaching and wanted to do research did it on their own time, or they left for better-paying positions in government, conducted their research wherever they could set up a lab,<sup>4</sup> and communicated their ideas in the scientific academies, literary salons, coffeehouses, Masonic lodges, and in books and pamphlets.<sup>5</sup> Non-university research institutes exist today, including those mentioned above. Other examples are the Max Planck Institutes operated by the Max Planck Society, the Weizmann Institute of Science, and CERN in Switzerland.

It was in Germany where the idea was conceived of an institution of higher learning including research as an integral part of its mission, combined with teaching. Wilhelm von Humboldt, a Prussian philosopher and government functionary, is given credit for what came to be called the Humboltian model of higher education that combined research and academic studies of the arts and sciences. It was first realized in the University of Berlin, which was established in 1810. Johns Hopkins University in Baltimore, Maryland, founded in 1876, is considered to be the first research university in the United States. It is the model that is used for most universities today, both public and private, and most of the U.S. universities founded prior to this time. There are still many non-research colleges, referred to as liberal arts colleges. Examples include Amherst College and Williams College in Massachusetts, and Pomona College in California.



*Picturesque, unless you are looking at it from inside the silo.*

### **There is no view from inside a silo**

When the quest for a driverless vehicle began in earnest, it was spearheaded by the U.S. Defense Advanced Research Projects Agency (DARPA). DARPA was created in 1958 by the U.S. Department of Defense (given the secondary name Department of War in September 2025 by presidential executive order) “to facilitate research in technology with potential military applications and is responsible for developing emerging technologies for military use”.<sup>6</sup>


the candidate for being the oldest university. It was founded in 859 A.D. by Fatima al-Fihri, a Tunisian woman, who used her inheritance to establish a mosque and a school, which has evolved into a modern university.

<sup>3</sup> The Royal Society originated on November 28, 1660, when 12 men met after a lecture at Gresham College, London, by Christopher Wren (then professor of astronomy at the college) and resolved to set up “a College for the promoting of Physico-Mathematicall Experimentall Learning.”

<sup>4</sup> Isaac Newton conducted his experiments in the study of his home, Woolsthorpe Manor.

<sup>5</sup> The Age of Enlightenment. ([https://en.wikipedia.org/wiki/Age\\_of\\_Enlightenment](https://en.wikipedia.org/wiki/Age_of_Enlightenment)).

<sup>6</sup> Dennis, Michael Aaron (December 23, 2022). "Defense Advanced Research Projects Agency | United States government". Encyclopædia Britannica. Retrieved January 5, 2023.



It is worth noting that DARPA is one of seventy-six (76!) U.S. federal research and development silos. NASA, NSF, NIH, USGS, and FHA are among them.<sup>7</sup> Section 2374a of Title 10 of the United States Code authorizes the Secretary of Defense/War, acting through the Director of DARPA, to award prizes in amounts up to \$10 million to recognize outstanding achievements in basic, advanced, and applied research, technology development, and prototype development that have the potential for application to the performance of the military missions (underline by editor) of the Department of Defense (DoD). The Fiscal Year 2001 National Defense Authorization Act was the basis for DARPA's aggressive engagement in "unmanned<sup>8</sup> remotely controlled technology". The Act stipulated the following: "It shall be the goal of the Armed Forces to achieve the fielding of unmanned remotely controlled technology such that by 2015, one-third of the operational ground combat vehicles of the armed forces are unmanned.

After conducting a number of studies, DARPA decided that the first use of the Congressional prize money would be in the area of autonomous ground vehicles with the main goal of "accelerating autonomous ground vehicle technology development in the U.S. in the areas of sensors, navigation, control algorithms, vehicle systems, and systems integration."<sup>9</sup> As it stated in the Grand Challenge 2004 Final Report, DARPA sought to 1) increase the number of performers working on autonomous ground vehicle technologies; 2) provide the Department of Defense with new talent, new ideas, and innovative technologies by motivating and enlisting innovators that would normally not work on a DoD problem; and 3) accelerate autonomous ground vehicle technology development in the U.S. in areas of sensors, navigation, control algorithms, vehicle systems, and systems integration. The vision? Projecting force without getting any personnel killed.

From where did the forty-five teams that expressed interest in participating in the contest come from? Principally from universities. Of the 45 total 2004 Grand Challenge applications, twenty were from universities. Of the 15 who made it all the way to the final race, 7 were universities, 1 was a high school (Palos Verdes, CA), and 7 were individuals and businesses. The contestants were required to build autonomous ground vehicles capable of traversing a desert course up to 175 miles long in less than 10 hours. The first vehicle to complete the course within the time limit would win the Challenge and a prize of \$2 million. None of the teams finished the course, so no prizes were awarded. A new event was scheduled for the following year. DARPA said in its 2004 report that one important result of the Challenge was that it proved only a relatively

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<sup>7</sup> NASA (National Aeronautics and Space Administration, Independent), NSF (National Science Foundation, Independent), NIH (National Institutes of Health in the Department of Health and Human Services), USGS (U.S. Geological Survey in the Department of the Interior), and FHA (Federal Highway Administration in the Department of Transportation)

<sup>8</sup> Following a November 2022 Pentagon report on China's military build-up that used the term "uncrewed aerial systems," the "uncrewed" adjective has become an increasingly fashionable alternative to the previously dominant "unmanned" descriptor.

<sup>9</sup> Grand Challenge 2004 Final Report. DARPA. July 30, 2004. ([https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/DARPA/15-F-0059\\_GC\\_2004\\_FINAL\\_RPT\\_7-30-2004.pdf](https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/DARPA/15-F-0059_GC_2004_FINAL_RPT_7-30-2004.pdf))



Thrun on the hood of the VW that carried Stanford's software and hardware to victory in the 2005 Grand Challenge. The Stanford team called it Stanley. VW called it Touareg. If you have always wondered what 'Topuareg' means, here is the answer: The Tuareg people /'twa:reg/ also spelled Twareg or Touareg, are a large Berber ethnic group, traditionally nomadic pastoralists, who principally inhabit the Sahara.

small number of research groups were working on the problem of autonomous ground vehicles, and that their research had emphasized “fundamental understanding and approaches that are often computationally intensive, “ focusing on route planning and terrain navigation challenges at low vehicle speeds.

There were 23 finalists in the 2005 Grand Challenge, and the top three finishers were from Stanford and Carnegie Mellon, Stanford taking first place and two teams from CMU taking second and third places. In the 2007 Urban Challenge, the six teams that successfully completed the course were all from universities.<sup>10</sup>

### *Drivers, man your silos*

**Stanley** is the name given by its Stanford University team to the 2004 Volkswagen Touareg R5 TDI which won Grand Challenge 2005 (see sidebar). The team produced a paper titled Stanley: The Robot that Won the DARPA Grand Challenge.<sup>11</sup> DARPA uses the term ‘robotic vehicle’, but does not, as the Stanley team do, refer to the vehicle itself as a ‘robot’. This is no doubt a reflection of the Stanford team’s leader, Sebastian Thrun, who was co-director of the Robot Learning Laboratory at Carnegie Mellon before joining the Stanford faculty as director of the Stanford Artificial Intelligence Laboratory. Look at the qualifications of those who participated in these challenges, and they come almost exclusively from the fields of robotics, artificial intelligence, and computer science with concentration in these two fields.

What about vehicle technology? Here is what the Thrun team says about this subject in their Stanley paper: “Before both the 2004 and 2005 Grand Challenges, DARPA revealed to the competitors that a stock 4WD pickup truck would be physically capable of traversing the entire course. These announcements suggested that the innovations necessary to successfully complete the challenge would be in designing intelligent driving software, not in designing exotic vehicles (editor’s underline). This announcement and the performance of the top finishers in the 2004 race guided the design philosophy of the Stanford Racing Team: Treat autonomous navigation as a software problem.”<sup>12</sup> This did not mean that there was no one with vehicle technology experience on the team. A group from the Electronics Research Laboratory of Volkswagen of America participated, although they were acknowledged as “supporters”, along with Android, Red Bull, and Mohr Davidow Ventures, a PR firm. The VW team had to show the Stanford researchers how to make all the necessary connections to the driving control functions and adapt the vehicle’s systems to allow the software to work. But, apparently, Thrun and company were not all that willing to share the glory.

Thrun carried this siloistic approach into Google when he was tapped by Google’s Larry Page in 2009 to lead the company’s self-

<sup>10</sup> In order of completion: Carnegie Mellon, Stanford, Virginia Tech, MIT, University of Pennsylvania, and Cornell.

<sup>11</sup> Thrun, S. et al. Stanley: The Robot that Won the DARPA Grand Challenge. Journal of Field of Robotics DOI 10.1002/rob. 2006 Wiley Periodicals, Inc.

<sup>12</sup> Ibid. page 665.

driving car team. He did other things as well, like leading the Google (Eye)Glass effort. He left the project in 2013 and was replaced by Chris Urmson, who had joined Google in 2009 after leading the DARPA Grand Challenge and Urban Challenge teams from Carnegie Mellon, and played second fiddle to Thrun. Urmson carried the “It’s a software problem” banner forward while he was in charge, and left Google when Waymo was founded to start his own company, Aurora Innovation.

### *Isn't it time to put windows in the silos?*

Making driverless mobility work for riders who cannot afford to take taxis or purchase their own car does actually require the equivalent of throwing the discus while pole vaulting. If you start, as Waymo did well before it was called Waymo, with the goal of adding software to a vehicle that does not have a human driver and the only constraint you set is that the vehicle does not hit things, you end up basing your design on a very expensive automotive platform that already includes much of the advanced driver assistance (ADAS) functionality on which to build the driverless functionality—even though Thrun and Urmson do not explicitly acknowledge the importance of this. Then, you add a considerable amount of specialized hardware and associated software to substitute for the replaced human’s sense of sight (although both hearing (sirens, thunder) and smell (gas fumes, burning rubber) should be included) and perhaps the senses of proprioception (awareness of body position) and balance that humans bring to the driving task. You end up with a vehicle that costs the equivalent of a new school bus, around \$200,000, that carries one-twelfth the number of passengers as the school bus. This is the approach used by the military to develop new fighter jets or by NASA when it ordered rockets to put men on the moon. Don’t worry about the cost of those boosters. Spare no expense.




*A Chrysler Pacifica fitted out with Waymo kit.*

What would the Waymo vehicle look like if someone on the development team said at the outset that there had to be a cost constraint added because it makes no sense to remove the driver and then add costs which exceed what the driver would have cost with a non-driverless vehicle? Driving a car to work is not quite the same thing as piloting a HUMVEE<sup>13</sup> into an enemy encampment. Instead of starting with a plug-in hybrid Chrysler Pacifica in 2016 which had a base price of \$43,090, and moving to a luxury car model like a Jaguar (to get better ADAS features), which had a base cost of around \$70,000 when Waymo began to use them in 2018, a cost constraint would have required that the team use a car with a more affordable purchase price. In 2018, the average transaction price (ATP) for light vehicles in the United States was \$36,270.<sup>14</sup>

<sup>13</sup> HUMVEE – High Mobility Multipurpose Wheeled Vehicle, used by the U.S. military, and its enemies when they capture one, since the 1980s for various roles, including transport and reconnaissance. ("A Brief History Of: The Humvee". Time Magazine. 4 September 2008. Retrieved 4 September 2008).

<sup>14</sup> Source: Kelley Blue Book (<https://mediaroom.kbb.com/2018-02-01-Average-New-Car-Prices-Rise-Nearly-4-Percent-For-January-2018-On-Shifting-Sales-Mix-According-To-Kelley-Blue-Book>)



The cost of the cameras, LiDAR, and RADAR sensors that Waymo adds to their vehicles, including the costs of specially integrating them into the vehicles at the time of manufacturing, is not insignificant. However, Waymo has not been apologetic for this fact. John Krafcik, CEO of Waymo from the time of its establishment by Alphabet in 2016 until 2021, said the following: *“It is a misconception that you can just keep developing a driver assistance system until one day you can magically leap to a fully autonomous driving system. In terms of robustness and accuracy, for example, our sensors are orders of magnitude better than what we see on the road from other manufacturers.”*<sup>15</sup> They are also orders of magnitude more costly than if you can approximate the capabilities of the human driver without all of the extra expensive kit.

What is the basis for Krafcik’s claim? Who determined that what he states is a misconception actually is a misconception? Did he pick it up from Thrun and Urmson? Urmson said something similar in a 2017 interview: *“One of the big open debates in the driverless car world is between Tesla and other automakers versus Google’s approach. The former’s approach (i.e., Tesla) is ‘Lets just keep on making incremental systems and, one day, we’ll turn around and have a self-driving car’. The latter (i.e., Waymo) is ‘No, no, these are two distinct problems. We need to apply different technologies.’”*<sup>16</sup> Urmson, Thrun, Krafcik and most of those who are working on driverless vehicle technology are in the second group. Although Tesla is in a technology group on its own, it remains inside its own technology silo with no windows.

### *You need windows in your silos if you care about vision*

Sebastian Thrun, who has been called the “godfather of the self-driving car industry” (although there is an exceptionally long list of individuals in the automotive industry who laid the groundwork for the work done by all of the individuals working in the first DARPA Challenges), says Larry Page taught him to be a visionary, not just an expert. Looking at Thrun’s web page, it is clear that he has milked his Stanley team leadership to the hilt and made it pretty much of a personal achievement, but the only vision that is apparent is a Waymo car in 2025 that looks for all the world like the VW in 2005 (but costs three or four times more), and it is doing exactly the same thing today as it did back then, trying to get to a place without hitting anything.

The absence of a compelling vision, like the one Henry Ford expressed in his book, *My Life and Work*, co-authored by Samuel Crowther, is the main reason there is ambivalence about the entire idea of passenger vehicles that drive themselves. The American Automobile Association (AAA), which has 65 million members in the United States, released in February 2025 the results of its annual survey that polls driver attitudes toward self-driving cars. It

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<sup>15</sup> Moreno, J. Forbes. (Jan. 22, 2021). Waymo CEO Says Tesla Is Not A Competitor, Gives Estimated Cost of Autonomous Vehicles. Forbes.com.

<sup>16</sup> <https://www.forbes.com/sites/chunkamui/2017/05/08/urmson-on-driverless-cars/>



*Four Waymo vehicles burning in the June 2025 Los Angeles riots*

showed a four percent increase in the number who would trust riding in a self-driving vehicle, from 9% in 2024 to 13% in 2025, but the percent of drivers who are “afraid” is still over 60%. “Most drivers want automakers to focus on advanced safety technology,” said Greg Brannon, the AAA’s automotive engineering director. “Though opinions on fully self-driving cars vary widely, it’s evident that today’s drivers value features that enhance their safety.” Clearly, the argument that removing the human driver and replacing him or her with a robot is not convincing. You may believe that this report is biased or that the people who responded to the survey are either misinformed or ill-informed, but that can be said about how any new and unproven technology is perceived.

Then there is the belief that self-driving cars are simply another way for the wealthy to become more wealthy by taking jobs away from the working poor, allowing those who can afford to take a taxi whenever they want to ride in luxury limos without needing to share the ride with a driver. Or there is the conviction that vehicles loaded with cameras and sensors are part of the police surveillance state. Or there is the view that driverless vehicles are intended as a substitute for public transportation and a reason for defunding it. All of these negative attitudes were exhibited in the June 2025 riots in Los Angeles, which were sparked by protests against aggressive enforcement of immigration laws by the Trump administration. There were photos of demonstrators spray painting graffiti on Waymo vehicles and setting them ablaze. Six Waymo vehicles were vandalized in the riots, and Waymo temporarily halted operations in the area.

There was no one in Los Angeles at the time of the riots, not the mayor or council members, not the social welfare organizers, not the state or federal members of congress, and definitely not Waymo and its parent Alphabet, who stood up and said, “Wait! The purpose of these self-driving cars is to give rides to people who cannot afford other transportation alternatives. Leave them alone!”



**WELL INTO THE** third decade of the 21st century, people are not asking for driverless cars. They are asking for a way to travel in their cars that is safer than it is today, when a large number of people both in and outside of cars are killed and injured in car-related accidents. They are asking for a way to travel that is less stressful than it is today, with that stress caused by increases in traffic congestion and the increased complexity of roadways built to carry ever larger numbers of ever larger sizes of vehicles. They are asking for a way to travel that is both less expensive for them and less harmful to the quality of the air they breath. They are asking for a way to travel that is more inclusive by being both more affordable and able to be used by individuals who cannot drive themselves.

The Waymos and Auroras, the AI and robotics departments in universities, and the single-purpose government research organizations like DARPA are not the ones who should be driving the driverless vehicle initiative. They see the problem from inside their own domain, whether it is robotics, artificial intelligence, wayfinding, image analysis, or brokering advertising sales (e.g., Google). They cannot take the kind of holistic view of why driverless vehicles make sense outside of the military realm or beyond the fixation with replacing humans with robots because they are convinced that robots make better workers than humans, and better drivers because they don't misbehave. Are we really sure about that? Let's give credit where it is do, but not before it is earned.

So far, there are two vision statements for a driverless vehicle (adapted and updated from Henry Ford's). One is the safety vision: "By buying one, a person could enjoy, perfectly alone or with your significant others, hours of pleasure in nature's great open spaces or the confines of a city, wherever you are more comfortable, without ever having an accident." Most of the technology to achieve this vision is available today, but governments have difficulty passing laws that prevent people from driving who have any form of self-induced impairment (e.g., alcohol, drugs, sleep deprivation), and that prevent vehicles from exceeding the speed limits. Presumably, if there is not a human driving, there will be no objections to making the robots who are driving obey the laws. Governments have difficulty doing what is necessary to prevent animals and pedestrians from occupying the rights-of-way reserved for motorized vehicles. Presumably, following the Laws of Robotics proposed by Isaac Asimov, robots will be programmed to never run into an animal or a pedestrian, unless by doing so, they put the riders of the car in danger. Governments have difficulty enforcing laws for how vehicles share public spaces where people get into and out of vehicles, such as at loading zones, bus stops, and crosswalks. Presumably, riders will accept being deposited in safer places even though it is less convenient for them if there is no driver to whom they can complain.




*William F. Buckley, Jr. on his way into Manhattan from Stamford, Connecticut in 1974 with an early version of a "mobile phone", accompanied by one of his best friends, a King Charles Spaniel, and being driven by his trusted chauffeur. WFB was a terribly busy man, and every minute he was doing something other than working was a minute wasted.*

The other vision is for the life of luxury: "By buying one, a person could enjoy going anywhere without needing to drive oneself." Wealthy people have always been able to do this, whether it was in a horse-drawn carriage or in a Rolls-Royce, and they can do it today by employing chauffeurs or taking taxis (Uber et al included). Presumably, the allure of being chauffeur-driven without the cost of a chauffeur will appeal to the masses as well as the penny-pinching billionaires. Everyone can feel rich and privileged.

#### *A third way forward*

There is a third vision. It is for people who are just as busy but not as rich as Mr. Buckley, so they cannot afford a chauffeur or a taxi to take them to wherever they need to go whenever they need to get there. It is for people for whom every minute wasted on exceedingly long journeys on public transportation to get to a job means less food on the table, less education, less security for a



healthy future, and less time spent with family and friends and doing the other things that make life worth living. “By having ride delivery vehicles that cost one-half to two-thirds less than human-driven vehicles for a ride, many more people could obtain access to jobs and services that are currently out of their economic reach.”

For this vision to become a reality, there need to be multidisciplinary teams working on driverless vehicle solutions with the goal of solving real, everyday problems for real, everyday people. Those teams need to take the full spectrum of requirements that people who ride in those vehicles will have. Getting somewhere without hitting things along the way is not a vision in itself. It is part of designing and developing every part of every car. Printing articles, having online discussions and conference panels about driverless vehicles that only discuss whether LiDAR is essential, as Waymo and its supporters contend, or whether it is “lame, stupid, and a fool’s errand”, as Elon Musk argues,<sup>17</sup> is now counter-productive. The focus needs to move to making driverless mobility work for riders – all riders.



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<sup>17</sup> “That’s Why Waymos Can’t Drive On Highways”. <https://electric-vehicles.com/tesla/musk-says-waymos-cant-drive-on-highways-as-lidar-radars-reduce-safety/>

### *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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