What's Next?

The Autonomous Vehicle Revolution Expands to Trucks

By Arthur D. Spratlin, Jr.

The transportation revolution is here! Fasten your seatbelts!

The race is on for the mass rollout of self-driving, autonomous vehicles (AVs). Google (now Waymo) and Nissan hope to get there by 2020. Ford and Volvo hope to have a fully autonomous vehicle on the road by 2021. You have probably begun to take more than a passing glimpse at the seemingly daily news articles about AV technology. The reality is that the technology is here (subject only to being fine-tuned), but the current federal and state regulatory schemes (or lack of them) are causing confusion and delays. In other words, our existing automobile laws are becoming more outdated day-by-day as AV technology continues to advance, and these outdated laws are creating barriers to the development, testing, and deployment of AVs.

While the "non-traditional" auto manufacturers (Google/Waymo, Apple, Uber, Tesla) raced to take a quick lead in the public's eye on AV technology, the major auto manufacturers quickly ramped up their AV development to keep the pace. Now, GM, Ford, Toyota, Nissan, Volvo, BMW, Mercedes, and Audi are all in the race to see which one can bring AVs to the commercial market first. Traditional auto parts suppliers such as Continental, known for its tire division, are also pioneering innovations in the autonomous vehicle race. Continental opened a Silicon Valley business unit called "Continental Intelligent Transportation Systems" in 2014.

The race has resulted in a series of mergers, acquisitions, and partnerships among the auto manufacturers and a variety of start-ups, software companies, and product suppliers. For example, GM recently invested $500 million in ride-share company Lyft, and then it invested $1 billion to purchase Cruise Automation, a self-driving vehicle startup. Among technology and software companies, Intel recently acquired Mobileye, and Nvidia is providing self-driving software to Audi. In May 2016, Google announced the construction of a 53,000-square-foot facility in Michigan, to test its AV technology, and Google/Waymo is testing its self-driving cars in Phoenix through its "early rider" program. Toyota recently announced a $1 billion investment

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in its AV program. Uber is operating autonomous cars in Phoenix and Pittsburgh, and it acquired self-driving truck start-up Otto in August 2016 in a deal reportedly valued at about $680 million. As a group, several of the companies recently banded together to form the Self-Driving Coalition for Safer Streets, a lobbying group, to ensure that AVs hit the market sooner rather than later. The coalition is promoting one clear set of federal laws, which they intend to help develop, as the best way to evolve the technology.

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Why All the Fuss?

Safety is the reason for all this attention. There were about 40,000 deaths in the United States in 2016 due to automobile accidents (an increase of 6 percent), including some 4,000 fatalities (11 per day) related to truck and bus crashes. In addition, there were 2.5 million injuries and over 6 million accidents. And more than 90 percent of those accidents were caused by human error. Estimates show that AV technology could reduce traffic deaths by about 80–90 percent. So the obvious problem is the human driver. Humans get tired, sleepy, and distracted, they text, they look at Facebook… and they drink. In fact, one theory is that our children and grandchildren will look back one day with shock and disbelief as they consider the number of deaths and accidents during the first 100 years of the automobile when we actually drove them ourselves! On the other hand, the recent, highly publicized, Tesla accident in Florida, believed to be the first fatality involving a vehicle in autonomous mode, has been a wake-up call to the industry. But statistically, Tesla points out that its autopilot mode, when used in conjunction with driver oversight, reduces driver fatigue and is still safer than purely manual driving. Tesla also notes that its system was still in the beta-testing phase and that it provided warnings to the drivers that they remain engaged and ready to take the wheel.

Other benefits expected to come about as a result of AVs include reduced traffic congestion, off-site parking, fewer cars on the road, and less individual car ownership, as our society moves to a ride-hailing and ride-sharing mentality. Who wants the cost, maintenance, and insurance expenses and the other hassles of car ownership when your vehicle sits unused in the garage depreciating 90 percent of the time? Studies show that the members of our younger generation do not want to be bothered with driving anyway. They much prefer the freedom to text and use social media. And AVs will give new freedom to the elderly and people with disabilities.

How Will It Work?

The AVs are loaded with radar, lidar, cameras, sensors, software, maps, and computers with 360-degree awareness that can see around corners and over hills and otherwise anticipate things that humans cannot, and they can react faster. And the AVs will be connected to each other by vehicle-to-vehicle (V2V) technology, and to the world around them by vehicle-to-infrastructure (V2I) technology, via dedicated, short-range communication (DSRC) links to a wireless spectrum band similar to Wi-Fi. The merger of these technologies will allow the AV to become part of an integrated transportation ecosystem. In fact, the National Highway Traffic Safety Administration (NHTSA) proposed a rule mandating the deployment of connected V2V communications in December 2016.

One of the biggest debates among the manufacturers is how much autonomy the car needs to have and whether to pursue "semi-autonomy," (meaning that the human driver must take over in emergency, *i.e.*, GM), or "full autonomy," (meaning no steering wheel, no brake pedals, *i.e.*, Google). Google argues that semi-autonomy is actually more dangerous because the whole point is to remove the humans from behind the wheel, since humans cannot be relied upon to act quickly enough in emergency situations.

Federal Regulation and Guidance

With the backing of the federal government, the manufacturers and the states have the support to move the AV technology, testing, and development along at a brisk pace. President Obama carved out $4 billion in the 2017 budget for AV development, and NHTSA is bullishly advocating for AVs. To circumvent the patchwork of various state laws that are already developing, the U.S. Department of Transportation (DOT) and NHTSA have issued two recent operational guidelines for AV testing and regulation and a "model" policy for the states to help end the mish-mash of regulations that threaten to stymie the development of AVs.

Federal Automated Vehicle Policy

The first proposal by NHTSA was a 116-page policy, entitled, "Federal Automated Vehicle Policy—Accelerating the Next Revolution in Roadway Safety" (FAVP), which was released during the Obama administration on September 20, 2016, and was intended to serve as a guideline to establish a foundation and a framework upon which future DOT/NHTSA action would occur. This first policy, divided into four sections, identified which aspects of AV regulation would be uniform, and which would be left to the states' discretion. The guideline, which uses the term "HAVs" (highly automated vehicles), focused on safety, acknowledging that there were over 35,000 deaths on U.S. highways in 2015, 94 percent of which were caused by human error or bad decision making. This initial regulatory framework served as a "best practices" to guide manufacturers in the safe design, testing, and deployment of HAVs. In keeping with NHTSA's "ambitious approach to accelerate the HAV revolution," and its desire "to be more nimble and flexible," the policy was expected to be updated annually, if not sooner.

"A Vision for Safety"

Accordingly, a year later, the DOT in cooperation with NHTSA, under the Trump

administration, issued a new federal AV policy on September 12, 2017, entitled, "Automated Driving Systems: A Vision for Safety 2.0" (A Vision for Safety), replacing the FAVP. The non-regulatory framework refers to automated driving systems (ADSs), whereas the original guideline referred to highly automated vehicles (HAVs). The new NHTSA guideline continues to adopt SAE International's six automation levels (levels 0–5), specifically focusing on vehicles falling within Levels 3 through 5, which are considered to be "conditional," "high," and "full automation," and include vehicles with no human driver. The new policy is "technology neutral" in that it does not favor traditional auto manufacturers over software companies; rather, it encourages one and all to enter the space to develop the AV technology sooner.

A Vision for Safety is a much leaner, 36-page document with only two sections. Section 1, "Voluntary Guidance," offers recommendations and suggestions by NHTSA for industry discussion among designers of ADSs to help analyze, identify, and resolve safety considerations with regard to design best practices before deployment. The new policy simplifies the process for manufacturing, testing, and deploying AVs, and it discourages the states from drafting conflicting legislation of their own. The policy attempts to strike a balance among competing groups by giving the manufacturers the flexibility that they need to allow the private sector to lead the charge on technology, while maintaining federal oversight over the process to appease the critics who are voicing safety concerns over the new technology. As for trucks, the "Voluntary Guidance" section notes that interstate motor carrier operations and commercial drivers continue to fall under the Federal Motor Carrier Safety Administration (FMCSA).

While NHTSA will be responsible for regulating the safety, design, and performance of the AVs, section 2, "Technical Assistance to States," provides clarity to the states on their role in the safe integration of Level 3–5 ADSs on public roads to ensure a consistent, unified, national framework, so as not to create barriers to ADS operation (such as any requirement that a driver keep one hand on the steering wheel at all times). The states will be responsible for regulating the human driver and most aspects of vehicle operation, including driver licensing, vehicle registration and titling, and ensuring that traffic laws do not hamper AV technology. Section 2 encourages the states to create or designate a lead agency to monitor ADS applications and testing, along with asking them to consider how to allocate liability among owners, operators, and manufacturers, and determining who must carry motor vehicle insurance.

Similar to the FAVP, the new policy is intended to be flexible and updated when necessary, with the expectation that it will evolve as the needle continues to move on AV development.

SELF DRIVE Act and AV START Act

The new guideline comes on the heels of the passage of H.R. 3388, by the U.S. House of Representatives on September 6, 2017—first-of-its-kind legislation entitled, "Safely Ensuring Lives Future Deployment and Research in Vehicle Evolution" (SELF DRIVE) Act. A rare bipartisan bill, the House passed the SELF DRIVE Act for the stated purpose of increasing safety, increasing mobility for the handicapped and the elderly, and keeping America at the forefront of autonomous vehicle research. The Act preempts the states from implementing laws creating barriers to AV technology, and to the contrary, it allows manufacturers to deploy 25,000 vehicles in the first year that do not meet normal safety standards, with that number increasing to 100,000 vehicles in subsequent years.

The SELF DRIVE Act expedites the continued development of AV technology by clearing out the patchwork of conflicting state laws around the country. The Act recognizes the urgency to improve traffic safety, noting the recent uptick in traffic fatalities, while placing a specific emphasis on mobility for those in our society who are unable to drive themselves, given AVs' promise to provide our handicapped and disabled communities with the experience and freedom of mobility.

The House bill, however, does not include heavy trucks. The Senate conducted a hearing on September 13, entitled, "Transportation Innovation: Automated Trucks and Our Nation's Highways," to consider whether to include trucks in the Senate version of the bill. The testimony on behalf of the American Trucking Association emphasized the importance of including trucks in the discussion and a desire to be at the table while the roadmap for AVs is being drawn. After all, there are some 33.8 million commercial vehicles in the United States, which travel an estimated 450 billion miles annually. The Senate is expected to pass its own version of the SELF DRIVE Act—S. 1885 the "American Vision for Safer Transportation through Advancement of Revolutionary Technologies" (AV START) Act—so we will continue to monitor the daily evolution of the ongoing federal legislation on AVs.

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State Regulations and the SAVE Act

Meanwhile, before the release of the new NHTSA policy and passage of the SELF DRIVE Act, some 22 states had already passed some form of AV legislation or issued an executive order concerning AVs. Among those states, several have passed what is known as "Save Act" legislation. The Save Act legislation (Safe Autonomous Vehicles Act) is seen by some as favoring traditional auto manufacturers over the non-traditional software companies, which merely add their equipment to existing vehicles. The new federal guideline puts an end to any preferential treatment for one manufacturing or software entity over another, and it discourages any such distinctions between those invested in the emerging autonomous vehicle space.

Beyond the legislation, several states have been increasingly proactive with their investment in AV infrastructure and technology. In an effort to make Virginia a leader in AV-technology research and

development, and to streamline the use of Virginia's roadways and state-of-the-art test facilities for AV testing and certification, the state announced on June 2, 2015, the creation of the "Virginia Automated Corridors Partnership." This initiative was created to help build a new economy, and to provide the opportunity for AV manufacturers and suppliers to experience ideal, real-world environments that they need to test complex driving scenarios. The program integrates numerous resources, such as 70 miles of interstate highway, dedicated high-occupancy toll lanes, high-definition mapping capabilities, enhanced pavement markings, and connected vehicle capability, via dedicated, short-range communications. Likewise, Ohio (home to some 70,000 truck drivers) committed $15 million to create a 35-mile stretch of highway outside Columbus for testing self-driving trucks.

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Similarly, Arizona Governor Doug Ducey signed an executive order on August 25, 2015, to encourage AV development and testing. Michigan lawmakers recently passed new legislation to allow for the expanded manufacture and road testing of AVs, in an effort to protect Michigan's dominance in the automotive research and development arena, before other states (and countries) beat them to the task. California and Nevada, among others, have already passed legislation to promote and encourage AV development and to allow AV testing on public roads. Much of the past debate among state legislatures involved whether to require a human driver behind the wheel who can take over, or whether the definition of "driver" can actually include the AV's computer system, which acts to control the vehicle. The new NHTSA policy and the SELF DRIVE Act take care of those issues, however.

From Self-Driving Cars to Robo-Trucks

While driverless cars have been getting most of the media attention, self-driving trucks are quickly entering the discussion. The chatter reached a high pitch in May 2015, when Daimler showcased its Freightliner Inspiration Truck at the Hoover Dam in Nevada, promising to unlock autonomous vehicle advancements that reduce accidents, improve fuel efficiency, cut highway congestion, and safeguard the environment. It was the first licensed, autonomous-commercial truck to operate on an open public highway in the United States. The truck is equipped with "highway pilot" sensors and computers that link together cameras, radar systems, lane stability, collision avoidance, speed control, braking, steering, and other monitoring systems, which combined, create a Level-3 autonomous vehicle, allowing the driver to cede full control under certain conditions. The driver is in control when exiting the highway, traveling on local roads, and making deliveries. Daimler expects its semi-autonomous truck to hit the market by 2020.

The Daimler event was followed by the Otto self-driving truck (in partnership with Uber), transporting a load of beer from Fort Collins, Colorado, to Colorado Springs, on October 20, 2016. (Otto was acquired by Uber in August 2016.) This was followed by Starsky Robotics and Embark coming out of stealth mode in February 2017, to reveal to the public their self-driving technology.

Embark, which received authority to test its trucks on public highways from Nevada in January 2017, was founded by two Canadian 21-year-olds in response to a shortage of long-haul drivers and the 10x job turnover ratio. Their vision is an exit-to-exit strategy: the truck operates without a driver until it reaches an exit point staging area. The result is the creation of more "local" truck-driving jobs for delivering the goods to their final destination. It is believed that handing off hundreds of miles of "boring" freeway driving to a robot partner will allow Embark to move more loads per day and increase driver productivity. Embark recently announced that it is teaming up with Peterbilt to roll out its new fleet of test trucks.

Starsky is designing an after-market kit to give trucks autonomous capabilities. Starsky's vision is to allow truck drivers to operate closer to home… actually, from home. Drivers will use a remote control to steer the truck from a highway exit to its final destination. Starsky is already hauling freight for money in Florida, and testing in Michigan, and Nevada.

Google/Waymo is reportedly set to test self-driving trucks in Arizona, in late 2017; Volvo is testing self-driving trucks in mines and self-driving garbage trucks in neighborhoods in Sweden; Amazon has reportedly formed a team to explore self-driving technology; and Tesla revealed its "Tesla Semi" electric truck, on November 16, 2017.

Trucking Economics 101

Why are trucking companies suddenly so interested in autonomous vehicle technology? It is a matter of simple economics. In fact, the economic rationale for driverless trucks may be even more compelling than the one for self-driving cars. Drivers account for about one-third of the per-mile cost of operating a truck. If a trucking company pays a driver $50,000 a year to drive a tractor-trailer that can only operate 11 hours a day and 60–70 hours a week due to the hours of service (HOS) guidelines, then why would the company not consider a one-time, $30,000 add-on piece of equipment to its tractors, which would potentially eliminate the need for drivers and allow the company to operate its assets 24/7?

The potential for 24/7 asset utilization is also expected to alter our current supply chain. For example, many of today's major warehouse distribution centers are located geographically, based on the distance that a tractor-trailer can drive under the current HOS regulations. And, along with the overlapping technology in the fields of 3D printing and drone delivery, further disruption is coming to the supply chain as we know it. Mercedes is now using cutting-edge, 3D printing to make metal components and spare parts, and UPS is experimenting with drone delivery of packages from the rooftops of its delivery vans.

Platooning

"Platooning" is a concept often discussed in the same conversation with self-driving

trucks. Platooning occurs when two or more trucks are electronically tethered about 40–50 feet apart by V2V communications, and it is thought by some to be the first step leading to a totally self-driving truck. It is estimated that in a two-truck platoon scenario, the lead truck would experience a 4 percent fuel cost savings, and the following truck would experience a 10 percent fuel cost savings, created by the reduction in wind drag and synchronized acceleration and braking. It is also anticipated that platooning drivers could alternate driving the lead truck so that the following driver (or drivers) could rest during those time frames, thus creating a reduction in driver fatigue (and additional arguments for extended HOS rules) and an increase in driver job satisfaction. Peloton is a leading AV-technology company and an innovator in the field of platooning.

Truck-Driving Jobs

It is estimated that there are approximately 3.5 million truck drivers, making it one of the most common jobs in America. It is also estimated that there is currently a shortage of approximately 50,000-100,000 drivers. Looking further, it is estimated that by 2024, there will be a driver shortage of about 175,000.

There are two schools of thought on the future of truck-driving jobs. On the one hand, it is believed that autonomous technology will merely serve as a part-time "driving assistant," allowing temporary hands-free driving in limited situations, such as on remote interstate highways, where the driver might get a two-hour break from the monotony and stress of driving. Thus, AV technology is seen as a job-enhancement feature, which along with automatic transmissions, and other improvements that will make truck driving easier (and easier to learn), are expected to make truck-driving jobs more attractive, allow older drivers to extend their retirement, and even entice younger millennials and females to enter the truck-driving market. In other words, AV technology has the potential to make truck driving a more readily desirable occupation, with less stress, and the ability to communicate with the outside world during periods of downtime created by frequent hands-free driving periods. It may also create an argument for extended HOS rules, given the resulting reduction in driver fatigue. Driver fatigue is estimated to be the cause of about one of seven fatal truck accidents.

The other side of the argument is that AV technology will slowly chip away at truck-driving careers, and as the technology evolves, it will completely eradicate the job of the long-haul truck driver. In fact, some groups have used this scenario as an argument to support a "universal income," which is a guaranteed income for our work force necessitated by the loss of jobs caused when the robots take over! There is a lot of concern, especially from the Teamsters Union, that self-driving trucks will eliminate thousands of truck-driving jobs, and the union is speaking out against the inclusion of trucks in the current and future AV legislation.

Uber for Trucking?

As mentioned above, Uber recently got into the trucking business when it purchased the self-driving truck start-up, Otto, with its sights set on "Uberizing" the long-haul freight business, with a new division called "Uber Freight." Uber unveiled Uber Freight in the early 2017, with plans for a "load-matching" app to connect shippers to trucks, as Uber connects riders to cars. Uber Freight is set to revolutionize the supply chain and increase efficiencies by cutting out the middleman (the broker) and by reducing empty miles (which some estimate to be 30 percent). At present, there is no self-driving component to Uber Freight, but Uber is using its experience with Otto to learn the trucking business. Uber Freight started in the "Golden Triangle"—Dallas, Houston, and San Antonio—and recently expanded into six new states. Uber Freight is continuing to catch on, as drivers get used to the app and the resulting efficiencies… and to getting paid quickly. There are several other Uber-for-trucking-type logistics companies out there, notably Convoy (based in Seattle), which is backed by Bill Gates, among others. Convoy has raised $80 million since its launch in 2015. Convoy originated with loads out of the Pacific Northwest, and it has since expanded into several other regions.

Liability?

The proliferation of AVs could indeed bring about a new paradigm in the way that we have traditionally viewed auto liability cases and insurance coverage. If the shift to AVs will result in fewer accidents caused by human drivers (*i.e.*, a shift in responsibility from the driver to the car itself), then we are likely to see a shift from traditional auto insurance (purchased by the driver), to product liability coverage (purchased by the manufacturer). Simply put, if the human driver is no longer "driving" the vehicle (since it may not have a steering wheel), then how is the human liable under a typical negligence analysis?

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On the flip side, if the promise of AV technology proves true, then there should be very few accidents at all, with few claims to pay, and lowered premiums. While the insurance industry is trying to get a handle on all of this, looking for some concrete information to gauge their potential risk exposures, some believe that the price of personal auto insurance will decline as human driver liability declines, while auto manufacturers and suppliers will need more product liability coverage to deal with an increase in defective technology claims. In fact, in an effort to speed the process and to settle any questions related to liability, several of the major auto manufacturers have stated publicly that they will be responsible for any accidents occurring while their vehicle is operating in autonomous mode. If the AV technology can truly account for most of the 94 percent of accidents currently caused by human error, then it sounds like a pretty safe bet.

Other Problems?

In addition to safety, there are a plethora of other thorny practical, legal, and regulatory

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issues to navigate before we see the mass commercialization of AVs, such as licensing, registration, certification, insurance, infrastructure, cybersecurity, privacy, and ethical dilemmas—such as when the AV must decide between two bad outcomes in an unavoidable accident scenario. But at the current pace of AV technology, expect to see these issues debated and resolved sooner than later.

What Else Is Out There?

Just when you thought that the concept of a self-driving car or truck was difficult to digest, you are already way behind! AVs are just a piece of the new transportation ecosystem. On October 27, 2016, Uber released a white paper revealing its ambitious vision for on-demand aviation via small, electric-powered aircraft known as VTOLs (vertical take-off and landing), by and through a new division called "Uber Elevate." Yes, flying cars. Uber Elevate does not intend to build the VTOL aircraft hardware itself, but it plans to collaborate with vehicle designers, entrepreneurs, regulators, government agencies, and others to bring on-demand urban air transportation to life.

In the larger scheme of things, we are steadily working our way toward "smart cities." The ever-connected and app-friendly smart cities will be engineered to alleviate everyday annoyances by using technology systems that react to the data collected. For instance, think smart power grids to address power outages immediately; smart garbage cans to compact trash and notify the sanitation department when they need to be emptied; on-demand mobility, with new car-sharing availability; smart parking meters that alert drivers to open spots; and smart policing, with artificial intelligence programs to predict where future crimes will occur 8–10 hours in advance so that police can concentrate patrols where needed.

And looking way on out there, Charles Bombardier has a design on paper for a supersonic plane called the Antipode, which can travel from New York, to London, in 11 minutes. The supersonic business aircraft can supposedly reach a speed of Mach 24—up to 16,000 miles per hour—which is 12 times faster the Concorde! Oh yes, the transportation revolution is here! Fasten your seatbelts. FD