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WHEN FANTASY BECOMES REALITY

MARCH 2017

PREPARING TODAY FOR TOMORROW'S AUTONOMOUS VEHICLES

BY MATT ALDERTON

Before German engineer Karl Benz created the first automobile in 1885, roads were made of dirt, gasoline was sold at drug stores as a treatment for head lice, and the best way to get across town quickly was on the back of a horse. The idea of a 'horseless carriage' powered by a motor instead of a mare seemed ludicrous. Over a century later, however, the only thing ludicrous about cars is the notion of a world without them.

The advent of autonomous vehicles means North America's transportation landscape is on the verge of yet another radical transformation. Instead of reacting to the shift years after it happens, like in the case of the first motorized vehicles, governments have an opportunity to do things differently this time—they can save lives by preparing for the shift years before. Which is exactly what regulators are doing across the United States and Canada, where autonomous vehicle policies are being engineered in step with automated vehicle technology.

THE FUTURE IS HERE

It took decades for Americans to trade in their horses for cars. Mass production of Henry Ford's Model T began in 1913, yet some areas of the country primarily relied on horse-and-buggy transportation until the end of the Great Depression in 1939. The transition to automated vehicles won't be much faster, predicts Nat Beuse, association administrator for Vehicle Safety Research at the National Highway Traffic Safety Administration (NHTSA).

> **FAST FACT**
> IHS Automotive predicts that by 2035, there will be **31 million** self-driving cars on the roads worldwide.

"It takes a long time for the fleet to turn over," he says. "The average age of a vehicle on the road today is well over 11 years old. That means that for some time we will have a mix of vehicles on our roads."

Indeed, the Institute of Electrical and Electronics Engineers (IEEE) predicts that by 2040, 75 percent of cars on the world's roads will be fully autonomous, which means at least some people will still be sitting in the driver's seat of their vehicle mid-century, even if most of their neighbors are lounging comfortably in the backseats of theirs.

That's not to say that automated vehicles are reserved for the future. Although it could take 30 years or more for all cars to be fully autonomous, some cars will be self-driving by the beginning of the next decade. A handful already are. Google, for instance, successfully tested its self-driving technology on a public road for the first time in 2015. Uber likewise has been testing its system since 2016. And Tesla already is manufacturing all of its vehicles with "the hardware needed for full self-driving capability"—even though drivers can't yet use it. Automakers like BMW and Ford, meanwhile, plan to begin producing automated vehicles as early as 2021; BMW's will be SAE Level 3, meaning it will be capable of self-driving only in certain conditions, like on highways, while Ford's will be SAE Level 4, allowing it to self-drive in most, but not all, conditions.

Google has been working on self-driving technology since 2009. To date, its vehicles (like the one pictured here) have driven more than 2 million miles.

"These technologies are already on the road," says NHTSA Director of Communications Bryan Thomas. "So the question isn't: When are autonomous vehicles coming? It's: What do we do about them since they're already here?"

JURISDICTIONS LEAD THE WAY

Since 2012, at least 34 states and the District of Columbia have considered autonomous vehicle legislation, with 10 jurisdictions passing such legislation.

Nevada was the first, authorizing the operation of autonomous vehicles in 2011, says Jude Hurin, administrator of the Management Services & Programs Division within the Nevada Department of Motor Vehicles. "The law required [the DMV] to create definitions for autonomous vehicles, a testing program, insurance requirements and a consumer deployment program," explains Hurin, who says the state's leadership on autonomous vehicles comes from the top. "Our governor is a high-tech governor who wants Nevada to be known not only for gambling and mining like it has been in the past, but also for cutting-edge technology. With that in mind, our goal has always been to bring forward new technology in a commonsense way that maximizes safety for consumers but minimizes red tape for industry."

Companies wishing to test autonomous vehicles on Nevada's roads must: allow vehicle operators to switch easily between 'autonomous' and 'manual' modes; pre-test their vehicles for at least 10,000 miles in a controlled environment; give their vehicles the ability to capture and store crash data for at least 30 seconds prior to a collision; deploy their vehicles with at least two occupants inside them, including one person who can manually operate the vehicle if necessary; display a designated red license plate on their vehicles; and supply a $5 million bond or insurance policy.

Although the DMV currently is issuing licenses only for testing autonomous vehicles, it already has regulations in place for publicly deploying them, too. Manufacturers wishing to sell autonomous vehicles must self-certify that their vehicles comply with minimum safety standards, while motorists wishing to purchase them must obtain a special driver's license endorsement and display a designated green license plate.

> **AUTONOMOUS EVOLUTION**
> There are six levels of vehicle automation, according to SAE International, whose definitions have been adopted by the National Highway Traffic Safety Administration (NHTSA) as part of its Federal Automated Vehicles Policy. Level 2 systems already are on the market, and Level 3, 4 and 5 systems are expected to be commercialized in the next decade.
>
> - Level 0: No Automation
> The human driver does everything.
> - Level 1: Driver Assistance
> An automated system on the vehicle can sometimes assist the human driver in conducting some parts of the driving task, like steering or accelerating. Adaptive cruise control and lane-keeping systems are examples.
> - Level 2: Partial Automation
> An automated system on the vehicle can actually conduct some parts of the driving task, while the human continues to monitor the driving environment and performs the rest of the driving task. Examples include park-assist technology and Tesla's Autopilot system.
> - Level 3: Conditional Automation
> An automated system can both actually conduct some parts of the driving task and monitor the driving environment in some instances, but the human driver must be ready to take back control when the automated system requests.
> - Level 4: High Automation
> An automated system can conduct the driving task and monitor the driving environment, and the human need not take back control. But the automated system can operate only in certain environments (e.g., flat road) and under certain conditions (e.g., dry weather).
> - Level 5: Full Automation
> The automated system can perform all driving tasks, under all conditions that a human driver could perform them.

Its regulations mean Nevada will be ready to press 'play' on autonomous vehicles at the same time as industry.

"Industry isn't going to wait for ... national standards," Hurin says. "They're ready to start deploying now, and they're looking for states that are ready to work with them."

Other states that have indicated a willingness to work with industry include Florida, which was the first state to let companies test autonomous vehicles without backup operators inside them; Michigan, whose governor recently signed legislation allowing the sale of autonomous vehicles to consumers once they're ready, as well as driverless testing and the operation of autonomous taxi services; and California, which in 2012 became the second U.S. state to pass a law allowing testing of autonomous vehicles with human operators. The latter currently is drafting regulations that will allow for true driverless testing as well as public deployment of fully autonomous vehicles by 2018, according to 2016-2017 AAMVA Chair of the Board Jean Shiomoto, director of the California Department of Motor Vehicles.

"California has a lot of tech companies in Silicon Valley that employ the scientists and engineers who are evolving automated vehicle technology," Shiomoto says. "That has afforded us a really unique opportunity to be on the cutting edge of learning how the technology works and where it's going inthe future."

Self-driving cars boast a number of high-tech features that help them to comprehend their surroundings. Video cameras located in different areas of the vehicle provide 360 degrees of vision. Ultrasonic sensors complement the cameras by detecting objects, and odometry sensors keep track of distance traveled. Radar sensors can detect objects through rain, fog or snow.

Companies that want to test highly automated vehicles on public roads in California must seek a testing permit, demonstrate their ability to pay damages and pre-test their vehicles. Additionally, they must have certified drivers in their vehicles, maintain a driver training program and report any accidents involving their vehicles to the DMV, as well as any 'disengagements' (i.e., instances where the human driver needs to take over for the car).

"For us, the focus has been safety first," Shiomoto says. "We need to make sure the technology is safe before we put it on the road with consumers."

A NATIONAL FRAMEWORK

As jurisdictions like Nevada and California have been developing their autonomous vehicle strategies, the federal government also has been fine-tuning its approach, according to NHTSA, which in September 2016 issued a four-part Federal Automated Vehicles Policy. The first part outlines 15 voluntary safety areas that manufacturers must address prior to developing and deploying autonomous vehicles. The second part, known as the Model State Policy, delineates federal and state roles in the regulation of autonomous vehicles. Finally, the policy's third and fourth parts outline what existing authorities and tools NHTSA can bring to bear to regulate automated vehicles today, as well as what new authorities and tools it might need in order to regulate them in the future.

"It's a pretty significant milestone, because some of these systems are on the road now," Beuse says. "This policy sets forth a framework for the country for how these vehicles should be tested and deployed."

Because automated technology is evolving at breakneck speeds, NHTSA and its stakeholders—including AAMVA—will revisit and revise that framework on an annual basis. "It's very flexible to allow innovation to continue while at the same time making sure all the necessary stakeholders continue conversing with each other and raising potential issues," Beuse continues.

For jurisdictions, the most significant component of the Federal Automated Vehicles Policy is the Model State Policy. Developed in close collaboration with AAMVA's Autonomous Vehicle Best Practices Working Group, it reaffirms for autonomous vehicles the roles that state and federal governments have traditionally played with regard to motor vehicle regulation. It states that NHTSA will continue to regulate vehicle safety and equipment, while jurisdictions will retain their traditional responsibilities for vehicle licensing and registration, traffic laws and enforcement, and motor vehicle insurance and liability regimes.

Given their regulatory responsibilities, the policy supplies jurisdictions with a regulatory template that's designed to enable consistent regulations across state lines.

"The Model State Policy [seeks to build] a consistent national framework of state laws and regulations," Thomas explains. "Today, you can drive from Seattle to Miami and never worry about whether your vehicle is in compliance with different laws as you cross state lines. We want a similar dynamic to exist for operators with automated vehicles. Likewise, we want the developers of these technologies to be able to design to a single standard instead of 50 different standards."

"If states choose to regulate the testing of automated vehicles, following the Model State Policy can provide a path toward consistent regulation, which will help ensure that vehicles are tested safely while supporting research, development and innovation," adds AAMVA Director of Vehicle Programs Cathie Curtis.

STEERING SUCCESS

Whether they leverage the Model State Policy or build their own policy from scratch, the best approach for jurisdictions to take toward regulating autonomous vehicles is the collaborative kind.

"We started by meeting with different manufacturers. We visited their offices and test labs in Silicon Valley, we met with their developers, and we rode in their vehicles to learn firsthand how the technology works," Shiomoto says of California. "It took a lot of boots on the ground, pounding of the pavement and just having really good discussions about what the technology can do and where it's going in the future."

Hurin, who is vice chair of AAMVA's Autonomous Vehicle Best Practices Working Group, echoes: "In Nevada, we thrive upon our partnerships with industry. We're the first to admit that we don't know everything, so it's important that we sit down with all stakeholders to identify what the issues are and build regulations together if they're needed."

> **AAMVA IS AUTOMATION-READY**
> Jurisdictions crafting their approach to automated vehicle testing and deployment can count on AAMVA for resource documents and guidance. "Our Vehicle Staff, led by Director of Vehicle Programs Cathie Curtis, who sees the association has been collaborating closely with state and federal stakeholders—including the National Highway Traffic Safety Administration (NHTSA)—to develop guidance for the jurisdictions that promote both safety and innovation.
>
> "At AAMVA, we're helping our members become more familiar with automation in vehicles by meeting with stakeholders, holding conference calls with our Autonomous Vehicle Information Sharing Group, continuously adding to the Autonomous Vehicle Information Library on our website and providing guidance for the regulation of autonomous vehicles with NHTSA through our Autonomous Vehicle Best Practices Working Group," reports Curtis.
>
> Curtis concludes, "AAMVA sees its role as helping jurisdictions to understand and prepare for automated vehicle technology, so we're making sure we provide our members with opportunities to learn, engage with stakeholders and receive assistance in whatever direction they choose to take with allowing the testing and deployment of automated vehicles on their roadways."

That collaborative spirit should extend not only to industry, but also to legislators, adjacent state agencies, law enforcement, insurance companies and other stakeholders, according to Shiomoto, who says jurisdictions such as California, Nevada and Pennsylvania have taken a steering-committee approach to identifying and addressing autonomous vehicle needs and requirements. California's steering committee, for example, includes representatives from NHTSA, as well as state agencies like the California Highway Patrol, the California Department of Transportation, the California State Transportation Agency and the Department of Insurance, all of which meet regularly to share information, ideas and concerns.

"You need to make sure everybody is aware of what the future holds and prepare for that collectively as a state," advises Shiomoto, who recommends sharing information not only across agencies, but also across state and even national borders. "There are a lot of resources out there that you can take advantage of, you don't have to do this on your own."

DESTINATION: SAFETY

Will 'drivers' of self-driving cars still need a driver's license? How will insurance companies write policies for people who aren't actually driving? When an autonomous vehicle commits a traffic violation, will law enforcement issue a ticket to its passenger or to its manufacturer? What about 'connected' vehicles, which will leverage sensor networks to steer around obstacles? What standards will they use to communicate securely with other vehicles and infrastructure?

Clearly, questions still outnumber answers. Establishing policies and partnerships now, however, will make jurisdictions more nimble later. The future they'll usher in as a result won't just be 'cool' or 'convenient,' according to NHTSA. It also will be safe.

> **FIND OUT MORE**
> Visit AAMVA's Autonomous Vehicle Information Library.

"Ninety-four percent of crashes in the United States can be tied back to human choice or human error," concludes Thomas, who says there were 35,092 deaths on U.S. roadways in 2015 alone. "That's a huge, huge number of crashes that could be prevented with autonomous vehicles, which is why we all have to work hard to accelerate the adoption of [this] technology."

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