
# When Your Car Is Smarter Than You

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CLIENT ALERT

# OHIO GOVERNOR KASICH SIGNS EXECUTIVE ORDER ALLOWING AUTONOMOUS VEHICLE TESTING

**MAY 2018**

On May 9, Ohio became the most recent state to allow the testing of autonomous vehicles when Governor John Kasich signed Executive Order 2018-04K (the Order). With it, Governor Kasich looks for Ohio to maintain a leadership role as a premier testing ground for autonomous vehicles, as well as promote economic development in the state.

The Order begins by discussing the need for innovation in this space, both generally and unique to Ohio. Citing research by the National Highway Traffic Safety Administration (NHTSA) that 94 percent of serious crashes result from driver error and up to 80 percent of accidents involving impaired drivers could be avoided or mitigated with new technologies, the Order lists the many advantages that Ohio offers for autonomous vehicle testing. These include:

- The Transportation Research Center located in East Liberty, Ohio, that "houses NHTSA's only test lab which performs crash avoidance and crashworthiness testing and research, automobile defects testing and analysis, and identifies cyber security issues to help regulators define national standards;"
- Ohio's 33 Smart Mobility Corridor, a 35-mile stretch of U.S. Route 33 with high-capacity fiber optic cable and embedded, wireless sensors; and
- The infrastructure necessary to test autonomous vehicles in a wide range of weather conditions throughout the state.

The Order authorizes testing and pilot programs for autonomous vehicles (defined as any vehicle with level 3 through 5 automated driving systems) on any public road or highway in Ohio, provided certain conditions are met.

For all companies testing autonomous vehicles on Ohio roads, companies must first register with DriveOhio, an Ohio government office self-described as a "one-stop shop for researchers, developers and manufacturers to collaborate on autonomous and connected vehicle initiatives in Ohio." In registering, the companies must provide DriveOhio with:

- The name and business address of the company intending to test the autonomous vehicle in Ohio;
- Identifying information about the vehicle(s), including make(s), model(s) and license plate number(s);
- The name(s) and contact information of any designated operator(s) authorized to monitor the vehicle remotely;
- Proof of insurance or other financial responsibility under Ohio law covering each vehicle and operator;
- The municipalities and other areas of the state where the company plans to test the vehicle;
- The conditions under which the vehicle can operate with full autonomy;
- Information that the vehicle being tested has been "certified to be in compliance with all applicable Federal Motor Vehicle Safety Standards or with the Federal Motor Carrier Safety Administration regulations, except to the extent exempted under applicable federal laws, and are capable of complying with all state traffic and safety laws;" and
- Either a summary report describing the company's approach for the safe testing of its autonomous system and how the company intends to assure public safety or a Voluntary Safety Self-Assessment as established by NHTSA in the Voluntary Guidance for Automated Driving Systems, Section I.

For companies seeking to test a level 4 or 5 autonomous vehicle, each company must also provide DriveOhio with "assurances, in a form acceptable to DriveOhio," that the vehicle will:

- Achieve a minimal risk condition if a malfunction occurs that makes the vehicle unable to perform the entire dynamic driving task;
- Have a designated operator;
- Be capable of complying with all Ohio motor vehicle laws; and
- In the event of a collision or violation of Ohio laws or regulations, cooperate with any appropriate law enforcement agency request for information about the accident. This includes sharing any non-propriety data recorded and preserved by the vehicle or company concerning the accident and maintaining a record of all other information until any law enforcement investigation concludes.

Although all autonomous vehicles tested in Ohio must have a designated operator, that operator is not required to be in the vehicle. Designated operators must:

- Be responsible for the safe operation of the vehicle while it is in use;
- Ensure that the vehicle reasonably complies with all Ohio traffic laws and regulations;
- Actively monitor the vehicle at all times while the autonomous system is engaged;
- Be able to detect whether the vehicle is not operating safely and, if so, be able to bring the vehicle to a minimal risk condition;
- Have a valid driver's license recognized by the State of Ohio;
- Be an employee, contractor, or agent of the company testing the vehicle or be faculty, staff, or a student of a college or university and actively involved in a partnership with that entity; and
- Report to DriveOhio any collision resulting from the operation of the vehicle while the autonomous technology is engaged on a public road.

If any company plans to test its vehicles without an operator in the vehicle, the company must first inform DriveOhio of: 1) the routes or areas where the testing will be performed; and 2) the designated operators monitoring each vehicle. If the testing takes place within a municipality's jurisdiction, the company and DriveOhio will coordinate notice to the relevant municipalities, but Governor Kasich has separately voiced his intent to prevent any communities from blocking such testing.

The Order also creates the Ohio Autonomous Vehicle Pilot Program to link municipalities interested in promoting autonomous vehicle testing with DriveOhio and companies looking to test such vehicles. Participation is completely voluntary, but those that enter into the program will work to create an inventory of testing attributes unique to their areas. This inventory will then be published to industry partners that have met the above requirements to connect them with the ideal municipalities in which to test their vehicles.

Last, Governor Kasich reserved the authority to pause any testing of autonomous vehicles "if there is clear evidence that the technology that a particular vehicle is using or that a particular company is testing is not safe." Before resuming testing, the company must demonstrate to DriveOhio that the technology complies with the Order's requirements.

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CLIENT ALERT

# DOT RELEASES UPDATED GUIDANCE ON FUTURE REGULATION OF AUTONOMOUS VEHICLES

**OCTOBER 2018**

On October 4, amid growing concerns about the safety of testing self-driving vehicles on public roads, the U.S. Department of Transportation (DOT) doubled down with a new guidance, *Preparing for the Future of Transportation: Automated Vehicles 3.0* (AV Guide 3.0). In it, DOT signaled its intention to revise federal safety rules that bar from the roads fully self-driving cars without equipment such as steering wheels, pedals, and mirrors. Perhaps more significantly, it addressed for the first time commercial vehicles of all sizes in addition to passenger vehicles. Because of the adverse impact such regulation would have on a huge employment sector, both DOT and the legislature previously had deemed commercial vehicles too contentious to address. In her introductory letter to AV Guide 3.0, U.S. Transportation Secretary Elaine Chao emphasized the importance of preparing for and promoting vehicle automation across every mode.

AV Guide 3.0 calls for the removal of unnecessary barriers to the innovation of autonomous vehicle (AV) technologies, asserting that such technology has the potential to vastly enhance security and increase mobility. It also builds upon (but does not replace) DOT's *Automated Driving Systems: A Vision for Safety 2.0*. In AV Guide 3.0, Secretary Chao wrote that automation has the potential to "significantly" reduce traffic crashes and road deaths, but she added, the "public has legitimate concerns about the safety, security, and privacy of automated technology." Secretary Chao "challenge[d] Silicon Valley and other innovators" to address the concerns.

In AV Guide 3.0, DOT announced six principles for shaping policy on autonomous vehicles:

1. Prioritize safety;
2. Remain technology neutral;
3. Modernize its regulations to eliminate those that unnecessarily impede development or fail to address critical safety concerns;
4. Encourage a consistent regulatory and operational environment: Regulatory conflicts among federal, state, and local requirements create confusion, introduce barriers and present compliance challenges;
5. Prepare proactively for automation: DOT will provide guidance, best practices, pilot programs, and "other assistance"; and
6. Protect and enhance freedoms, including preserving conventional human-operated vehicles while expanding access to transportation choices for the disabled and the older population.

Besides revising Current Federal Motor Vehicle Safety Standards (FMVSS), specific issues that AV Guide 3.0 addresses include the following:

- Given the novelty and sophistication of AV technologies, new safety standards will focus on performance outcomes rather than dictate the means for achieving those outcomes;
- The National Highway Traffic Safety Administration (NHTSA) will retain the current certification process – whereby manufacturers self-certify compliance of their products with applicable standards – and be charged with promoting self-certification with international partners;
- NHTSA will seek comment on changes that would streamline and modernize its procedures for processing applications for exemptions from FMVSS, including eliminating delays associated with seeking public comment to exemption applications;

- NHTSA will seek to implement a national pilot program for the testing and development of AV technology (DOT cancelled the "Automated Vehicle Provider Grounds" the Obama administration adopted); and
- In conjunction with the Labor, Commerce, and Health and Human Services departments, DOT will study the workforce impacts of automated vehicles.

As in past iterations of NHTSA guidance, AV Guide 3.0 highlights the need for cybersecurity and privacy against cyber-attacks. DOT encourages a coordinated effort across the government and private sectors for cyber situational awareness and a unified approach to cyber incidents, including the voluntary exchange of information regarding vulnerabilities and threats.

DOT intends to focus its research resources on (a) developing strategies to remove barriers to innovation; (b) evaluating the impacts of AV technology, especially regarding safety; and (c) addressing market failures and other compelling needs, such as access to transportation for the disabled.

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# Defensive driving for manufacturers in the autonomous revolution

**By Jonathan F. Feczko, Esq., and Zachary J. Adams, Esq., *Tucker Ellis LLP***

**MAY 2, 2018**

In every company developing autonomous vehicles today, someone just hit "Send" on an email. Any one of those emails may one day be turned over to plaintiffs' lawyers seeking millions of dollars for damage caused by the crash of one of those vehicles.

As speculation grows on the law surrounding autonomous vehicles, those facing liability should be equally mindful that the facts underlying future litigation are being written now.

And while the automakers have seen product liability lawsuits before, this new era of autonomous vehicles will include legal theories more commonly seen in other industries. Companies that take lessons from those arenas can positively shape autonomous vehicle litigation for decades to come.

Recent automotive mass torts have primarily stemmed from two legal theories: design defect and misrepresentation. In design defect cases, the plaintiff claims that the manufacturer produced a defective car that has injured people. Often, the manufacturer does not appreciate the existence, scope or severity of the defect during the product's design phase.

Examples of this type of claim include the Takata air bag and General Motors ignition switch litigations.

Takata air bags were included in vehicles produced by 19 automakers around the world. Under certain circumstances, the chemical used to rapidly inflate the air bags could deteriorate when exposed to heat. The faulty inflator housing could then rupture, sending metal fragments at the driver and passengers.

The ensuing lawsuits are based on the notion that the design of these air bags is defective, that consumers suffered physical or economic harm as a result of the air bags, and that manufacturers are therefore liable to consumers.

Takata has since filed for bankruptcy, and the effects of the litigation have rippled down its supply chain. Estimates place the number of affected vehicles at more than 37 million.

The second legal theory that has served as a centerpiece for recent automotive mass torts is misrepresentation. Misrepresentation claims can take many forms (ranging from breach of warranty to negligent misrepresentation and fraud) depending on the degree of fault alleged against the manufacturer.

Common to all of them, though, is the allegation that the manufacturer made some representation about the vehicle that was incorrect.

One recent example is the litigation concerning Volkswagen's emissions controls on their turbocharged direct injection diesel engines. Volkswagen admitted to having installed software that could recognize whether a vehicle was operating in a laboratory setting or under real-world conditions.

> Consider the dilemma presented by an autonomous vehicle forced to choose between hitting a pedestrian or harming its passengers by hitting a tree.

If the vehicle concluded that it was operating in a laboratory, it would alter the operation of the engine to satisfy government emission regulations.

When the car was on the road, however, it would not alter its operation and — as a result — would not comply with the same government regulations.

To date, Volkswagen has paid over $15 billion in settlements related to this litigation.

A key distinction between these litigations and those that companies may face over autonomous vehicles is the role of inherent risk as it applies to crashes. Inherent risk is the danger associated with a useful product that cannot be eliminated without reducing the product's functionality.

Surgery to implant an artificial knee, for example, is an inherently dangerous procedure. It carries with it the potential for infection, rejection of the implant, and even death. At least with current technology, it is impossible to place an implant without exposing the patient to these risks. Yet patients continue to accept these risks in exchange for the chance at a more active lifestyle.

For autonomous vehicles, crashes will be an inherent risk. As long as these vehicles share the roads with human drivers and pedestrians, that human element will introduce a degree of unpredictability that will prevent even the most sophisticated systems from operating absolutely accident free.

One day, technology may progress to the point of eliminating accidents altogether, but until then we should resist the temptation to delay the better in pursuit of the perfect.

Without question, these vehicles carry the potential to be vastly safer and more efficient than vehicles operated by human drivers. Indeed, the National Highway Traffic Safety Administration has found that Tesla's current Autopilot system reduces the vehicle crash rate by almost 40 percent.

Soon, however, vehicles operating exactly as intended will be responsible for deciding when and why crashes happen.

Consider the dilemma presented by an autonomous vehicle forced to choose between hitting a pedestrian and harming its passengers by hitting a tree. Even assuming that the vehicle functioned properly in leading up to and making that decision, several product liability claims could result from the inherent risk of the crash itself.

The first type of product liability claim resulting from the hypothetical attacks the design of the vehicle's programming.

Depending on the state's law, design defect claims are analyzed under one of two frameworks: the risk-utility test or the consumer expectation test.

As implied by the name, the risk-utility test balances the dangers posed by a product against its benefits to society. This test is typically more friendly to defendants.

The factors balanced when employing this test vary by state, but they include such things as the availability and cost of an alternative design and the degree to which the product's risk is obvious or avoidable.

In contrast, the consumer expectation test analyzes whether a product is defective by asking whether it is dangerous to an extent beyond that which would be contemplated by the ordinary consumer.

The subjectivity of this test offers greater flexibility to plaintiffs, but its application can be difficult when the product is particularly complex or specialized.

For companies developing autonomous vehicles, these tests present both challenge and opportunity.

Beyond the obvious challenges created by a rise in the complexity of product liability suits, companies may face difficulties based on the very technology that allows autonomous vehicles to exist in the first place.

Artificial neural networks are vital to the decisions that autonomous vehicles will make every second that they are on the road. But unlike a series of if-then statements — where the programmer's code predetermines the output — neural networks do not operate by such a rigid, algorithmic structure.

Instead, neural networks gather inputs and produce outputs based on their training. Between input and output can exist several hidden layers that adjust themselves based on the training and form the network's decision-making process.

In many ways, eliminating the rigid and predictable algorithmic structure is good and necessary. Neural networks are adaptable to less predictable situations that cannot be captured through a coded algorithm.

Moreover, they are capable of learning based on experience and improving function over time.

> Without knowing how the vehicles will behave in every situation, it will be difficult to warn how they will react in a given situation.

Neural networks can also make real-time decisions with the speed needed to replace human drivers. But when hidden layers exist in the reasoning process, neural networks may obfuscate why autonomous vehicles make the choices they do.

Conversely, autonomous technology can also result in new opportunities for defendants facing design defect claims.

To begin with, defendants will have far greater control over the facts underlying accidents because it will be their decision-making that operates the vehicles. Defendants will also have access to cameras, radar and light detection and ranging (known as "LiDAR") to better record all of the moments leading up to a crash.

Moreover, since these products are still being developed, companies who are mindful of the design defect tests can work those tests into their decision-making processes.

For instance, it is unlikely that autonomous vehicles will be mass produced until regulators are convinced that the benefits outweigh the risks.

Similarly, it is unlikely that the vehicles will be mass used until consumers are satisfied that their expectations of safety have been met. Companies that reflect defense theories in their documents today will set themselves up for success in litigation tomorrow.

The second type of product liability claim that may result from the hypothetical examples attacks the warnings that accompany the vehicle.

For example, if the vehicle chooses to risk injury to its passengers rather than the pedestrian, the passengers may allege that the manufacturer improperly failed to warn them that the programming would make that decision.

Failure-to-warn claims are also dependent on state law and exist in a number of forms, including strict liability and negligent failure to warn. Common to all of them, however, is the allegation that the manufacturer failed to provide an adequate warning and that the failure caused injury to the plaintiff.

When dealing with unsophisticated users, the adequacy of the warning becomes particularly important. A warning that is buried in a dense manual accompanying a vehicle will have a more difficult time holding up than one that is more specifically called to the user's attention.

In the medical device and pharmaceutical context, this has led to the use of "black box" warnings that specifically call to the user's attention certain serious or life-threatening risks. Just as medical device and pharmaceutical manufacturers have attempted to do for years, automakers will have to balance the thoroughness and adequacy of warnings.

The more that warnings are imprecise and overly general, the more their adequacy will be attacked due to a lack of specificity.

Conversely, the more a warning is detailed but begins to resemble a small town's phone book, the more its adequacy will be attacked because it would be unreasonable to expect an average user to understand it.

It may be tempting to dismiss failure-to-warn claims because it is impossible to warn how an autonomous vehicle's programming will react in every scenario.

Indeed, the use of neural networks will again have fascinating ramifications because it will be impossible to know how the vehicles will react to every scenario until they actually encounter them.

Imagine a system that learns to answer the question of whether an image contains a dog by showing it pictures that contain dogs and pictures that do not contain dogs. As the system gains more information, it will make better decisions. Yet even after the system has reviewed millions of pictures, there is no guarantee that its next answer will be correct.

Although it is extremely oversimplified example, this is not unlike the case of an autonomous vehicle approaching an intersection and processing variables about pedestrians, stoplights and crossing traffic.

The vehicle will be equipped with reasoning that helps it make the right decision — reasoning that will only become more advanced as millions of these vehicles hit the roads and log billions of hours each year.

But the potential for variation — especially because unpredictable human drivers and pedestrians share the road with these vehicles — will continue to frustrate efforts to guarantee how these vehicles will behave.

Without knowing how the vehicles will behave in every situation, it will be difficult to issue appropriate warnings in a given situation.

In addition to providing warnings about the decisions that an autonomous vehicle may make, companies may also need to provide continuous warnings about driving conditions.

For example, when drivers today enter a thunderstorm, they can choose if and when conditions become so dangerous that they must pull over and wait. Currently, vehicles with partial autonomy avoid this dilemma by giving control to the human driver when road conditions deteriorate.

But when cars are so autonomous that they no longer require a driver or even have a steering wheel, they may make these choices for their passengers or give passengers an option to pull over when conditions deteriorate past a certain point.

The latter scenario could present opportunities for defendants to argue that the causal chain has thus been broken, but driving may eventually be so foreign to humans that it no longer makes sense — or is safe — to ask them to make this decision.

In any event, there may still be situations in which the passengers need to override the reasoning of the vehicle, no matter how sound the vehicle's reasoning is.

Perhaps the thunderstorm previously mentioned was actually a Category 5 hurricane that the passengers were desperately trying to outrun. Perhaps one of the passengers was suffering from a medical emergency that outweighs the need for safe driving. These scenarios are certainly outliers, but they must be addressed if full autonomy is to be embraced.

As decisions concerning the development of autonomous vehicles are being made, companies should remember the legal theories underlying these product liability claims so they can best prepare to support their decisions.

Perhaps even more important, companies should be mindful of the optics surrounding those decisions — and not just the final decisions themselves. The best intentions can still result

in high-dollar verdicts when the plaintiff's counsel has a poorly worded email to wave in front of a jury.

As companies create the technology that will one day drive this new industry, they should act as though someone is looking over their shoulder with access to every communication and document they create. That is exactly the scenario they may find themselves in one day.

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# The Brave New World Of Autonomous Vehicle Litigation

By **Jonathan Feczko and Zachary Adams** (June 4, 2018, 3:03 PM EDT)

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Autonomous vehicles promise to change the way we commute, work and even plan cities. Perhaps equally dramatic will be the way they change how we prepare and try litigation following a motor vehicle accident. Exploring how autonomous vehicle litigation could look, from presuit investigations to trial themes, will help practitioners better prepare for the inevitable wave to come.

**Presuit Investigation and Discovery**

Even before a complaint is filed, autonomous vehicles can impact the way we practice by providing unprecedented information about the moments leading up to an accident. Autonomous vehicles operate by receiving inputs from cameras, radar and often lidar sensors, processing these inputs through the vehicle's neural network and outputting decisions such as braking or turning.

Until now, the vast majority of motor vehicle accidents had only witness accounts and reconstruction experts to determine who should be named as a defendant in a complaint. Witness accounts, however, can be naturally unreliable due to the passage of time, the traumatic experience of witnessing (let alone being in) a car accident and the limitations of having only one vantage point.

Similarly, while accident reconstruction experts base their opinions on calculations derived from measurable data, they ultimately depend on secondary indicators (skid marks, final resting positions, collision debris, presumed impact areas, etc.), all of which take a great deal of time and money to gather. But with autonomous vehicles, attorneys have the potential to watch a crash for themselves from multiple angles and using several technologies before deciding from whom they will seek recovery.

When crashes occur between autonomous vehicles and those operated by a person, defendants and insurance companies will benefit by having better information on which to resolve claims than they have ever had before. And while in some cases this information may make the liability case against them easier and cheaper for plaintiffs to establish, defendants can benefit in other ways.

For example, defendants gain the efficiency of replacing a long and costly legal battle over fault with the certainty of knowing key facts at an early stage. Stepping past liability sooner will reduce the overall

burden on parties and courts alike by narrowing the issues for discovery and trial and bringing the parties together for settlement more quickly.

Moreover, when crashes occur between two autonomous vehicles, manufacturers can use this information to determine the cause of an accident. If a manufacturer reviews data from its vehicle and finds no fault with its operation or decisions, it would have every incentive to share that information with the passengers to avoid being wrongly dragged into a suit.

Conversely, if a manufacturer does find an issue with its programming, it can use that to make a faster decision about when it is worth litigating a case involving one of its vehicles. It can also use the data to modify the training of its vehicles to prevent further similar accidents. At a time when companies already face an uphill battle to sway public opinion on the safety of autonomous vehicles, lengthy and public legal battles will not aid their cause.

Wise plaintiffs would use this information to streamline their complaints and avoid “shotgun” pleadings. Those that do will come to court armed with evidence approximating a Lone Pine order by making a showing of specific causation from day one. By having evidence of the issue that led to the accident, they can instantly win credibility with the court.

And in cases where the plaintiff has not thoughtfully named the parties, prepared defense counsel can use this evidence to identify the true cause of an accident and press for an early dismissal. By presenting this information to the court at an early stage, such defendants would also have less incentive to offer even a nuisance value settlement, further discouraging the inclusion of meritless defendants in future pleadings.

As parties and courts become more trusting of this evidence, they will become less patient with attorneys that burden the system by not making good use of it. This will especially be true when cases do proceed to trial. Jurors will see the evidence from autonomous vehicles' cameras and sensors, unfiltered by a witness’s account or an expert’s opinion.

This removes the potential for counsel to steer trial strategy toward a remaining defendant, and forces plaintiffs to acknowledge the cold facts of their case before significant investment has been made. But with jurors questioning less about the accident itself, it will become increasingly important for companies facing product liability suits to communicate effectively their themes about product safety and efficacy.

**The Case for Safety**

A key point for manufacturers on the safety of autonomous vehicles will be the amount of on-road experience they will have compared to the average person. Waymo LLC's vehicles recently surpassed five million miles of driving on public roads.[1] In contrast, the average driver logs 13,474 miles per year.[2] It would therefore take the average driver over 371 years to catch up with Waymo’s current experience. (For those wondering, the Guinness record for highest human-driven vehicle mileage is just over 3 million miles — still well short of Waymo’s benchmark.[3])

And as autonomous vehicles exponentially increase the amount of miles and data from which their neural networks can draw, the day may come when people are accused of negligence for the simple act of continuing to operate motor vehicles by themselves. Besides being the most experienced drivers on the road, autonomous vehicles also have more ways in which they can gather data to make decisions

while driving. People rely on the single viewpoint created by their eyes to inform the decisions they make while driving.

A Tesla Model S operating on Autopilot (which does not even claim full autonomy, but rather Level 2 or “hands off” autonomy) has eight cameras that provide the car with a 360-degree view of its surroundings at up to 250 meters away.[4] The Model S also comes equipped with ultrasonic sensors and radar, to help the vehicle detect objects regardless of weather conditions. These sensors will reach farther as the technology improves, and autonomous vehicles will eventually communicate with each other and the very infrastructure around them. When coupled with the speed and accuracy at which autonomous vehicles will process this information, it will be impossible for human drivers to keep pace.

One final way that companies could argue for the safety of autonomous vehicles is by explaining how they are the “perpetual good driver.” Autonomous vehicles will not have to worry about the consequences of taking the wheel after a happy hour or an all-nighter at the office. They will not get road rage after being cut off or suffer a case of "lead foot" while listening to their favorite song. They will not be distracted when fumbling with the navigation system or sending an email that should wait for a safer time. Their cameras and sensors will remain focused on the road at all times, processing information and making what they determine to be the safest decision. In short, autonomous vehicles will always drive as well as we wish all those around us would drive.

**The End of the Soccer Mom**

Beyond safety, lawyers defending autonomous vehicles can employ case themes about their benefits and efficiency in future litigation. For example, car owners spend roughly $8,500 per year on car-related expenses — for the most part shouldering the burden themselves.[5] Conversely, many have suggested that autonomous vehicles will operate pursuant to a subscription service rather than being purchased outright.

By way of example, Uber Technologies Inc. — one of the ride-hailing companies investing heavily in autonomous vehicles — currently charges $0.90 per mile to transport customers.[6] But between 70 and 80 percent of the total cost of their rides goes to their drivers.[7] If Uber can replace its drivers with autonomous vehicles, it stands to grow its profit margin even while reducing the cost to its consumers. If they were able to reduce the cost to even $0.60 per mile, it would be cheaper for the average driver to travel their annual 13,474 miles entirely by Uber rather than owning a car.

Even if customers want to purchase autonomous vehicles rather than subscribe to a service, the ability to send and summon your car could result in more families being able to transition to a one-car household. It is estimated that the average car is parked 95 percent of the time.[8]

But by being able to commute to work, then send their cars back to their families for use throughout the day, only to have the cars return when needed to pick them up, many workers could do away with a second or even third family vehicle. This could reduce not only the overall transportation costs for a family, but the number of vehicles on the road in general — lessening everything from traffic jams to road wear to greenhouse emissions.

Beyond any cost savings, autonomous vehicles may offer benefits by opening automotive transportation to new segments of the population. At one end of the spectrum, parents will no longer suffer restless evenings when they send their teenagers out with the car keys for the first time. Indeed, since no one in the vehicle will be a driver, there will arguably be no difference between sending a child on a bus and in

an autonomous vehicle — pushing the "driving" age to a much younger "riding" age. At the other end of the spectrum, children would no longer have to discuss with aging parents when they should stop driving. By turning to autonomous vehicles, all these individuals could claim an independence presently closed off to them.

While mass litigation involving autonomous vehicles is not yet here, one can already envision how discovery and trials might look when it is. And in the always-competitive fields of automobiles and law, we should never forget that "the secret of getting ahead is getting started." That is exactly what autonomous vehicle companies and their counsel should be doing today.

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[1] https://www.forbes.com/sites/alanohnsman/2018/03/02/waymo-is-millions-of-miles-ahead-in-robot-car-tests-does-it-need-a-billion-more/#9f9b0741ef4c.

[2] https://www.fhwa.dot.gov/ohim/onh00/bar8.htm.

[3] http://www.guinnessworldrecords.com/world-records/highest-vehicle-mileage.

[4] https://www.tesla.com/autopilot.

[5] https://newsroom.aaa.com/auto/your-driving-costs/.

[6] https://www.ridesharingdriver.com/how-much-does-uber-cost-uber-fare-estimator/.

[7] http://www.businessinsider.com/uber-drivers-are-growing-angrier-over-price-cuts-2017-3.

[8] http://fortune.com/2016/03/13/cars-parked-95-percent-of-time/.

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# What Makes Autonomous Vehicles Autonomous?

By Jay Campbell

**An artificial neural network is trained by showing it a driving situation and telling it the desired response. It then adjusts each node so the response of the neural network mimics the desired response.**

To properly understand the legal issues presented by the burgeoning field of autonomous vehicles, we must first understand how they work. In a word: magic.

Unlike most other devices which operate by a defined set of computer-encoded rules, it is impossible to determine how an autonomous vehicle makes a decision. It may as well be magic.

We cannot burrow into an autonomous vehicle's computer code and see a traditional "If-then" statement. There is no code that says, "If the car in front slows, then apply the brakes." That is because an autonomous vehicle decides what to do based on its learning, as opposed to the knowledge of a smart computer programmer.

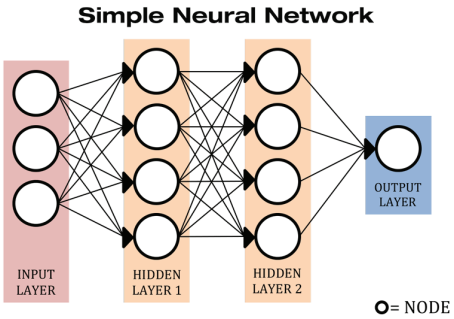
And its learning is embedded into a black box known as a neural network.

What is a neural network? First, a neural network is short for an artificial neural network. Artificial neural networks are computers that simulate a real neural network – a human brain. Like we did at age 16, neural networks learn to drive based on the same input: what they are taught.

They then encode that learning in multiple layers of highly interconnected nodes. Each of these nodes functions somewhat like a neuron in your brain. They sum up various inputs from other nodes, perform a simple function and send an output to all nodes in the next layer.


An artificial neural network is trained by showing it a driving situation and telling it the desired response. It then adjusts each node so the response of the neural network mimics the desired response.

Here is an example of a very simple neural network (below):




In this neural network, the inputs to the input layer nodes may be the brightness of three pixels of an image. The output layer node is the decision that the neural network has been trained to make based on the inputs. The hidden layers represent the training of the neural network.

Each node in the hidden layers is connected to each of the input nodes and to the output node. During the training process, the neural network assigns a weighting to each input of each node in the hidden layers. In operation, each node simply totals each input with its respective weighting.

If the sum exceeds a certain threshold, then that node exports a 1 or a 0 to each node in the next layer. Of course, the neural network in an autonomous vehicle would be more complex and receive many more inputs, but it functions in the same fashion.

If we wanted to "slice open" a trained neural network to attempt to see how our autonomous vehicle made a decision, we could

*Continued on next page*

determine little more than the weighting of each input at a certain node.

But an individual node means nothing. It is the interconnections and weightings of all the nodes in all of the layers, collectively, that determine the operation of the neural network. We would not see a meaningful decision made at any one node or layer.

The fact that a neural network is undefined and works as if by magic – without the constraints of programming a set of defined rules – is the key to its effectiveness. The real world is immensely complicated, unstructured and unpredictable. No set of rules could ever account for every situation the driver of a vehicle may encounter. But a neural network can infer the proper decision in an unprecedented situation because it has been trained in many similar situations.

As it encounters more situations, the artificial neural network learns to make correct inferences in situations that were not part of the training. In other words, the neural network learns to "act" like the driver of a car, only better – in part because it has more training.

Indeed, the world's most experienced drivers today are the neural networks employed by Waymo, Uber and Tesla. They have been trained with literally millions of miles of cumulative driving from thousands of cars – far more than any human driver – and thus potentially are better able to instantly recognize an atypical driving situation than a human driver can.

In an autonomous vehicle, the artificial neural network has many advantages over the human neural network it replaces. An artificial neural network can handle several inputs simultaneously, like those from ultrasound, radar, cameras, lidar and GPS.

An artificial neural network is much more responsive than the reaction time of the human brain. And most importantly, an artificial neural network is never distracted. It does not fumble through radio stations, drop a phone, respond to texts, get tired or drink a drop of alcohol.

Despite the advantages of artificial neural networks over our brains, autonomous vehicles likely will never be perfect. Currently, they are far from it, but even today they are generally safer than a human driver.

Unfortunately, autonomous vehicles are judged by a wholly different (and largely unfair) standard than humans. They are expected to be perfect because, after all, they are computers.

Thus each accident in an autonomous vehicle is highly publicized regardless of its circumstances. Hopefully, this unrealistic standard will not slow the introduction of autonomous vehicles into our world.

Autonomous vehicles soon will change the way we look at our laws, regulations and our court system. Down the road, they will even change the way cities are planned. Farther down the road, human driving will be viewed as dangerous and may not even be permitted on public roads.

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# Time To Jump-Start Stalled Autonomous Vehicle Regulation

By **Tod Northman and Chris Pantoja** (October 1, 2018, 2:09 PM EDT)

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In his famed 1965 book "Unsafe at Any Speed," consumer advocate Ralph Nader argued that the automobile industry's focus on style over safety was needlessly killing thousands of people each year. Nader's claims helped provoke Congress to create the National Highway Traffic Safety Administration. NHTSA is the federal agency responsible for the enforcement of the Federal Motor Vehicle Safety Standards, or FMVSS, a comprehensive set of regulations on vehicle design, construction and performance.[1]

Now, over 50 years later, the rise of autonomous vehicle technology has led Nader to again voice his concern about automotive safety regulations in the United States. In a recent article in the Wall Street Journal, Nader decried proposed driverless car legislation that he — along with various consumer and public-interest groups commenting on the topic — believes would go too far in exempting the autonomous vehicle industry from regulation.[2]

Nader's concern about the direction of autonomous vehicle regulation is ill-considered. His premise is that manufacturers will soon roll out fully autonomous vehicles for purchase, thereby imperiling us, and that the federal government must save us. That misapprehends the most likely present danger from self-driving vehicle oversight — underpowered state regulation.

AV testing is conducted pursuant to state laws, which have widely varied levels of administrative oversight. For example, California has adopted rigorous oversight, requiring permits and annual reports.[3] By contrast, testing in Arizona is conducted under less rigorous supervision, pursuant to an executive order that was promulgated with the direction "to eliminate unnecessary regulations and hurdles to the new technology."[4]

More important, Nader's alarm ignores the looming problem of inadequate technical expertise by federal regulators. The federal-state regulatory collaboration reflects the traditional distinction between regulating automotive hardware — the province of NHTSA — and regulating driver behavior — the states' responsibility. As long as AV companies remain in the testing phase, retaining that structure makes sense. Manufacturers will continue to produce vehicles with increasingly robust safety equipment and will gradually introduce vehicles with higher levels of autonomy in geofenced areas. States can appropriately determine how best to regulate AV testing within their borders.

The AV industry understandably wants a unified system of rules and regulations so that they aren't burdened by local variations. There is also a risk of "rogue" states cutting safety corners in order to attract their share of the economic boom from the burgeoning autonomous vehicle industry. However, the desire for uniformity and protection against risk-tolerant states is not a regulatory hole best plugged by federal regulation.

NHTSA already has the authority to address safety issues arising from self-driving cars, notwithstanding the traditional federal-state division. Under the Motor Vehicle Safety Act, "Motor Vehicle Safety means the performance of a motor vehicle or motor vehicle equipment in a way that protects the public against unreasonable risk of accidents occurring because of the design, construction, or performance of a motor vehicle, and against unreasonable risk of death or injury in an accident, and includes nonoperational safety of a motor vehicle."[5] In other words, NHTSA's authority is plenary where motor vehicle safety is at issue.

Preparing for necessary federal regulation once self-driving cars are commercially available is advisable. The autonomous vehicle industry has the urgent opportunity, which existing and proposed legislation misses, to gather information. As vehicles reach full autonomy, the "driver" will become the vehicle's processing unit; the sensors and cameras on AVs are already vacuuming up and sending information back to the car manufacturers. AV test vehicles and vehicles with enhanced safety features are a potential source of data, and with machine learning, data is gold.[6] It can and should be used to better understand such questions as how self-driving cars best function, how they interact with other vehicles and the environment, what forms of AV training are best and in which situations full autonomy is safe; the questions that could be investigated are endless.

Our proposal is simple: Instead of wringing hands over the gradual proliferation of autonomous vehicles, and asking Congress to regulate the unknowable (the future of autonomous vehicles), Congress should require autonomous vehicle developers operating in the United States to share aggregated, anonymized information from high-tech driving systems (from automation levels 2 through 5 as defined by the Society of Automation Engineers). This data should be made available for study by NHTSA, academics and industry professionals, and Congress should give NHTSA the authority and budget necessary to use those learnings to develop regulations that will tap the benefits of autonomy as effectively and safely as possible.

**The Uncertain Status of Current Autonomous Vehicle Regulation**

Since 1966, vehicle miles driven in the United States have increased from 51 billion to 322 billion. But while the number of miles driven has increased over sixfold, the number of traffic fatalities over that timespan has actually decreased — from approximately 51,000 in 1966 to just over 40,100 in 2017. Stated in other terms, fatalities have dropped from 5.50 fatalities per million vehicle miles driven to 1.18 fatalities per million.

Much of this reduction can likely be attributed to federal regulations, including the FMVSS. When it comes to self-driving technology, however, NHTSA has taken a surprisingly "hands-off" approach to regulation, preferring instead to allow self-regulation at the state level. NHTSA has explained its perspective in various speeches to the industry[7] as well as in its "Automated Driving Systems 2.0, A Vision for Safety," a set of guidelines developed to facilitate the integration of autonomous vehicle technology.[8]

In deciding to engage in a supervisory as opposed to a law-promulgating role, NHTSA explained its belief that (1) autonomous vehicle technology is changing too rapidly for NHTSA to effectively regulate self-driving cars, and (2) it needs to "support industry innovators" while working to safely introduce automation technologies. In short, NHTSA believes that its regulatory guidelines should encourage, rather than hamper, the safe development, testing and deployment of automated vehicle technology.[9]

But as the technology continues to develop, questions such as those posed by Nader challenge the appropriateness of the federal government's laissez-faire approach. Once the computer becomes the driver, a different regulatory approach will be needed. Filling that gap will require deep knowledge about autonomous vehicle operations — knowledge that can only be gained through sustained study.

The current lack of federal oversight is not for want of trying by those involved. On Sept. 7, 2017, the United States House of Representatives passed the Safely Ensuring Lives Future Deployment and Research in Vehicle Evolution Act, or SELF DRIVE Act.[10] This bill encourages the testing and deployment of autonomous vehicles by preempting states from enacting laws regarding the design, construction or performance of highly automated vehicles or driving systems. And on Sept. 28, 2017, Senator John Thune, R-S.D., introduced the AV START Act. This bill allows federal preemption for autonomous vehicle design and safety.[11] Both bills, however, have faced strong opposition in their respective chambers based on concerns about the safety of autonomous vehicles, and it does not appear that resolution of the issues raised, or the passing of either bill, is on the near horizon.[12]

**Unintended Consequences of NHTSA's "Hands-Off" Approach**

Unless action is taken to give federal regulators the knowledge they will require to regulate the self-driving "driver," these objections will have the unintended consequence of leaving autonomous vehicles void of any federal regulatory framework for the foreseeable future. Self-driving vehicles are underregulated or unregulated in most states. Even where there is some semblance of state-level regulation, the rules are inconsistent.

Some states, such as New York[13] and California, have chosen to regulate the testing of self-driving vehicles. Many have elected not to. Either way, the difficulty is determining what to regulate. Federal preemption precludes states from regulating the hardware of automobiles, except for limited instances when a FMVSS establishes a minimum standard. The FMVSS conflict in a number of areas with anticipated features of autonomous vehicles, such as requiring a rear-view mirror or a steering wheel. For testing purposes, autonomous vehicle manufacturers have worked around such limitations through the exemption process.

Thus, while Nader is right to express concern over the speed with which autonomous vehicle technology is being integrated, his premise that lawmaking is moving too fast is wrong. The real problem is that lawmaking is not moving at all. As self-driving technology matures to the point of full autonomy, the federal government likewise needs to take more control — indeed, some level of control — over the regulatory framework.

**What Should NHTSA Regulate?**

When it comes to autonomous vehicles, NHTSA should vary its traditional approach to regulating automobiles. Instead of focusing on the hardware facilitating autonomy, NHTSA should focus its attention more generally on the ramifications of a computer having complete autonomy over vehicle operations. That is, NHTSA should focus its attention on regulating how the autonomous vehicle

performs its driving function, instead of focusing on regulating the hardware components of the vehicle such as sensors and steering and braking systems.

As it currently stands, NHTSA permits autonomous vehicle manufacturers to self-assess the safety of their vehicles and make decisions on recall if the manufacturer deems appropriate. Such a framework may work in a mature industry where changes are iterative and generally well understood. But in the fast-evolving field of self-driving cars, such a deliberative process does not adequately protect the public.[14]

These vehicles are equipped with high-tech sensors, computer vision, sophisticated onboard computers, artificial neural networks containing advanced decision-making algorithms and black boxes that relay information back to a central processing center. Regulation of autonomous vehicle technology and its public integration requires the kind of expertise and resources only available at the federal governing level.

Beyond the typical safety concerns associated with human-operated passenger vehicles, autonomous vehicle technology raises nontraditional safety issues that require federal standardization. For instance, given their complex and evolving computer systems, autonomous vehicles are subject to cybersecurity concerns. One can only imagine the potential terror wrought by computer hackers taking over control of an autonomous vehicle's operating system, let alone an entire fleet of autonomous vehicles traveling on public roadways. While NHTSA emphasized the importance of the issue in its "Automated Driving Systems 2.0," it offered no solutions. The autonomous vehicle industry would no doubt benefit from a comprehensive regulatory approach that mandated, at minimum, a system of immediate communication of threats and implementation of a set of agreed best industry practices.

Continuing its pattern of recognizing potential issues, two years ago, NHTSA called for industry participants to submit voluntary safety self-assessments. But without legal weight behind this suggestion, many companies have yet to follow through. For instance, of the 57 companies[15] in California who hold a permit to test autonomous vehicles, only four (GM, Ford, Waymo and Nuro) have voluntarily filed reports.[16] Moreover, without any concrete standards for what information must be provided, the four reports are of limited value.[17] Thus, our proposal: As the AV industry is learning, its would-be regulators must remain abreast of the technology's limits and capabilities to promulgate effective rules.

**Conclusion**

Autonomous vehicles offer exciting and welcomed changes to the way passenger vehicle transportation occurs in the United States. Along with affording a new structure of personal transportation to groups of consumers currently devoid of such fundamental mobility, the safety advances associated with autonomous vehicle technology cannot be ignored.

But without prompt and adequate federal regulation aimed at empowering NHTSA to collect and analyze the myriad data generated by this evolving technology, the promise of autonomous vehicles may never be fully realized.

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[1] NHTSA was known as the Transportation Department at the time. The FMVSS set forth particular equipment that an automobile must include. They are comprehensive, covering nearly every component of a vehicle. The Volpe Report concluded that there are 12 equipment requirements that potentially conflict with the implementation of autonomous vehicles. "Review of Federal Motor Vehicle Safety Standards (FMVSS) for Automated Vehicles, Preliminary Report — March 2016," https://rosap.ntl.bts.gov/view/dot/12260; see also "The Ongoing Transformation of the Global Transportation System," DOT VNTSC-1804, February 2018, https://www.volpe.dot.gov/sites/volpe.dot.gov/files/docs/events/62316/transforming-transportation-series-final-report.pdf. For the time being, manufacturers are invited to apply for exemptions. See, for example, NHTSA's response to Waymo (then Google) at https://isearch.nhtsa.gov/files/Google%20--%20compiled%20response%20to%2012%20Nov%20%2015%20interp%20request%20--%204%20Feb%2016%20final.htm.

[2] Nader, Ralph, Driverless Car Legislation Is Unsafe at this Speed, Aug. 22, 2018, https://www.wsj.com/articles/driverless-car-legislation-is-unsafe-at-this-speed-1534973755.

[3] https://www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/bkgd.

[4] https://azgovernor.gov/governor/news/2018/03/governor-ducey-updates-autonomous-vehicle-executive-order.

[5] 49 U.S. Code § 30102(a)(9).

[6] Cf. Urmson, Chris, "The Fuzzy Numbers for Tracking AV Progress," Sept. 21, 2018, https://www.axios.com/the-fuzzy-numbers-for-tracking-av-progress-8a06c0f6-027b-49bc-b82a-9622c77bf5ec.html.

[7] See, for example, the speech by Secretary of Transportation Elaine Chao, on Aug. 8, 2018. Mulero, Eugene, "Transportation Secretary Elaine Chao Touts Department's Approach to Autonomous Policy," Transport Topics, https://www.ttnews.com/articles/transportation-secretary-elaine-chao-touts-departments-approach-autonomous-policy (last visited Sept. 17, 2018).

[8] https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf.

[9] Id.

[10] See The Library of Congress, H.R.3388-SELF DRIVE Act, https://www.congress.gov/bill/115th-congress/house-bill/3388.

[11] See The Library of Congress, S.1885-AV START Act, https://www.congress.gov/bill/115th-congress/senate-bill/1885 (last visited Sept. 17, 2018).

[12] See, e.g., Kulisch, Eric, "Lobbying Push Targets Holdouts on Autonomous Vehicle Bill," March 16, 2018, http://www.autonews.com/article/20180316/MOBILITY/180319765/lobbying-senate-holdouts-av-start-act; John McKinnon, Self-Driving Car Safety Legislation Stalls in the Senate, Feb. 12,

2018, https://www.wsj.com/articles/self-driving-car-safety-legislation-stalls-in-the-senate-1518436800.

[13] New York has the most restrictive regulations. In fact, the regulations are so burdensome that GM Cruise's announced plans to begin testing have been delayed more than eight months with no end in sight. "What Happened To GM Testing Self-Driving Cars In New York City?," Sept. 13, 2018, https://transportationvoice.com/what-happened-to-gm-testing-self-driving-cars-in-new-york-city/ (GM Cruise officials stated that its AV testing application process is ongoing and noted the "complex regulatory environment").

[14] A Tesla accident resulted in a NHTSA investigation, which took eight months and cleared Tesla of responsibility for the accident, because the vehicle's manual had instructed drivers not to rely on the autopilot and to remain in command of the vehicle. https://static.nhtsa.gov/odi/inv/2016/INCLA-PE16007-7876.PDF.

[15] As of Aug. 29, 2018. https://www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/permit.

[16] https://www.nhtsa.gov/automated-driving-systems/voluntary-safety-self-assessment.

[17] Keith Laing, "Few carmakers submit self-driving car safety reports," Sept. 10, 2018, https://www.detroitnews.com/story/business/autos/mobility/2018/09/10/few-carmakers-submit-self-driving-safety-assessments/1076691002/ ("The result of that is the three we have seen are much more like slick marketing brochures than anything that shows what kinds of tests have been passed or what these things can do").


## DRIVERLESS

Hosted by Zach Adams, *Driverless* is a groundbreaking podcast devoted to exploring the legal issues surrounding autonomous vehicles and other artificial intelligence technologies. We share fascinating conversations with industry and intellectual leaders about the legal and technical challenges of automating vehicles and bringing them to market. We will explore the state of the industry for policy/regulation, legal liability, corporate and business structures, mergers and acquisitions, deep learning, and how these issues intersect with other AI technologies.

*Driverless* is part of the Tucker Ellis Autonomous Vehicles & Artificial Intelligence Technologies practice group. This group was specifically designed to bring together attorneys with a variety of legal backgrounds to prepare clients for the ever-changing landscape in the upcoming autonomous revolution.