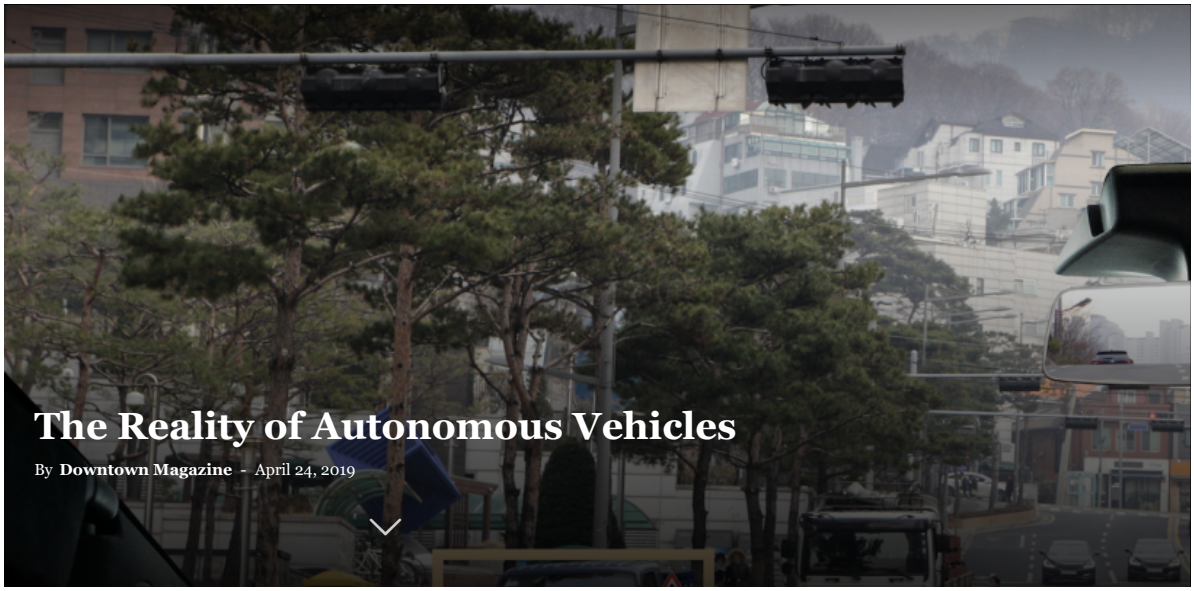


The Reality of Autonomous Vehicles

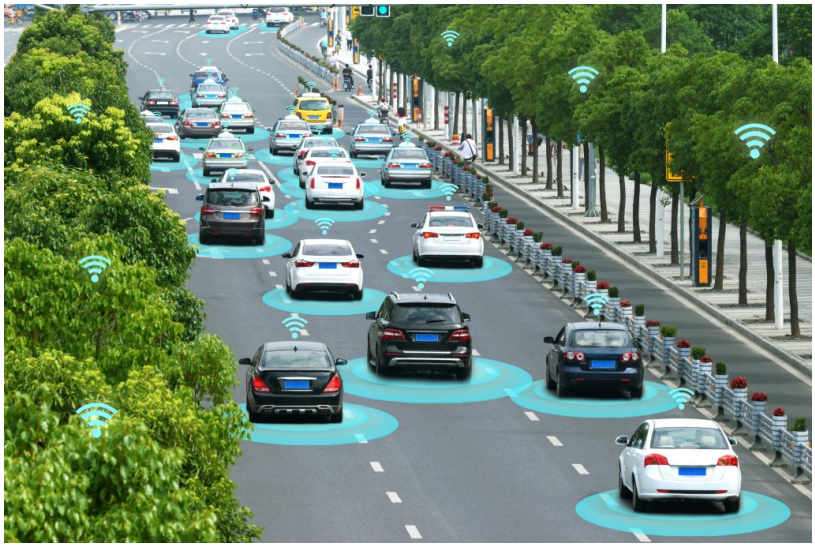
By **Downtown Magazine** - April 24, 2019

The age of autonomous vehicles is upon us. The time has arrived when driverless personal automobiles and commercial trucks, vans, and taxis owned by privately-operated tech companies, will take center stage on the landscapes of the United States, Europe, and Asia. Is this a truism or not? Ask the average man and woman on the street and you will undoubtedly receive several different answers: driverless vehicles are already operating in the here and now; driverless vehicles are right around the corner – at best a year or two away; driverless vehicles will not be seen on our roadways for many years to come.

Numerous benefits are touted by automakers, tech companies and software designers that predict the new technology will improve driving efficiency; provide more leisure time in this increasingly populated world; reduce serious traffic accidents, and the aftermath of resulting injuries and fatalities; eliminate or substantially reduce parking congestion; allow for lower fuel consumption; and eventually result in the manufacture of lighter and more versatile vehicles.

Benefits will obviously come with certain obstacles and limitations. The challenges ahead include: artificial intelligence and software functional limitations; susceptibility of vehicles' sensing and navigation systems to address different types of weather conditions, and the avoidance of darting animals; the need for changes to existing road infrastructure; an increase in liability issues arising from vehicle accidents because of more finger-pointing among parties; increased tort litigation and a backlog of civil cases in our courts; and moral and ethical issues, including the loss of commercial jobs.

There will also be serious privacy concerns once a vehicle's location and position are integrated into aninterface to which other people have access. This communication brings the risk for automotive hacking through the sharing of information via vehicle to vehicle protocols, including the potential risk for terrorist attacks by loading self-driving vehicles with explosives.



Smart car (HUD) and Autonomous self-driving mode vehicle on metro city road with graphic sensor signal.

Author John Esposito spoke with Dr. Scott Le Vine, assistant professor of urban planning at SUNY New Paltz, about the future of autonomous vehicles. Dr. Le Vine has authored and coauthored a number of studies on autonomous vehicles and provided expert testimony to various levels of government in both the United States and the UK.

John Esposito: Our discussion today will center on the future of autonomous vehicles in society, primarily here in the United States and also Europe and China. The term autonomous vehicles are sometimes used interchangeably when also referring to automated vehicles, driverless vehicles, robot vehicles or robo-vehicles. There is an important distinction between autonomous and these other terms. As we move ahead, I will ask you to please explain the differences.

Unless any one of us have been living under a rock for the past ten or so years, the population at large has been made acutely aware through the likes of social media that the age of autonomous vehicles is upon us. The big question is exactly when will this new technology become mainstream.
The public'sacceptance of this new form of automation appears to vary. Some will embrace driverless vehicles at every turn and want to be the first in their neighborhood to own one, not unlike those who are willing to wait in line for ten hours every year for the Apple store in New York City to open so they can purchase the latest and greatest iPhone. Some consumers will completely resist because of their long-held love affair with automobiles and an unwillingness to part with their 5-speed shift. Others will remain on the fence and greet the news of this technology with much trepidation, fearing autonomous vehicles will result in serious injuries and even death should the software and sensor modules fail.

This leads back to my opening comments. Please explain the difference between autonomous vehicles and automated vehicles and how they do and do not constitute a driverless vehicle?

Dr. Scott Le Vine: That's a great question and it is a nuance that is lost in many discussions both by the man on the street and by many who observe this industry. There is a clear distinction. Automated refers to the automation of driving tasks, and there are various levels of automation. Automation runs from no automation where the human is in complete control of everything, the complete driving task, and full automation which is the holy grail. Full automation is where the driver, the human in the vehicle is completely disengaged from the driving task. There may not even be a human inside the vehicle. The vehicle can go anywhere, do anything under its own control. That is automation. Autonomy (autonomous) refers to where the vehicle is getting its source of information. What information is that vehicle using to make driving decisions? Autonomous implies the vehicle is receiving information from its own sensors. Connected is the opposite of autonomous. Connected vehicles speak to each other, speak to traffic lights, speak to other bits of roadside infrastructure and exchange information that way. A connected vehicle can see around a corner if it is receiving

information from something which can see around that corner. An autonomous vehicle only has its own sensors what it can physically see.

JE: Where do we stand today in the evolution of this technology? I understand there are actually five levels of the new automation which will ultimately all coexist on our roadways for the foreseeable future. Separating the available facts from speculation, what is the realistic time frame before we can realistically expect these vehicles to be in everyday use, in both the United States and Europe? Can you be specific?

SLV: Well, I can tell you that in planning school the first thing you are taught is: give them a number orgive them a date, but don't give them a number and a date. So, it's a really difficult question. You askabout the U.S. and Europe, but I think a more interesting comparison might be the U.S. and Europe versus China. Here there are issues of liability, of responsibility for crashes where there seems to be a different tolerance in China than there is in Western societies. It is plausible to me that you might see things move more quickly in places like China than in North America or Europe.

The answer to *when*, you can get an answer from *yesterday* at Tesla, with some automation, to *never*, as we're unlikely to ever have a vehicle that can drive anywhere, do anything with no human input, except choose a destination. Humans also can't drive anywhere and do anything. It snows and sometimes we don't make our journey. If it's a hurricane, we're not making our journey, etc. So that's unlikely to ever happen in that sense.

What automakers seem to be doing is moving forward quite rapidly with mixed, mushy mixed levels of automation, which is, level two to level three in the five-class categorization you mentioned earlier. That categorization comes from The Society of Automotive Engineers International (SAE). It runs from level zero which is no automated, (you think of the Ford Model T), through level five, which is the go anywhere, do anything, all dancing, bells and whistles driverless car. What we are seeing is automakers move forward with level two, level three vehicles, which can take on some of the driving tasks in some places, sometimes under some circumstances. What automakers and other mobility services seem to be doing in the near future with regards to the highest levels of automation is geo-fencing. This is allowing their vehicles to operate within very well-defined geographic boundaries, like city centers. Manhattan, for instance, or central Boston or central Phoenix. Within those geographic areas, the road system is extremely well mapped, extremely well digitized so that they have a great control over what that vehicle is doing.

The second thing which we are seeing is automakers planning to roll out these systems as parts of fleets of vehicles so you would use them before you will buy one. Later this year, Waymo, (formerly the Google self-driving car project), plans a rollout at commercial scale, of their driverless taxi service in Arizona.

JE: What do you anticipate the five-class categorization level would be for this rollout?

SLV: It depends on what the driver is doing. If the driver is actively engaged in monitoring the vehicle and has power to override a driving decision, that would be a level three or so vehicle. If the driver is simply there as a sort of chauffeur, then that would be a level four vehicle.

The initial deployment is in Arizona. They have been operating on public roads already. What's changingis that they are allowing members of the public to use it on a commercial basis.

JE: I understand there are 46 corporations currently working on autonomous vehicles. The tech companies include Uber, Waymo and Lyft and automakers like GM, Toyota and Ford have spent upwards of $6 billion developing driverless technology. Dr. Le Vine, who in your estimation are the leaders in this field?

SLV: It's a great question to ask. Certainly, Waymo, formerly Google, is head and shoulders ahead in terms of the miles of driving tasks that have been done with automated vehicles. The German carmakers are very far along, BMW, Dähler, Audi, etc. There is GM's Cruise division. They are one of theleaders.

JE: Several recent fatalities associated with the operation of autonomous vehicles have made national headlines. On May 7, 2016, the first known fatality involving a semi-autonomous vehicle occurred when a collision took place in Williston, Florida between a Tesla Motors Model S, with autopilot technology, that was being operated by Joshua Brown, and a tractor-trailer. A second fatality occurred on March 18, 2018 in Tempe, Arizona when an Uber self-driving test car struck and killed 49-year-old Elaine Herzberg, who was pushing a bicycle, filled with plastic bags, across a four-lane road, allegedly by a distracted safety driver who failed to react in time. Following the accident, the governor of Arizona banned Uber from testing there; and Uber let its autonomous vehicle testing permit lapse in California. Uber also pulled its vehicles off the streets of Pittsburgh, Pennsylvania, the home to its self-driving research and development center. Then on March 23, 2018 a third fatality occurred in Mountain View, California involving a Tesla Model X, with autopilot engaged. The driver, Walter Huang, was killed when the car crashed into a freeway divider and burst into flames.

SLV: All these crashes are fairly well understood as to what had taken place. They all involve situations in which a human was, in principal, responsible for monitoring the operation of a semi-automated system and there was a breakdown in that system that the human did not, for whichever reason, correct in time. And one thing we are learning is that humans are pretty terrible stewards of machines. Machines that fail infrequently. Why? We like to text. We get distracted very easily. Humans are not built to maintain laser beam-like concentration when we're doing a task which seems like it doesn't require our involvement. That seems to be the case in at least some of these crashes. There may have been an overexpectation on the driver's part about what the system could do or the human driver was simplymisbehaving in the sense of doing another task they should not have been doing at the time.

JE: This new technology that will bring consequences. Ethics and law often diverge and under certain circumstances when we drive our vehicles today, good judgment may compel us to act illegally. But what about a fully self-driving vehicle programmed to strictly obey the law? Can fully autonomous vehicles, those without any human driver input whatsoever, ever be capable of making difficult and ethical judgment decisions in the dangerous scenarios?

SLV: Well, you drive conservatively. You choose a safe following distance behind whatever is ahead ofyou; maintain a vigilant lookout for what's happening on the side of the road, for objects or people thatare moving towards your path. Roads are an open system. Therefore, there are going to be balls runningout into street in front of vehicles. There's going to be dogs running into the street in front of vehicles.There are going to be jaywalkers. Those are unpredictable open systems. We'll never completelyeliminate crashes, fatalities, etc. That is not going to happen. The best strategy we can do is to do much better than humans do. And we can do that by driving defensively, not speeding, driving conservatively, being constantly aware of our surroundings. Humans have two sensors in the front of our face: our eyes.And that is what we use to learn about what's going on around us. The vehicles we are talking abouthave a 360-degree field of vision, so they have that advantage. These vehicles have another advantage of being able to process information basically instantaneously, again on the order of milliseconds. Humans take something between one and two seconds to react, even in cases of emergency. Those are humans who are not distracted, and then think about someone texting. For lots of reasons we can expect to do better than humans, how much better is a judgment question.

JE: When the initial major rollout of autonomous residential vehicles occur, is it reasonable to expect that these vehicles will be permitted to operate only on less populated roads or country roads, but not in large populated cities like New York, Boston, Los Angeles and Philadelphia? I can't comprehend howstate and local municipalities would even be able to enforce such restrictions.

SLV: I think we will see a messy evolution. We can only state that Tesla's Auto Pilot system is notdesigned for Manhattan's street grid. Tesla's Auto Pilot is designed for freeways and not DowntownManhattan. On the other hand, for shared taxi services, like Waymo is rolling out in Arizona, demand is not on freeways, demand is not on country roads. The demand is in places like Downtown and Midtown Manhattan. There is a real tension between where the market is that is attractive to them, and what they are able to do in a technical sense. We shall see how that tension is managed over time.

JE: I believe several very important issues need to be addressed even prior to instituting speed changes, like establishing new vehicular laws and road rules, and new roadway infrastructure. In addition, computer navigation and car sensing systems must operate perfectly in these new vehicles. Please explain vehicle-to-vehicle communications functionality. You previously mentioned that eachmanufacturer's system will have unique system attributes and operate in its own way. If this is the case, are vehicle-to-vehicle communication systems at a significant risk of not effectively "talking" to eachother because their unique systems may react very differently?

SLV: Vehicle-to-vehicle communications are known as "V2V." We are working on a common language. It would be a Tower of Babel if every vehicle was only able to talk to friendly vehicles. The system would work best if every vehicle is talking to every other vehicle within proximity. At the moment we have a protocol for vehicle-to-vehicle communication which is a bit like every car screaming at every other car nearby and not listening whatsoever. And it's screaming baby talk. It's screaming extremely, extremelylimited information. In the future there will have to be Shakespeare talking to each other and gettingconfirmation: "Did you get my message? Yes, I got my message. So, what are you going to do? This is what I'm going to do." Right now, it's simply we're screaming out who I am, this is the direction I'mgoing, this is what I speak. Very limited information.

JE: What is presently being explored to address the serious issue of privacy concerns, that potentially can result when a vehicle's location and position is integrated into an interface which other people haveaccess? And more specifically, what are your thoughts about the risk for automotive hacking through the sharing of information via V2V (Vehicle to Vehicle) and V2I (Vehicle to Infrastructure) protocols, including the potential risk for terrorist attacks by loading self-driving vehicles with explosives.

SLV: I am not at the forefront of discussions about security. I think the point you make about a self-driving autonomous car being used as a directed bomb, there's plenty of other ways for terrorists to blow things up. I'd be surprised to see that. I think the point you made earlier is more relevant to this specific technology, which is hacking, which is ways of disrupting traffic or disrupting peoples lives short of some sort of weaponization. There will need to be redundant systems, so the stealth fighters apparently have three or four different decision-making brains, each of which must agree before a decision is made. We will need redundancy built into these vehicles to deal with the hacking situations.

In terms of privacy, the lesson of the past ten and fifteen years, people have been willing to part with an awful lot of privacy in exchange for consumer goods and whether that will continue to be true here, mygut tells me yes, but we won't know beforehand.

JE: Are you aware of the total number of fatalities related to vehicular accidents is this year in the United States?

SLV: It is presently somewhere between 35,000 and 37,000.

JE: Proponents have made the case that these figures will be drastically reduced after driverless vehicles have become mainstream. However, since this has not come to fruition and there is no hard-

statistical data to bear this out, how can such a determination be made? These predictions seem to be more conjecture than anything.

SLV: That is an excellent point. The standard headline figure is that driver error is a factor in 94% of crashes. And that comes from police reports. The question is how much of that 94% will be reduced and in what way will it be reduced, and how many new crashes will occur that would not have occurred otherwise. Those crashes may not have occurred if there was alert human that was driving. So,therefore it is likely that car crashes will change in several ways. Maybe we'll reduce them, my view iswe probably will reduce them. But the ones that remain might be more high speed because humans fail in different ways than machines fail.

JE: If I understand correctly by the examples you have provided, in the early stages of their release, autonomous vehicles will, in fact, be programmed so that you cannot increase the speed of the vehicles, and thus these vehicles will be operating as fully autonomous. Is that your understanding?

SLV: This decision will be made by the General Counsel of Ford, the General Counsel of GM, and the General Counsel of Tesla.

JE: A major topic which is probably quite high on everyone's agenda are the insurance laws andregulation. Insurance is state-regulated as to existing tort systems and no-fault laws. This will undoubtedly require rewrites. Some state laws have comparative negligence liability laws and other states recognize contributory negligence laws where there can be more than one party responsible for an accident. There will quite possibly be more finger-pointing in the future as to who is liable for the accident then there is today.

SLV: Classically, motor insurance is to insure the driver. The individual human, me or you, or any of our colleagues are that driver. It looks like, what seems quite clear is, liability will shift, whether entirely or partially onto some combination of the system manufacturer, the software designer, the sensor manufacturer.

JE: Certain limitations may also impede or slow the arrival of autonomous vehicles in the short term. One such issue posing serious consequences that must be addressed is infrastructure. As an urban planner I am certain you recognize that the infrastructure of many roadways will require significant changes to function properly and bring about new rules and regulations. Would such regulations fall under federal control or be run state by state?

SLV: This is a meaty topic on the public agenda, right now. Who is in control of what? Traditionally, the federal government has been in control of vehicle safety and state governments have been in control of drivers licensing and driver safety. Now that the vehicle is a driver, what happens? This is an active issueof discussion and debate. I don't think I will surprise you or any of your readers by saying that everybody seeks to stake their claim. The federal government is seeking ownership of the space and the states willeffectively do what's left over from the federal government.

JE: We have spent considerable time discussing residential and commercial autonomous cars, buthaven't delved into the autonomous commercial trucking. I can envision the look of total panic and doom on a driver's face operating a conventional car if a fully autonomous 18-wheeler comes barreling around the bend on the north side of a highway, and crosses into the southbound lanes because of a software failure, striking the car head on.

SLV: Individual drivers don't get to decide who the other drivers are, so it is a question as to how it manifests through our regulatory agencies and democratic processes legislatures. And here, my crystalball tells me it's going to be a situation where victory has a thousand fathers and defeat is an orphan. Ifrollout is smooth and if it seems to be a success, then nobody will be wanting to play catch-

up and we'llall want to be on the cutting edge. However, if there are more and more crashes and more questionmarks that we fully didn't anticipate and things are not going well, then I think we'll see much moreactivism from the public sector.

JE: It is certainly fair to say there are many benefits to be realized by the public once driverless vehicles become a part of the everyday landscape. There are also clear obstacles, limitations and much speculation which will need to be addressed and resolved by the ultimate decision-makers in various sectors. Any unsolved issues that negatively impact the public's safety will no doubt stonewall any widespread release of fully autonomous vehicles for some time. Dr. Le Vine, do you have final thoughts on this very provocative subject, one that apparently will only intensify in the days ahead.

SLV: There is so much speculation and there is so enormously little hard data for many of these questions, the answer is simply, we shall see.

To learn more about this topic and read the extended conversation visit John's website here.

John Esposito is a freelance journalist based in New York and New Jersey. His work has appeared in various newspapers and magazines including USA Today, The Star-Ledger, The Philadelphia Inquirer, Greenwich Time, Stamford Advocate, The Record, Downtown-NYC, New Jersey Newsroom, The Irish Echo, UNICO, Rosebud.