AUTONOMOUS VEHICLES

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Introduction

The topic of driverless cars has caught the imaginations of many people. Who wouldn't want to relax as his car drove him to work, then parked itself? Families could reduce the amount of vehicles if mom could take the car to work then send it home so another family member could do errands, go to the doctor, take the cat to the vet, or other tasks. To many this seems like a fantasy come true; in reality it is a fantasy that is going to be realized in the not too distant future.

While not all business and societal implications can be covered in this article, the insurance and regulatory implications are key to the future of this technology becoming readily available to the consuming public.

History

Until Henry Ford developed the Model T, automobiles operating on internal combustion engines were few and far between. Karl Benz built his first automobile in 1885 and production began in 1888, after his wife proved that the horseless carriage was suitable for daily use by taking a long distance trip from Mannheim to Pforzheim and back. The Model T was considered the first affordable automobile and it opened travel for the average American. In 1930 the car radio was born. From the beginning, people wanted entertainment in their vehicles.

In the early 1950s a rather forward thinking person, Dr. Hunter Shelden, proposed retractable seat belts, recessed steering wheels, reinforced roofs, roll bars, door locks, and passive restraints such as air bags. Congress passed legislation in 1959 requiring all vehicles to have certain safety standards.

From there numerous options for the comfort and enjoyment of the driver and passenger were developed, including air conditioning and heat, power windows, power seats, cruise control, heated seats, and other options. Add to these options anti-lock brakes, air bags, safety bumpers, and stability control, and you have a modern automobile.

While this automobile is much safer than its predecessors, there are still thousands of fatalities every year. In 2012 33,561 people were killed in roadway crashes. Injuries totaled 2,362,000, making vehicle safety a constant concern. Technology, which is rapidly making changes to the way vehicles operate, has great potential for increasing safety as well.

Safety

As mentioned earlier, thousands of people are killed annually on American roads, and millions are injured. Alcohol impaired driving accounted for 31 percent of those fatalities. Distracted driving accounted for 10 percent of fatal crashes, and 17 percent of injury crashes were related to distracted driving. Other causes of crashes involve user error and careless activity such as following too closely, speeding, aggressive driving, or over-compensation. Ninety percent of the primary factors behind crashes are human errors. A vehicle that drives itself, an autonomous vehicle (AV), would compensate for these human errors and could make the roads much safer. Volvo has a goal that no one be killed or seriously injured in any of its vehicles by 2020, only seven years away.

Technology

Nissan and Volvo both have announced intentions to have AVs available by 2020. While initial costs may be prohibitive, it still may be possible for AVs to be available on the mass market by 2022 or 2025. Volvo plans a pilot test using 100 vehicles over fifty kilometers of roadway in and around Gothenburg, Sweden, a town that includes typical commuter arteries including motorway conditions and traffic tie-ups. The goal is for the vehicle to handle all scenarios itself, including leaving traffic and finding a safe place to set if the driver is unable to take control of the vehicle. Fully

automated parking will be tested as well, where the driver can leave the vehicle and it will find a parking spot and park itself. Such vehicles should be on the road by 2017.

The University of Michigan Transportation Research Institute is currently running a pilot test using 3,000 vehicles driven by Ann Arbor residents. The vehicles are not driving themselves but are collecting data by interacting with each other and sensors that are posted at busy intersections, around sharp curves, and on local freeways. The goal is to expand the capability of the sensors so that they can have decision-making power. The ultimate goal is to have a fleet of connected and AVs on public roads by 2021.

There are many steps, however, on the way to fully autonomous vehicles. The National Highway Traffic Safety Administration (NHTSA) had identified five levels of vehicle automation.

The first level is level 0, and is your basic vehicle with no system that can control the vehicle on its own. The vehicle may have lane warnings, collision warnings, or even back-up warnings, but the vehicle never takes control. It may issue audible or visual warnings to the driver, but it is the driver's responsibility to make corrections as needed.

Level one allows the driver to relinquish temporary control of a primary function. Adaptive cruise control that adjusts the vehicle's speed based on the car in front to maintain a specified following distance is one such technology. Electronic stability control is another, and this has been mandatory on new vehicles since 2011. Electronic stability control detects loss of steering control and automatically applies the brakes to help steer the vehicle in the intended direction. Braking is applied to the wheels individually; NHTSA studies indicate use of this technology could prevent one-third of fatal accidents.

In level two the driver can disengage physically and have both hands off the wheel and feet off the pedals. The driver must, however, be ready to take over at a moment's notice. This is where primary controls work in unison to relieve the driver of control—for example adaptive cruise control and lane centering combined together. Note the driver may not have his hands off the wheel for long; lane centering will do what it can to put the car back into a lane, but it is not designed to navigate continuously in place of the driver.

Level three involves limited self-driving by the vehicle. The driver can cede full control to the vehicle, and the vehicle will signal the driver to retake control. An example is a vehicle driving on a highway that comes into a construction area; the vehicle can advise the driver to retake control giving the driver ample time to take over. The Google car is level three technology.

Level four is a truly autonomous vehicle: it performs all driving functions and monitors the roadway conditions for an entire trip. The driver will tell the vehicle where it wants to go and the vehicle will go there without any further input from the driver. These vehicles can maneuver without a passenger, so a disabled person can call for a car to come and pick them up and take them to the doctor, and an empty vehicle will arrive at the person's home for the person to enter and ride in to the specific destination.

While various manufacturers are making statements that by a certain date in the future they will have a fully autonomous vehicle available, that day is not yet here. However, there are several semi-autonomous technologies that are available in 2014 models that are worth noting. The technology tends to be on more expensive models of vehicles, and not every model has such options.

The first such technology is a forward collision alert system with crash imminent braking. This system warns the driver of an impending front end collision and applies the brakes to try to avoid or at least lessen the impact of such a collision. The system scans the vehicles ahead to advise of potential hazards.

Adaptive cruise control allows the driver to not only set a cruising speed but a distance the vehicle is to keep between it and the vehicle in front of it. The vehicle adjusts speed accordingly to maintain the distance.

Lane departure warnings give audible warnings if the vehicle heads into another lane without the turn signal being used. Some vehicles take this a step further and actually brake the wheels on that side of the vehicle to steer the vehicle back into the proper lane.

Side blind zone alert does just that: alerts the driver when there is something or someone in the driver's blind spot.

Rear cross-traffic alert warns the driver when something crosses its path in the rear when the vehicle is in reverse. Some vehicles have rear cameras as well as the alerts to show the driver objects or vehicles in the way. Rear park assist is an option that issues an audible warning if the vehicle is within a certain distance of another object; this allows the driver to make adjustments before it is too late.

The following is a sampling of vehicles with some of these technologies available for 2014. Most manufacturers, however, have disclaimers on their websites that the driver is responsible for safely operating the vehicle and avoiding collisions and that the semi-automated technology may not work in all situations. The manufacturers are making it clear that liability still rests with the driver.

2014 VEHICLE MODEL	FORWARD COLLISION ALERT	ADAPTIVE CRUISE CONTROL	LANE DEPARTURE WARNING	BLIND SPOT ALERT	REAR CROSS-TRAFFIC ALERT	REAR VISION CAMERA	ULTRASONIC REAR PARK ASSIST
Chevrolet Impala LTZ	X	X	X	X	X		
Cadillac Escalade ESV				X		X	X
Honda Accord Sedan EX-L	X *– does not include braking feature, just issues warning*		X				
Toyota Avalon		X		X	X	X	
Buick Regal	X	X	X	X			
Mazda 3-S Grand Touring			X	X	X		
Acura ZDX	X		X *– option can be turned off*				
BMW 528i		X *– will bring vehicle to a stop if traffic ahead stops*	X	X	X	X	
Mercedes Benz Class C		X					
Mercedes Benz Class E		X	X *– will keep vehicle from changing lanes if possible*	X			
Mercedes Benz Class S				X		X	X
Audi S8				X		X	X
Volvo XC90				X		X	X

Technology is far enough along that the Highway Loss Data Institute (HLDI) has conducted early tests with crash avoidance technologies that show that forward collision systems, especially those that brake autonomously, and adaptive headlights, which shift direction as the driver steers, show the biggest reductions in crashes.

Cyber Issues

One of the larger concerns involved with the use of this technology is privacy and cyber security. Some testing regulations require a manufacturer to record data thirty seconds before a collision. In order to record data thirty seconds before a collision, the vehicle must be recording data all the time. Could this data be sold to vendors so that the vehicle, knowing that a person visits Taco Bell every Thursday, would be sure to navigate past Taco Bells on a regular basis? Could a private investigator use the data to prove to an individual that the spouse was indeed at a lover's house when the spouse had said he was at work? Could a terrorist hack into the systems and have all AVs speed up to ninety miles per hour and turn right? Experts say that is unlikely because it is one thing to hack into a system and gather credit card or identity information, and another to input instructions for numerous vehicles to all do the same thing at once. The hacking of an individual vehicle would not be practical because one vehicle causing an accident is not going to cause more damage than the average texting, eating, or other distracted behavior that is causing accidents now. However, it may be possible that a thief could hack an expensive car and have it show up at his door for his own use.

Shared Vehicles

Autonomous technology is not only applicable to individuals and their vehicles. Many in the industry believe that vehicle sharing, where an individual can get into a vehicle he does not own and have the vehicle take him somewhere and drop him off, similar to a taxi or rented vehicle, is where this technology will make the most difference. Currently there are some vehicle-sharing systems that could be models for how sharing autonomous vehicles could work.

RelayRides is one example of individual car renting. An individual lists his vehicle on the website with parameters for rental such as cost per day, week, or month and where the vehicle is located. Renters then make a request to use your vehicle; the owner has approval over the renter, and the renters' driving records are screened by RelayRides. The renter reserves a vehicle and enters credit card and driver's license information into the website. The owner and renter meet at a given time, and the keys are turned over to the renter. Renters are to replace gas used on the trip. The owner receives 75 percent of the rental price and excess mileage charges.

Zipcar is a similar service, although individuals are not renting their vehicles; the vehicles owned by Zipcar are parked in various locations and the renter picks them up at that location. Zipcar requires users to join the service for a small fee; driving records are reviewed and, if the potential user's record is acceptable, the user will be approved and a Zipcard will be issued. The Zipcard allows access to the Zipcar. The Zipcard unlocks the vehicle when held up to the windshield. The member uses the vehicle then returns it to the original parking spot.

Liability

Liability is of course the big question in using this technology; just exactly who will be liable if an AV is involved in an accident? Will responsibility fall on the passenger, or will responsibility ultimately fall back on the manufacturer? It is possible that states will develop regulations mandating liability; Florida already has a statute stating that a person is the operator of an autonomous vehicle in autonomous mode if the person activated the technology, even if the person is not in the driver's seat or even in the vehicle. This is important. AVs will have an override available so that a driver can override the autonomous technology; this may disable all the nonmandated safety technology, so the driver is solely responsible for the operation of the vehicle. Liability of course then rests totally with the individual who overrode the autonomous technology.

Another issue is liability for vehicles that were not originally manufactured with autonomous technology but were retrofitted after the fact. Google is developing technology to make vehicles autonomous but does not manufacture vehicles; such technology would have to be added to an existing vehicle. However, since the autonomous equipment is added to an existing vehicle, if the added equipment fails to work as advertised, is Google responsible, is the shop that added the technology responsible, or is the individual in the vehicle at the time of the accident responsible? These and other liability issues may not be sorted out until lawsuits occur.

Insurance

Regardless of where liability ultimately lies, insurance is going to be involved. If the manufacturers are held liable for an error by an autonomous car, not necessarily a malfunction, product liability coverage will be invoked. The ISO Products/Completed Operations Liability Coverage Form, CG 00 38 04 13, provides coverage for bodily injury or property damage the insured is legally liable for within the defined products-completed operations hazard. The form defines "products/

completed operations hazard" as "bodily injury" or "physical damage" arising out of "your product" unless the work is still in the insured's possession or the work is not completed. Transportation of property causing injury or damage is not covered. "Your product" is defined as goods or products manufactured, sold, handled, distributed, or disposed of by the insured, others trading under the insured's name, or a person or organization whose business or assets the insured has acquired. Therefore, if an autonomous vehicle crashes and the passenger is injured, the product liability coverage could be invoked because the AV technology did not avoid an accident and therefore caused an injury.

However, what if states or courts decide that the owner/passenger of the vehicle retains liability? The ISO Personal Auto Form, PP 00 01 01 05, provides liability to the insured or any "family member" for the ownership, maintenance, or use of any auto. However, the policy excludes coverage if the vehicle is being used as a public or livery conveyance. Currently there are carsharing services where the insured's renting of his vehicle would exclude coverage to the vehicle.

As mestioned previously, RelayRides is such a service. It allows an owner to rent her vehicle to others when it is not in use. RelayRides reviews potential users' driving records. The owner of the vehicle is provided with a one million dollar combined single limit liability policy that provides bodily injury and property damage to third parties on a primary basis. The users have the option to select state minimum liability coverage or $300,000 liability coverage per occurrence. Personal injury protection and uninsured/underinsured (UM/UIM) benefits are provided as well; the user can reject the UM/UIM coverage. For collision damage or other than collision damage excluding acts of nature, the owner is covered up to the actual cash value of the vehicle. For acts of nature such as floods, falling tree branches, hail, and other causes, the owner receives coverage identical to what the owner had on the vehicle immediately prior to the rental of the vehicles. So while the insured's individual coverage may not apply in such a situation, the carsharing service provides insurance for the individual.

The renter is responsible for damage to the vehicles caused during the rental period. The renter has three options for coverage: premium that provides a $500 deductible; basic, which has a $2,500 deductible; and decline coverage, where the renter assumes all losses up to the actual cash value of the vehicle plus any related costs.

In similar fashion, Zipcar provides insurance for users of its vehicles. The vehicles are owned by Zipcar, not individuals. Insurance of $300,000 combined single limit is provided; personal injury protection is provided where required by law. For physical damage coverage, a damage fee of $750 may apply. Those over twenty-one years of age and accident free for the past twelve months may buy a damage fee waiver. Users are allowed up to 180 miles per day, with additional mileage charged at $.45 per mile.

Such services could become models for how autonomous vehicle services could be insured. An autonomous vehicle service may allow passengers to select coverage levels depending upon the amount of risk they are willing to assume. The rider will need individual coverage in case he has an accident that exceeds the limits of insurance provided by the autonomous vehicle company.

As far as coverage for the vehicles in an autonomous fleet that operates similar to a taxi operation, coverage would be provided by a business auto form. The ISO CA 00 01 10 13 provides both physical damage and liability for the owner of the vehicles.

Rating

One of the advantages predicted once autonomous vehicles take hold is a significant reduction in insurance premiums. While this may eventually happen, there are a number of factors that must be considered. First, it will be many years before autonomous vehicles make up most of the vehicles on the road. The average age of vehicles on the road today is ten years old, so it will be many years before the fleet of vehicles turns over. Not everyone is willing to accept the technology; some people are not sure that the vehicle can really handle all situations, and others simply like to interact with the vehicle. There are still those who drive a manual transmission because they enjoy having more control over the vehicle. An insured's driving record, accident history, and location (urban or rural) will still be important factors in creating premiums for many years.

Individuals who have ridden in autonomous vehicles report that other drivers are fascinated by the vehicles and some drivers will speed up or slow down to look at the vehicle; this presents a distraction to other vehicles. While the AV may not be involved in an accident, it may have a role in other vehicles having accidents. Likewise, there may be people who drive autonomous vehicles to see how they react; they may want to see if they really will swerve to avoid a vehicle in its lane or will brake in time to avoid rear-ending a vehicle in front. Autonomous vehicles, while safe themselves, may not be able to avoid the distracted or erratic behavior of all other drivers on the road. While the AV may be able to swerve to avoid hitting another car, the vehicle may hit a tree instead, still causing damage to the vehicle.

There will also still be hail, tornadoes, floods, and other natural events that will damage a vehicle that have nothing to do with the action of the vehicle in motion. These things will still occur, and while they may not occur frequently, the cost to repair the autonomous vehicles may be higher than current repair costs.

Regulations

How states regulate AVs is another major factor in putting them on the road. Currently California, the District of Columbia, Florida, Nevada, and South Carolina have regulations for the use and testing of AVs on their roads. However these regulations are specific to testing and do not apply to the general population since the vehicles are not on the market. While the regulations are similar in many ways there are some variations.

The regulations contain various definitions, including artificial intelligence, autonomous vehicle, driver, and manufacturer. Most testing regulations require one or two people in the vehicle, with one person in the driver's seat at all times ready and able to take control if the vehicle malfunctions.

Insurance requirements range from minimum state financial responsibility requirements to five million dollars. Acceptable are insurance policies, surety bonds, or self-insurance.

Requirements for the vehicles themselves include the ability to operate on the states, roads, mechanisms to disengage the autonomous technology, ten thousand miles of previous testing, and compliance with all federal and state safety guidelines.

Some states require reporting of any accidents and some require storing of sensor data for at least thirty seconds before a collision occurs.

Some states will use an endorsement for test drivers stating that a person is not actively required to drive the AV. Other states simply require the driver to have a valid license. However, licensing will be a large issue. Will individuals need training to understand when the vehicle needs a human to take over controls and how to transition from automatic to manual mode? Predictions exists that AVs would be helpful to the elderly, disabled, and others who cannot drive, and that this is one of the major benefits of AV technology. If states require a driver to have a valid license, is the benefit to these nondriving individuals taken away?

Conclusion

The possibility of autonomous vehicles is exciting new technology, and the potential benefits to society and individuals are enormous. However, there are issues that need to be resolved, many of which cannot be solved in advance of states creating legislation or even the first lawsuit to determine liability when an AV has an accident. Infrastructure also needs to be addressed, because technology for the vehicles to be able to understand a roadway covered in snow may ultimately be required. Changes to infrastructure are expensive and time consuming.

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