AUTOMATED VEHICLES AND THE CONNECTED ENVIRONMENT

A CRASH COURSE
AGENDA

• Overview of Automated Vehicles
• Health and Safety Considerations
• Government Actions
• Industry Adoption
• Teamster Response
Automated vehicles are those in which at least some aspect of a safety-critical control function (e.g., steering, shifting, or braking) occurs without direct driver input.

- Also Know As:
  - Autonomous Vehicles, Self-Driving Car, Driverless Vehicles, Intelligent Transport Systems
SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) DEFINES SIX (6) LEVELS OF AUTOMATION
## EXAMPLES OF TECHNOLOGY AT EACH AUTOMATION LEVEL

<table>
<thead>
<tr>
<th>SAE Level</th>
<th>Example Systems</th>
<th>Driver Roles</th>
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<tbody>
<tr>
<td>1</td>
<td>Adaptive Cruise Control OR Lane Keeping Assistance</td>
<td>Must drive other functions and monitor driving environment</td>
</tr>
<tr>
<td>2</td>
<td>Adaptive Cruise Control AND Lane Keeping Assistance</td>
<td>Must monitor driving environment (system nags driver to try to ensure it)</td>
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<tr>
<td>3</td>
<td>Traffic Jam Pilot&lt;br&gt;Automated parking&lt;br&gt;Highway Autopilot&lt;br&gt;Vehicle Platooning Technology</td>
<td>May read a book, text, or web surf, but be prepared to intervene when needed</td>
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<tr>
<td>4</td>
<td>Closed campus driverless shuttle&lt;br&gt;Valet parking in garage&lt;br&gt;Automated Tractor Trailers&lt;br&gt;‘Fully automated’ in certain conditions</td>
<td>May sleep, and system can revert to minimum risk condition if needed</td>
</tr>
<tr>
<td>5</td>
<td>Automated taxi&lt;br&gt;Car-share repositioning system</td>
<td>No driver needed</td>
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HOW DO AUTOMATED VEHICLES WORK?

Under the bonnet
How a self-driving car works

Signals from GPS (global positioning system) satellites are combined with readings from tachometers, altimeters and gyroscopes to provide more accurate positioning than is possible with GPS alone.

Lidar (light detection and ranging) sensors bounce pulses of light off the surroundings. These are analysed to identify lane markings and the edges of roads.

Video cameras detect traffic lights, read road signs, keep track of the position of other vehicles and look out for pedestrians and obstacles on the road.

Radar sensors monitor the position of other vehicles nearby. Such sensors are already used in adaptive cruise-control systems.

Ultrasonic sensors may be used to measure the position of objects very close to the vehicle, such as curbs and other vehicles when parking.

The information from all of the sensors is analysed by a central computer that manipulates the steering, accelerator and brakes. Its software must understand the rules of the road, both formal and informal.

Source: The Economist
Figure 2 Several driver-assistance systems are currently using radar technology to provide blind-spot detection, parking assistance, collision avoidance, and other driver aids (courtesy Analog Devices).
AUTOMATED VEHICLES VS. CONNECTED VEHICLES

**Autonomous Vehicle**
Operates in isolation from other vehicles using internal sensors

**Connected Vehicle**
Communicates with nearby vehicles and infrastructure

**Connected Automated Vehicle**
Leverages autonomous and connected vehicle capabilities
SPECIFIC ISSUES FOR DRIVERS

• Health and Safety Considerations
  • Ethical Dilemma
  • Liability
  • Regulations Impacting Drivers
RADARS AND ELECTROMAGNETIC ENERGY

• Electromagnetic Energy
  • Radio waves
    • Radiofrequency RF Waves/ RF Energy/ RF radiation (nonionizing)

• Biological Effects of RF Radiation?
  • Thermal effects- tissue damage to eyes and testes- high power RF source (cell tower)
  • Non-Thermal Effects- inconclusive animal models showed tumor formation

• Will radars in automated cars produce enough energy to cause cancer?
  • Will a cumulative exposure (infrared, radar, laser-lidar, coupled with increased cell phone use and environmental EF energy pollution) make a difference ???
THE HUMAN MACHINE INTERFACE:
ERGONOMICS AND COGNITIVE STRESS

• What will the dashboard look like?
• Will drivers be expected to be familiar with the different makes and models of automated CMVs?
• How will carriers handle technology updates for fleet vehicles?

Is this HMI dashboard overwhelming?
HOW SENSOR TECHNOLOGY INTERPRETS THE ENVIRONMENT

Yellow box = pedestrian
Red box = cyclists
Pink box – vehicle

Red fences – location where the car will make itself stop
Green fences – location where the car thinks it will need to slow down
LIDAR: GOOGLE CAR
LIDAR: VELODYNE
IS THERE A DIFFERENCE IN THE QUALITY OF TECHNOLOGY?
DRIVER ASSISTED TRUCK PLATOONING

Connecting Trucks

Network Operations Center

Real-time Cloud Supervision
Platooning Only:
When Safe
Where Safe
Correctly Ordered
Dynamic Adjustment to Conditions

Advanced Data Products
Platooning Sensor Data
Driver, Vehicle and Route
Maximize Context

Active Braking
Always On
Cloud Hazard Alerts
Cloud Optimizations

Peloton
Active Braking Systems Linked
Both Drivers Steer
Both Trucks Save Fuel

The Platooning Experience

Connected Braking & Acceleration
Peloton’s truck platooning system uses Vehicle to Vehicle (V2V) communication to connect the braking and acceleration between the two trucks. The V2V link allows the lead truck to control the acceleration and braking of both trucks virtually simultaneously, reacting faster than a human or even radar sensors could.

Aerodynamic Benefit
The reduction in aerodynamic drag of two-truck platoons provides unprecedented fuel savings for both the trailing and the leading truck. Independent fuel efficiency testing by a major fleet, NACFE, and the U.S. Department of Energy and Transportation has shown double digit fuel savings. The aerodynamic improvement allows the front truck to save fuel along with the rear truck.
- LED text status display
- Three-light display indicating position of truck in platoon
- Three-light display, with pattern of colors indicating operating condition
- Reflector to aid sensors
2ND VEHICLE MONITOR DISPLAY (PLATOON)
FATIGUE MONITORING DEVICES AND MISUSE

WHOOP STRAP 2.0
WORN ON THE WRIST AND USED FOR FITNESS APPLICATIONS.
WHOOP is a scientifically-grounded wearable which tracks and reports on strain, sleep, recovery analysis and more. It has been endorsed by...

MAVEN CO-PILOT
WORN ON THE HEAD AND USED FOR INDUSTRIAL APPLICATIONS.
The Maven Co-Pilot is a wearable device designed to address truck driver fatigue and distraction. The device is able to detect the...

SMART CAP
WORN ON THE HEAD AND USED FOR INDUSTRIAL APPLICATIONS.
The Smart Cap is a fatigue monitoring system designed for industrial purposes. This wearable device is excellent for keeping truck drivers...

EASYWAKEME
WORN ON THE WRIST & ANKLE AND USED FOR FITNESS APPLICATIONS.
EasyWakeMe is a high-tech device developed by Dreamrap Technologies to capture sleep patterns. This wearable device detects optimal wake-up...

VIGO FATIGUE MONITOR
WORN ON THE HEAD AND USED FOR LIFESTYLE & INDUSTRIAL APPLICATIONS.
The Vigo Fatigue Monitor is a wearable device that tracks alertness over time. It has the capability to alert the user when they are drowsy...

FATIGUE SCIENCE READIBAND
WORN ON THE WRIST AND USED FOR MEDICAL, INDUSTRIAL & FITNESS APPLICATIONS.
The ReadiBand is a wearable device worn on the wrist and designed to collect wrist movement data. From this data, Fatigue Science is able...

OPTALERT EAGLE
WORN ON THE HEAD AND USED FOR LIFESTYLE & INDUSTRIAL APPLICATIONS.
The Optalert Eagle is a fatigue monitoring system that detects the physiological warning signs of early onset drowsiness. The Eagle’s...
OTHER HEALTH AND SAFETY CONSIDERATIONS OF CMV PLATOONING

- Alarm Fatigue (DSRC Passive Alerts)
- Intellectual Overload (fatigue)
- Ergonomics
- Technological Malfunction
- Workplace Stress/Workplace Violence
HIGH TECH SECURITY CHALLENGES (HACKING)

Critical Vehicle Data
• Engine control unit
• Transmission control unit
• Body controllers (locks/lights)
• Air bag control unit
• Steering, suspension, and stability

Cyber Security Attack Points

Infotainment & Telematics
• Vehicle data from OBD II, GPS coordinates, driving patterns, diagnostics
• Internet, smartphone interfacing, Bluetooth, Wi-Fi, app store
• Radio and media streaming

External Interfaces
• Keyless entry
• Tire pressure monitoring system
• V2x communication/DSRC
• Satellite data
• Sensor and camera data

In the automated scenario, there is a high possibility of vehicle being compromised. Drivers of the vehicle must be provided with a failsafe switch to shut down ADAS systems to regain full control over the vehicle.

Heavy dependence remains on an Internet network, and the exchange of data is to be managed properly. Encryption of data exchange will bring third-party security solution providers into the value chain.
LOW-TECH SECURITY CHALLENGES
SPECIFIC ISSUES FOR DRIVERS

• Health and Safety Considerations

• Ethical Dilemma

• Liability

• Regulations Impacting Drivers
ETHICAL DILEMMA:

HOW WILL AUTONOMOUS VEHICLE BE PROGRAMMED?
LIABILITY CONCERNS

• Who's liable when an autonomous car crashes? The driver? The manufacturer? The programmer? The Carrier?

Liability is a major ethical issue surrounding autonomous vehicles. Complex systems inherently have errors and bugs. An issue that will arise surrounding liability is assigning fault when an autonomous vehicle crashes. However as autonomous vehicles become more prevalent a system of responsibility must be established. If the software misinterprets a worn down sign does the blame fall on the department of transportation for poorly maintained signage or the company who produced the self-driving software? It is unclear where the future of liability will rest in the realm of self-driving cars however it is known that the United States is fast to place blame on car manufacturers. The precedent set over the next few years will have a significant impact on how willing car companies will be in pursuing autonomous vehicle technology.

• Google, Volvo, Mercedes have all accepted liability for crashes due to AV technology failure
REGULATORY CONSIDERATIONS

- Changes to the Federal Motor Vehicle Safety Standards (FMVSS)
- Driver Licensing
- Maintenance Standards
- Vehicle Inspections (Pre-Trip / DVIR)
- FMCSA Hours of Service changes for operators of CMVs
- Federal Automated Vehicle Policy (should this be a regulation?)
- What guidance will law enforcement have in citation or stopping an autonomous vehicles?
- How will autonomous vehicles behave at grade crossings where there is no arm limiting crossing and the “connected environment technology is not ubiquitously implemented.
WHAT WE KNOW
WHAT SECTOR IS LIKELY TO ADOPT THIS TECHNOLOGY?
IMPLEMENTATION PROJECTIONS

Timeline for Adoption

Phase 1 (now to 2016): 'Passive' autonomous driving

Phase 2 (2015 to 2019): Limited driver substitution

Phase 3 (2018 to 2022): Complete autonomous capability

Phase 4 (two decades): 100% autonomous penetration, utopian society

Source: Company data, Morgan Stanley Research
WHO IS PUSHING THIS?
• Passenger Vehicles Auto Companies
  • Honda, Volvo
• Internationally
WHO ELSE IS INVOLVED? - TECH COMPANIES

- Google (Alphabet)
- Apple
- Uber
- Baidu - The Chinese internet company
- Thousands of smaller companies
WHO ELSE IS INVOLVED? - SUPPLIERS
THE MOVEMENT TO TRUCKS

• Self driving trucks are one part of the equation
• Different dynamic in Trucking
• Each segment presents it’s own challenges – we know they can’t be lumped together into one group
• Issues impacting tankhaul aren’t the same as LTL
• Manufacturers dictate much of what companies can buy, many trucking companies are consumers also
• For the self driving tech – same similar suppliers
• Volvo Group
• Otto
• Embark
PLATOONING

- Level 3+ automation
- Hybrid of human and computer interfaces
- Operate like trains on wheels
- UPS, FedEx, truckload OTR companies, anywhere fixed point to point operations with multiple vehicles is being examined
- Creates unique risks to commercial drivers and other motorists on the road
PLATOONING

• Why? Fuel efficiency
• Same concept as race cars
PASSENGER CARRYING VEHICLES

Automated Transit, Shuttle, Bus, Circulator, First/Last Mile Service and Taxi Project Announcements and Launches

US CRASH STATS

- Motor Vehicle Crashes are Costly
  - Human toll: 32,675 people died in 2014
  - $836 billion dollars a year to society
  - A leading cause of death for 4 to 34 year olds
  - U.S. falling behind other European countries and Japan in terms of crashes

What they don’t say - 80 percent of truck crashes are caused by other cars on the road

- Need to accelerate deployment of current crash avoidance technologies (automatic braking, lane departure warning, etc) that will directly help
WHAT HAPPENS TO WORKERS

• Job loss?
• Change to what the job itself is
• Difficulties attracting drivers to field?
• Degradation of skills?
• Downward pressure on wages?
• More duties without commensurate pay?
SOCIOECONOMIC CONSIDERATIONS

• Potential broad impacts:
  • 4.5 Million Jobs lost? ~less than 400,000 jobs created?
  • Trucking, Transit, Taxi, Hotel, Food Service, Medical, Parking garage, Waste, Construction, Port, and Mining sectors, potential for various impacts
  • Related industries – hotels and truck stops
  • African America, Latino, American Indian communities exponentially impacted
  • Environmental Concerns (increased traffic)
  • Forecasted reduced injuries and fatalities as a result of vehicle crashes. Probably increased in the early stages of implementation however as non AVs and Avs coexist on roads and highways
GOVERNMENTAL ACTIONS

- Federal Department of Transportation
  - NHTSA - guidance policy
  - FMCSA - TBD?
- State Laws
- City initiatives (Las Vegas, LA, etc.)
WHAT ARE THE FEDS DOING?

• Obama carved out $4 billion in the 2017 budget for AV development, and the National Highway Traffic Safety Administration (NHTSA)
• FMCSA listening session in Atlanta, putting out potential guidance
• Thune-Peters Legislation tackling initial parts of regulatory side
• Senators calling on DOT to approve proving ground funding
• House Ed and Workforce and other committees examining workforce impact
• DOT Automated Working Group – limited union participation
• Tacking major infrastructure bill, with a/v component?
WHO RULES THE ROADS? STATES VS THE FEDS

• So many different issues states are filling in the gaps licensing, registration, certification, insurance, infrastructure, cybersecurity, privacy and ethical dilemmas

• Some groups want feds to take the reins, interstate operations become direct importance

• Will depend on state and federal political dynamics

• Some states want to get the upper hand in competition, even if not in citizens best interest
AVIATION

**Similarities:**
- Driver disengagement during long stretches (highway automation vs autopilot during flight)
- Still need drivers

**Differences**
- Reaction times
- Public Acceptance?
- No Patchwork ofRegs
- FAA requires pilots to be hands-on for takeoffs and landings while a plane is below 500 feet
SAN PEDRO BAY, CA WHARF
AUTOMATED VEHICLE TALKING POINTS FOR MEDIA

- Communicate the message/Teamster perspective
- Raise questions and share concerns
- Clarify the industry(ies)
- Educate and have open conversations with reporters
- Work as a team to maintain a consistent message
- Give our union and our members a voice