



Human Factors and Citizen Understanding of Connected and Autonomous Vehicles

Lisa Miller
Outreach and Growth Manager, UDOT
2018 Wisconsin ITS Forum

CARLOS' TOP TEN

10. Travel times will decrease in our urban areas.
9. We will be a national leader in the evolution and development of connected autonomous vehicles during the next few years.
8. First DOT in the country to have real-time full situational awareness of our systems.
7. On July 24, 2021 you will see the first CAV drive from Salt Lake City to St. George without any driver override.
6. UDOT will become the first DOT in the country to go completely paperless.
5. In 2021, our pavements and bridges will be the envy of the nation.
4. Our current culture of trust will lead us to a new level of openness.
3. Our public approval ratings will reach the highest level its ever been: 90%.
2. Every employee will be given the best training and education available.
1. We will be the safest DOT in country with less than 200 fatalities per year.



THE FIVE PILLARS OF THE UDOT CAV PROGRAM

Connected and Automated Vehicles (CAV) are advancing rapidly and will soon be a reality on our roadways. UDOT believes that CAV represents the next opportunity for a significant leap forward in both traffic safety and mobility. It is UDOT's goal to be at the forefront of CAV development and implementation, and in the process to accelerate the realization of the safety and operational benefits of these technologies.



TECHNOLOGY ADVANCEMENT

Developing UDOT's technological capabilities is crucial to advancing the state of the practice in Utah and across the nation.

Priorities: Expand the implementation of Multi-Modal Intelligent Traffic Signal System (MMITSS) to the TRIP BRT project, and in snow plows on key routes around the state



ACADEMIC COLLABORATION

Collaboration with Utah's Universities is critical to a vibrant and successful CAV community.

Priorities: Data analysis, Human factors investigation, development of safety applications



POLICY & LEGISLATION

Oversight for safety and efficiency is instrumental in CAV advancement. Policy and legislative decision makers need to be well informed.

Priorities: Legislative coordination, facilitation of demonstrations, Task Force establishment



PRIVATE SECTOR ENGAGEMENT

Strategic partnerships will strengthen the success of UDOT's CAV program and can be instrumental in bringing high-paying jobs to Utah.

Priorities: Development of safety applications, product testing and development



OUTREACH & GROWTH

Strategically sharing the UDOT CAV story will attract partners and strengthen economic development.

Priorities: Strategic outreach plan, education and marketing materials

Session #14: “What does the public think about autonomous vehicles and why should we care?” (Tuesday, November 6, 1pm, 200D)

Session #30: “Autonomous shuttles: What does the future hold and what are UDOT’s plans?” (Tuesday, November 6, 3:15pm, E-1)

Session #37: “Crunching the numbers: Analysis of the Redwood Road Transit Signal Priority Project” (Tuesday, November 6, 4:30pm, 300C)

Session #70: “Where is UDOT going when it comes to transportation technology deployments and connected and autonomous vehicles?”
(Wednesday, November 7, 2:00pm, E-1)

Session #85: “Traffic signals talking to buses and plows? Wow! Why?”
(Thursday, November 8, 8:00am, 300A)

14

What does the public think about autonomous vehicles and why should we care?

Lisa Miller

Communication & Media

30

Autonomous shuttles - What does the future hold and what are UDOT’s plans?

Christopher Siavrakas

Operations

37

Crunching the numbers: Analysis of the Redwood Road Transit Priority Signal Project

Blaine Leonard, Jamie Mackey
Michael Sheffield

Operations

70

Where is UDOT going when it comes to transportation technology deployments and connected and autonomous vehicles?

Blaine Leonard

Operations

85

Traffic Signals talking to buses and plows? Wow! and Why?

Peter Jager
Chuck Felice

Operations

Transportation

Foxconn plans self-driving trucks on I-94 as early as 2021



Louis Woo, special assistant to Foxconn Technology Group chairman and CEO Terry Gou

SCOTT PAULUS



Proving It: Connected Infrastructure & AV Research Vital to a National Strategy

April 10, 2017 • Robert Fischer, GTiMA President

When envisioning the coming age of autonomous vehicles, it's easy to get stuck on picturing AVs themselves. Their sophisticated sensors, flashy dashboards, and roomy cabins have created a lot of well-deserved buzz.

The problem with that is it's an incomplete vision. While AVs themselves are glamorous, vehicle-to-infrastructure (V2I) technologies are essential to their efficacy. Without V2I tech, the autonomous vehicle dream might not come

POLL EVERYWHERE

- How many of you are:
 - Excited about automated vehicles?
 - Apprehensive about automated vehicles?
 - Can't answer either of these questions because you have to many questions and hypotheticals?



A Majority of U.S. Drivers Still Don't Trust Self-Driving Cars



You're not alone...



Do you **trust**
self-driving cars?

By [KIRSTEN KOROSEC](#) January 24, 2018

Fears about riding in a self-driving vehicles are beginning to wane with millennials leading the way, according to an annual study released Wednesday by American Automobile Association. Compared to just a year ago, AAA found that 20 million more U.S. drivers would trust a self-driving vehicle to take them for a ride.

However, the majority of U.S. drivers are still afraid of giving control to an AI-powered vehicle or feel safer sharing the road with self-driving vehicles.

The landscape is changing...



Hyundai Will Review TV Ad Featuring Profoundly Irresponsible Driver



CONSUMERIST

Last updated: April 25, 2017



[Toyota](#) [Hyundai Safety](#) [Irresponsible Driver](#)

Volkswagen Polo advert banned for 'encouraging irresponsible driving'

Advert showing an accident-prone driver being saved by the Polo's safety systems has been banned in the UK by the Advertising Standards Agency



by Jimi Beckwith
1 August 2018

[Follow @JimiBeckwith](#)

The [Advertising Standards Agency \(ASA\)](#) has banned a [Volkswagen Polo](#) television advertisement for encouraging irresponsible driving, which represents a breach of the industry watchdog's code.

Six complaints were filed about the advert, alleging that the advert encourages dangerous driving and exaggerated the benefits of the safety systems being showcased. The ASA upheld the complaints, and ruled that the ad must not appear in its current form.

iSpot.tv



▶ ⏮ 00:00 ● 00:30 🔊 🔗



U.S. Secretary of Transportation Elaine Chao's Guidance

- “Let me challenge you to stand up and tell your story about this new technology to the public.”
- “Without public acceptance, automated vehicle technology will never reach it's full potential.”
- “Consumer acceptance will frame the growth of this technology. We have to work together to get it right.”

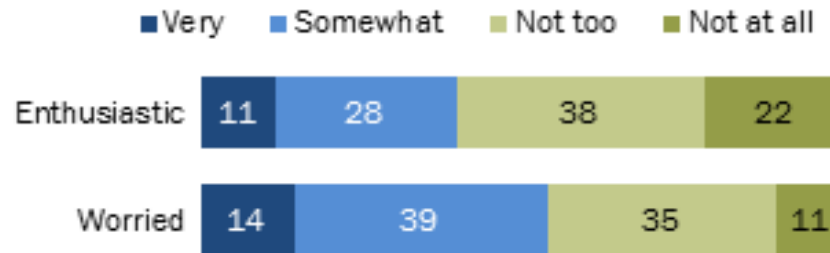




How does actual research stack up against popular opinion?

Public somewhat more worried than enthusiastic about driverless vehicles

% of U.S. adults who say the development of driverless vehicles makes them feel...

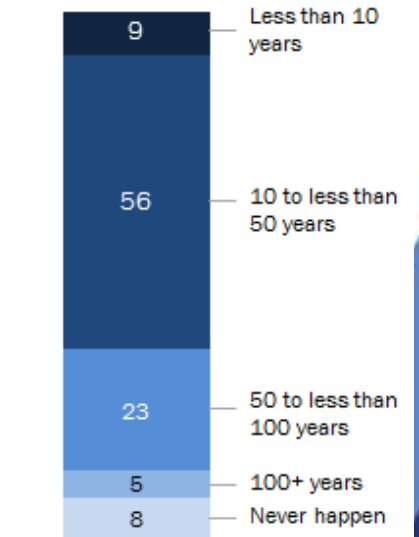


Note: Respondents who did not give an answer are not shown.
 Source: Survey conducted May 1-15, 2017.
 "Automation in Everyday Life"

PEW RESEARCH CENTER

Roughly two-thirds of Americans expect most cars to be driverless in next half century

% of U.S. adults who say it will take ___ for most vehicles on the road to be driverless



Note: Respondents who did not give an answer are not shown.
 Source: Survey conducted May 1-15, 2017.
 "Automation in Everyday Life"

PEW RESEARCH CENTER

What the public sees...

Uber self-driving car crash: Vehicle detected Arizona pedestrian 6 seconds before accident

Nathan Bomey, USA TODAY Published 9:40 a.m. ET May 24, 2018 | Updated 4:06 p.m. ET May 24, 2018



Tempe, Arizona police released video of the Uber Self-Driving SUV crash that killed a woman on Sunday. It shows a woman push her bicycle on a dark road and the human back-up driver's reaction. This video includes images some may find disturbing. (March 22) AP



JACK STEWART TRANSPORTATION 03.30.18 10:34 PM

TESLA'S AUTOPILOT WAS INVOLVED IN ANOTHER DEADLY CAR CRASH



A self-driving shuttle in Las Vegas got accident on its first day of service

Surprise: it was the human's fault

By Nick Statt | @nickstatt | Nov 8, 2017, 7:14pm EST

f t SHARE



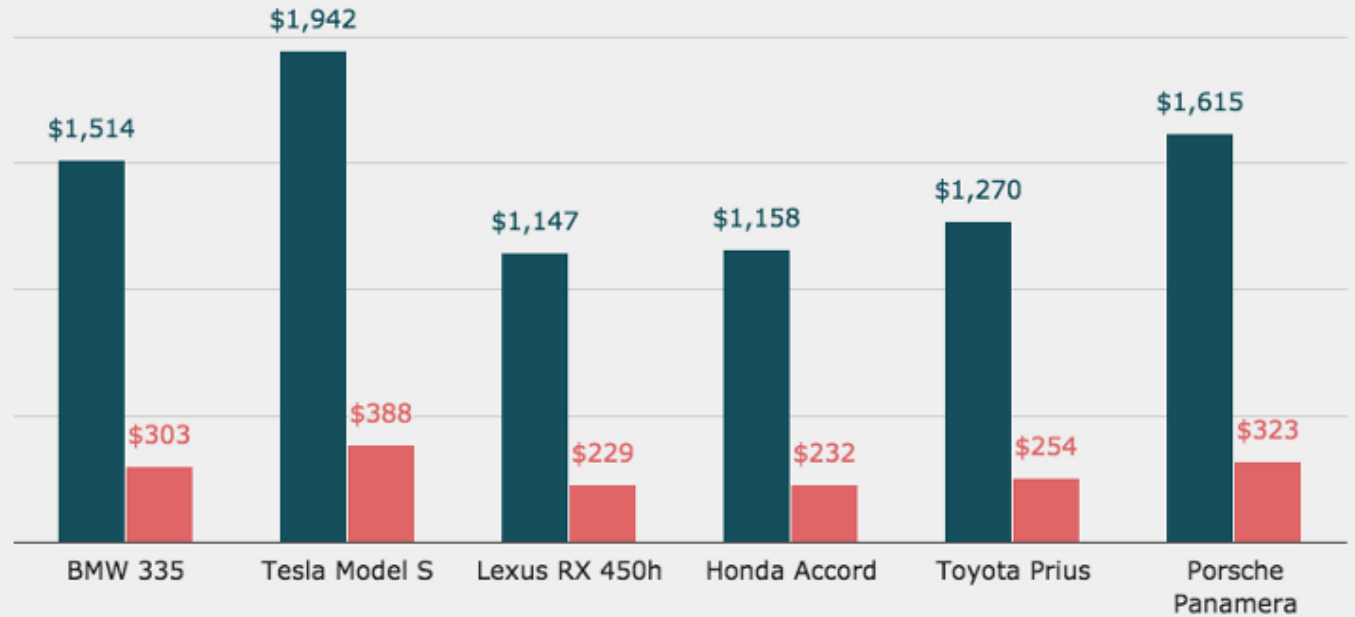
A Las Vegas-based [self-driving shuttle service](#) celebrated its launch day by getting into an accident with a human driver, according to a [news report from local Nevada broadcast station KSNV News 3](#). The shuttle, made by French startup Navya and owned and operated by French private transportation company Keolis, operates on a 0.6-mile loop around downtown Las Vegas offering free rides to residents. Within an hour of starting its new



What we see...

Company	Autonomous miles	Disengagements	Rate per 1000 miles
Google	635868	124	0.20
Cruise	10015	284	28.36
Nissan	4099	28	6.83
Delphi	3125	178	56.95
Bosch	983	1442	1466.94
Mercedes	673	336	498.95
BMW	638	1	1.57
Ford	590	3	5.08
Tesla	550	182	330.91
Honda	0	0	0.00
VW	0	0	0.00

Estimated Auto Insurance Costs: Self-Driving Vs. Human-Driven Cars Of Same Model (Self-Driving Price In Red)



(Credit: Ferenstein Wire / Source: Metro Mile)



How do we break through?

FIGURE 1: SUMMARY OF SAE INTERNATIONAL'S LEVELS OF DRIVING AUTOMATION

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/
HUMAN DRIVER MONITORS THE DRIVING ENVIRONMENT			
0	No Automation	the full-time performance by the human driver of all aspects of the dynamic driving task, even when enhanced by warning or intervention systems	Human driver
1	Driver Assistance	the driving mode-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the human driver perform all remaining aspects of the dynamic driving task	Human driver and system
2	Partial Automation	the driving mode-specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the human driver perform all remaining aspects of the dynamic driving task	System
AUTOMATED DRIVING SYSTEM ("SYSTEM") MONITORS THE DRIVING ENVIRONMENT			
3	Conditional Automation	the driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task with the expectation that the human driver will respond appropriately to a request to intervene	System
4	High Automation	the driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task, even if a human driver does not respond appropriately to a request to intervene	System
5	Full Automation	the full-time performance by an automated driving system of all aspects of the dynamic driving task under all roadway and environmental conditions that can be managed by a human driver	System

SOURCE: SAE. (2016). AVAILABLE AT: [HTTPS://WWW.SAE.ORG/MISC/PDFS/AUTOMATED_DRIVING.PDF](https://www.sae.org/misc/pdfs/automated_driving.pdf) (ACCESSED 4 AUG. 2017).

AUTOMATION LEVELS OF AUTONOMOUS CARS

LEVEL 0



There are no autonomous features.

LEVEL 1



These cars can handle one task at a time, like automatic braking.

LEVEL 2



These cars would have at least two automated functions.

LEVEL 3



These cars handle "dynamic driving tasks" but might still need intervention.

LEVEL 4



These cars are officially driverless in certain environments.

LEVEL 5



These cars can operate entirely on their own without any driver presence.

SOURCE: SAE International

BUSINESS INSIDER

How do we break through?

The Free **AAA**
Self-Driving
Shuttle



UTAH
LTDOT
Keeping Utah Moving



Industry Research



Criminal behavior: Criminals could block an ADS, knowing that it will stop for them, and rob its passengers. Criminals could use a driverless ADS to deliver drugs, stolen goods, or even a bomb. Routine traffic stops have helped solve many unrelated crimes. These interactions will drop substantially for ADSs that regularly obey traffic laws.

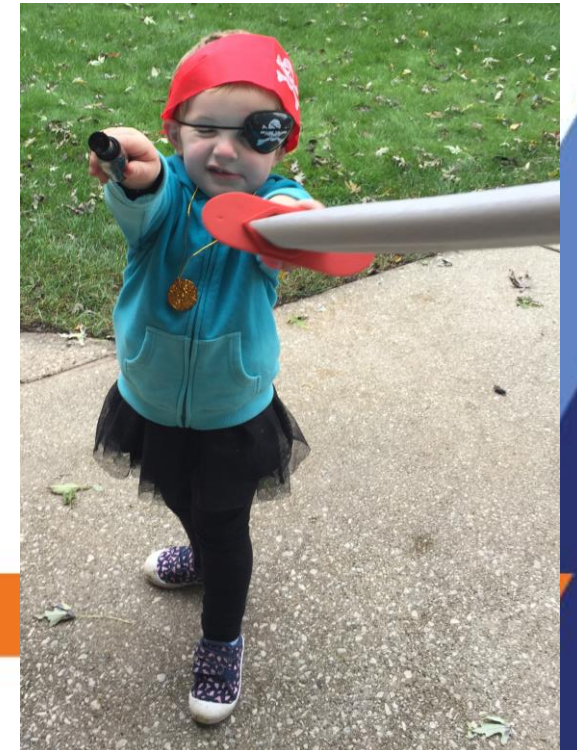
How will this change the transportation landscape?

Figure 2: Potential impacts of CAV deployment

TOPIC	POTENTIAL IMPACT OF CAV DEPLOYMENT
Public perception	The public's perception and acceptance of self-driving technology will play an important role in the testing and adoption of AVs.

It's clear from all predictions that **AVs and ADSs will share the road with vehicles driven by humans** for many years.

AVs, especially ADSs, promise to increase mobility, in particular for those who cannot drive, and reduce traffic crashes enormously, as **over 90% of crashes involve driver error.**



Who is talking about this? Where can I get more info?

U.S. Department of Transportation Public Listening Summit on Automated Vehicle Policy

Summary Report



July 2018



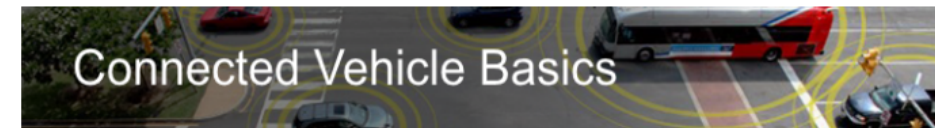
U.S. Department of Transportation



GHS
Greater Highway Safety Association
The State Farm Highway Safety

**PREPARING FOR AUTOMATED VEHICLES:
TRAFFIC SAFETY ISSUES FOR STATES**

MADE POSSIBLE BY A GRANT FROM **State Farm**



20 Questions About Connected Vehicles

1. What is connected vehicle technology?

Connected vehicles enable safe, interoperable networked wireless communications among vehicles, the infrastructure, and passengers' personal communications devices.

2. How long will it take before I see these cars in my dealership?

In 2016 NHTSA issued a Notice of Proposed Rulemaking on vehicle-to-vehicle (V2V) communications technology for new light vehicles. More than 400 comments were received by the public and they are being reviewed by USDOT. Equipment suppliers have indicated that they could have an adequate supply of readily available, mass-produced, internal components for a V2V device approximately 2.5 to 3 years after NHTSA moves forward with some type of regulatory action. In the meantime, General Motors has installed connected vehicle technology in select 2017 Cadillac models.

3. How much will this technology increase the cost of a new car?

Based on preliminary information, NHTSA currently estimates that the V2V equipment and supporting communications functions (including a security management system) would cost approximately \$341 to \$350 per vehicle in 2020. These costs would also include an additional \$9 to \$18 per year in fuel costs due to added vehicle weight from the V2V system.

4. How is my privacy protected?

V2V technologies do not pose a significant threat to privacy and have been designed to help protect against vehicle tracking by the government or others:

- The system will not collect or store any data on individuals or individual vehicles, nor will it enable the government to do so.

[Connected Vehicles Home](#) >



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- [How do they work?](#) >
- [How will they be used?](#) >
- [What are their benefits?](#) >

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Innovation is not an endeavor of certainty. It requires the willingness to accept and manage risk and to learn from the challenges. However, I firmly believe it is the most certain path to continual improvement.

Monte Aldridge P.E.
Director of Transportation Performance



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