



2019 Texas Research Peer Exchange

Summary Report

Texas Department of Transportation
Research and Technology Implementation Division

March 2019

Contents

Introduction	3
The Requirements for a Peer Exchange	3
Attendees.....	3
Process - Day 1	6
Process - Day 2	6
Requirements for the Report.....	7
Day 1 - Connected and Automated Vehicles (CAV) – State by State Program Overview	8
Overview	8
Key Takeaways	8
Presentation Highlights	10
DAY 2 - (CAVTrack) – Freight and Passenger CAV Projects, Challenges, Procurement of New Technology and Implementation	21
Overview	21
Key Takeaways	21
Presentation Highlights	21
Day 2 - (Research Track) – Research Program Discussions	31
Overview	31
Key Takeaways	31
Conclusion	34
Appendix A. Peer Exchange Agenda.....	35
Appendix B. Participants Contact Information	37
Appendix C. Resources	42
Appendix D. Follow Up Survey Results.....	48
Appendix E. Presentations	8

Introduction

The Texas Department of Transportation (TXDOT) hosted a peer exchange in Austin, Texas on March 25-26, 2019 to discuss Freight and Passenger Vehicle Connected and Automated Vehicles (CAV) programs.

The Requirements for a Peer Exchange

Under Title 23, Subpart B of the United States Code of Federal Regulations (23 CFR) §420.209 (a)(7), as a condition for approval of Federal Highway Administration (FHWA) planning and research funds for research activities, each state's department of transportation (DOT) is required to periodically conduct a peer exchange. FHWA defines "periodic" as at least once every 5 years. The use of peer exchanges was established to provide State DOT Research Development and Technology (RD&T) programs with the opportunity to examine and evaluate their own programs through a collaborative team of peers, experts, and persons involved in the process, where the exchange of vision, ideas, and best practices could be fostered to benefit both their program and the program of the peer team participants.

The basic approach is to invite an outside panel of managers from State DOT research divisions, FHWA, other public agencies, and the private sector to meet with the host agency to discuss and review a specific area of focus. During the peer exchange, the group analyzes the agency's policies and practices, shares case studies and experiences, and develops recommendations for improvements. The information gathered from the exchange is presented to TXDOT and FHWA management, and is documented in a written report.

Attendees

The TXDOT Research and Technology Implementation Division (RTI) hosted the Peer Exchange on March 25-26, 2019. Attendees included invited participants from other State DOTs, FHWA, RTI staff, UTA staff, and Technical Writer.

Peer Exchange Team Leader

Texas – James Kuhr, Project Manager, TXDOT Research & Technology Implementation Division

Peer Exchange Team

Leidos – Chris Stanley PMP, P.E., Senior Director of Surface Transportation Research, Saxton Transportation Lab Program Manager, Leidos

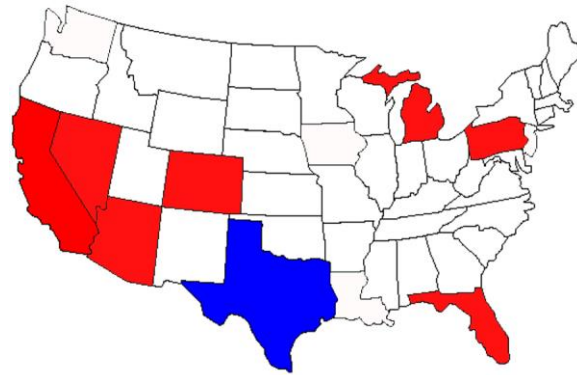
FHWA – John M. Corbin, PE, PTOE, Connected Automated Vehicle Program Manager, FHWA Office of Operations

FHWA – Amelia (Millie) Hayes, P.E., Safety and Traffic Operations Specialist, FHWA Texas Division

FHWA – Georgi Ann Jasenovec, Transportation Manager Freight Operations / International Border, FHWA Texas Division

FHWA – Karyn Vandervoort, Program Management Analyst, FHWA Pennsylvania Division

California (Remote participant)– Gurprit (Pete) Hansra, PE, TE, Chief Transportation System Management and Operations Research, Division of Research, Innovation and System Information, CalTrans



Texas – Darran Anderson, Director of Strategy and Innovation, Administration

Texas – Rocio Perez, Division Director, TXDOT Research & Technology Implementation Division

Texas – Jianming Ma, Ph.D., P.E., Senior Transportation Engineer, Traffic Management Section, TxDOT Traffic Safety Division

Texas – Caroline Mays AICP, Director, Freight and International Trade Section, TxDOT Transportation and Planning and Programming Division

Texas – Phillip Hempel, Section Director, TXDOT Research & Technology Implementation Division

Texas – Darrin Jensen, Project Manager, TXDOT Research & Technology Implementation Division

Texas – Zeke Reyna, Project Manager, Strategic Planning, TXDOT Research & Technology Implementation Division

Texas – Sherry Pifer, Freight Planning Branch Manager, Freight and International Trade Section TxDOT Transportation Planning and Programming

Florida – David Sherman, FCCM, Research Performance Coordinator, FDOT

Florida – Raj Ponnaluri, PhD, P.E., PTOE, PMP, Connected Vehicles and Arterial Management Engineer, FDOT

Pennsylvania – Douglas Zimmerman, Acting Director Bureau of Research, PennDOT

Pennsylvania – Mark Kopko, Special Advisor Transformational Technology, PennDOT

Michigan – Andre Clover, P.E., Program Manager, Research Administration, MDOT

Michigan (Remote participant) – Joe Gorman, P.E., ITS Program Office, MDOT

Arizona – Dianne Kresich, Research Center Manager, ADOT

Arizona – Martin Lauber, P.E., T.E., Transportation Engineer Manager, ADOT

Colorado – Bryan Roeder, Research Project Manager, CDOT

Colorado – Ashley Nysten, Connected and Autonomous Technologies Program Manager, CDOT

Nevada – Kenneth Chambers, Research Chief, NDOT

Nevada – Kandee Bahr Worley, Division Chief – NV2X, NDOT



Participants

Peer Exchange Participants from the TXDOT Research & Technology Implementation Division

TxDOT - Renee Susaste, Contractors Lead for Rocio Perez, RTI

TxDOT – Barbara Cisneros, Contract Specialist, RTI

TxDOT – Kevin Pete, Portfolio Manager, RTI

TxDOT – Chris Glancy, Research Project Manager, RTI

Peer Exchange Observers

FHWA - Anthony M. Jones, Transportation Planner, FHWA

TxDOT – Yvette Flores, AICP, Strategic Research Analyst, TxDOT Office of Strategic Planning

UTA - Bryan Sims, Executive Director, The University of Texas at Arlington, Division for Enterprise Development

UTA – Debra Dehn, Assistant Director Business Administration, The University of Texas at Arlington, Division for Enterprise Development

UTA – Dawn Hinton, Program Manager TxLTAP, The University of Texas at Arlington, Division for Enterprise Development

UTA – Amelia Medford, Program Coordinator TxLTAP, The University of Texas at Arlington, Division for Enterprise Development

Tim Osbaldeston, Technical Writer, President, OzTech Services

Process - Day 1

The TXDOT Research & Technology Implementation (RTI) Division identified the following topics for discussion as they relate to each State DOT's CAV Programs:

- Current Resources
- Strategic Plan
- Stakeholders
- Issues
- Potential Research Initiatives

Each participating State DOT was asked to prepare a 15-minute presentation with 15-minute Q&A to follow.

The peer exchange began with introductions and an overview of the agenda, but quickly moved to the first presentation. Each participant gave their presentation, and took questions during and after. The afternoon of the first day, the group was able to complete the presentations and move to open discussions.

Process - Day 2

For the second day the group split into separate rooms, a CAV track and a Research Track.

The CAV track was tasked with presenting another 15-minute presentation along with Q&A with the following CAV related topics:

- Technical Overview of Projects
- Technical Challenges
- Procurement Process
- What is Ready for Implementation
- What is Coming Soon

Frequent questions and discussions highlighted the key issues relating to the above topics for each State DOT and the role of FHWA.

The Research Track was given the following topics for their round-table discussions:

- University Contracting, Service Centers and Indirect/Direct Costs
- Implementation in a Big State, Getting Research from Report to the Field
- Project Selection, Value of Research and Performance Metrics for the Project and the Program
- Communication and Outreach

Senior research staff from each of the participating states shared in discussions around challenges and solutions to the topics above.

Requirements for the Report

In accordance with the FHWA State Planning and Research **Guide for Peer Exchanges** (June 2010), this report satisfies the necessary requirements to provide the following:

1. A brief **introduction** that identifies all of the participants on the panel and describes the purpose and intent of the activity.
2. The **body** of the report should briefly discuss those aspects of the research program that the panel explored.
3. The **conclusion** section of the report should reflect the highlights of the open discussions and should be written as a panel.

Day 1 - Connected and Automated Vehicles (CAV) – State by State Program Overview

Overview

On day 1, FHWA presented first and then each participating state was asked to present for 15-minutes, with 15-minute Q&A to follow, based on these prompts:

- What resources has your organization dedicated to Freight and Passenger Vehicle CAV (dedicated people, dedicated staff, funding sources, etc.)? Do you have a strategic plan, program plan? Please provide an org chart if available.
- Who are the stakeholders in the program? What other government agencies, private sector, universities, etc. are involved and how are they involved?
- What are the unique issues for passenger and freight CAV? Consider policy/programmatic/infrastructure/enforcement. How are you responding to these issues?
- What do you want to see from a national/multi-state initiative? Pooled funds study? NCHRP research ideas? TRB? Etc.

Key Takeaways

- FHWA has established, and is continuing to define, broad frameworks for CAV operation at a national level. However, FHWA is also seeking opportunities to encourage and promote state collaborations to define best practices and solve underlying technical and administrative challenges.
- Participant states encouraged use of existing organizations and efforts, such as AASHTO committees and NCHRP research to help navigate shared policy coordination among the states.
- Participants also identified several potential growth areas to promote communication and the sharing of ideas, success and failures between states. Participants requested federal assistance in coordination of these ideas
 - Multistate program support targeting Interstate Corridors
 - Repository of best practices, lessons learned, and template agreements for private sector partnerships (NOCoe posted)
 - Creation of an interstate data exchange for “typical” transportation data, such as work zone information
 - Lingo/jargon standardization, officially defined terms
- Work that will support CAVs in the future may be justifiable now through measurable impacts to DOTs and human drivers, and this can be leveraged to begin streamlining data collection and tracking. For instance, understanding and digitizing on-system facilities serves a dual role of advancing asset management now and aiding with route planning for CAVs in the future.
- Transportation Pooled Fund studies are powerful opportunities for collaboration and all participants showed interest in at least one of the following:

- AV Pooled Fund
 - CAV Planning Pooled Fund
 - Freight CAV Pooled Fund
 - Cross Border Pooled Fund
- Participant states expressed a variety of approaches and program maturity levels. Some key steps that several states pursued included:
- Establishing some sort of CAV task force
 - Develop a CAV Strategic/Business Plan
 - Participate in CAV pooled fund research
 - Seek opportunities for multi-state collaboration
 - Engage private sector partners and academia
 - Establish strong links with other governmental entities with overlapping jurisdiction that are pursuing CAV projects.

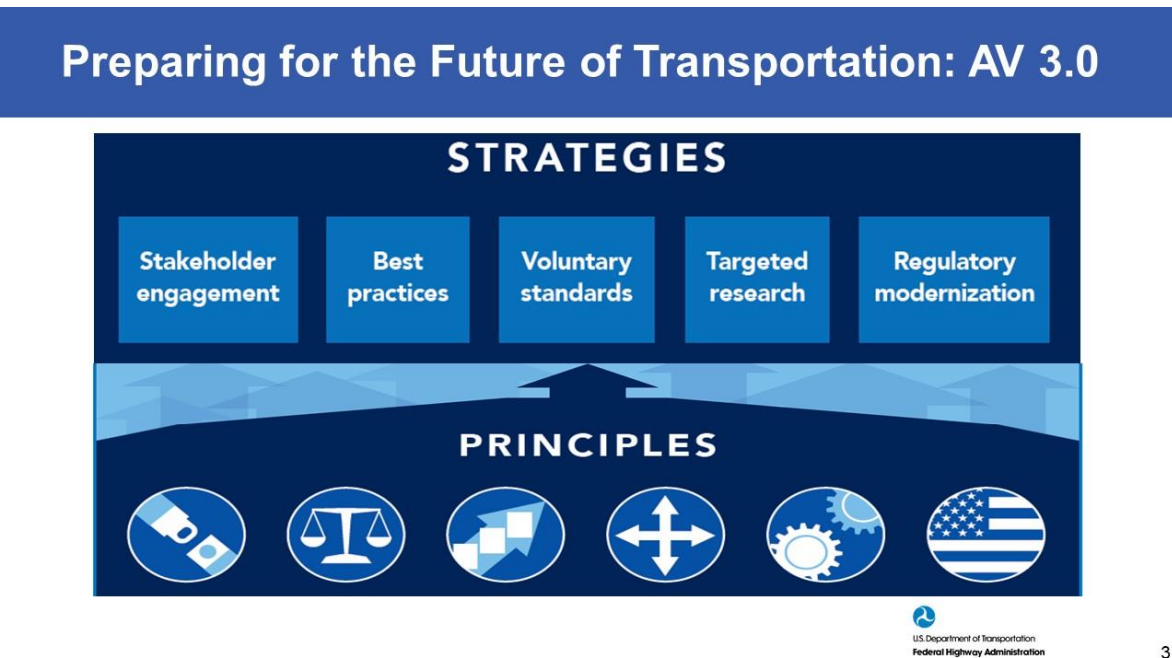
Presentation Highlights

FHWA

Presenter: John Corbin

John's presentation highlighted AV 3.0, the related 2018 RFI, and the National Dialogue on Highway Automation, a series of 6 workshops that were held to facilitate a national discussion about CAVs and the future of our on-road surface transportation system. John provided a comprehensive list of insights taken from the National Dialogue and these are included in the accompanying presentation materials. Other key takeaways follow.

- AV 3.0 (<https://www.transportation.gov/av/3>) is structured around three key areas:
 - Advancing multi-modal safety,
 - Reducing policy uncertainty, and
 - Outlining a process for working with U.S. DOT.



3

- U.S. DOT provides the following considerations for infrastructure owners and operators, including State DOTs, metropolitan planning organizations (MPOs), and local agencies.
 - Support safe testing and operations of automated vehicles on public roadways.
 - Learn from testing and pilots to support highway system readiness.
 - Build organizational capacity to prepare for automated vehicles in communities.
 - Identify data needs and opportunities to exchange data.
 - Collaborate with stakeholders to review the Uniform Vehicle Code (UVC).
 - Support scenario development and transportation planning for automation.

- While a national collective vision is needed, FHWA is looking to promote state collaboration to define best practices within federal frameworks.
- FHWA will pursue an update (expected 2020) to the 2009 MUTCD that will take into consideration new technologies (Cyber-Physical Infrastructure) and other needs.
- The National Operations Center of Excellence (NOCoE), maintains the following resource page for CAVs: <https://transportationops.org/resources-connected-and-automated-vehicles>

❖ Pooled Fund Idea: CAV Planning Pooled Fund
Transportation system planning
Strategic program planning
Business and organizational planning
Communications and outreach planning
National planning (interoperability & architecture)

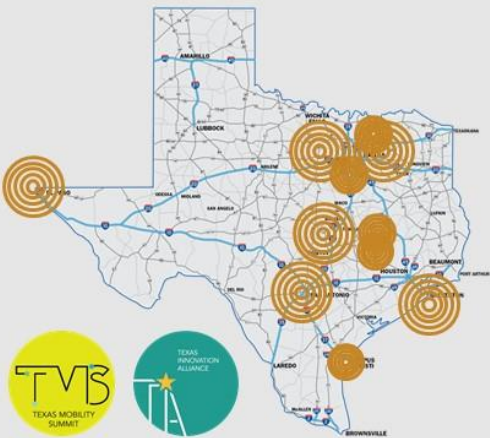
TxDOT

Presenters: James Kuhr, Jianming Ma and Caroline Mays

The TxDOT presenters covered the newly announced CAV Task Force that will span state agencies in Texas, discussed Texas’ extensive network of cross collaboration at all levels of government, including its very successful Texas Innovation Alliance, reviewed national efforts related to CAVs and previewed their plan to advance their program. Key takeaways follow.

Texas Innovation Alliance

- Action network of local, regional, and state agencies and research institutions who are committed to addressing mobility challenges by creating a platform for innovation



- Mobility summits: Dec 1-2, 2016 in Austin, TX; Oct 16-17, 2017 in Houston, TX; Oct 28-30, 2018 in Arlington, TX
- Teams representing 11 Texas cities/regions and 3 research institutions
- Over 40 different transportation agencies
- 22 industry sponsors for the Summit (e.g. data, OEMs, AEP firms) & 25 + Demonstrations
- Use cases identified by each team
- Combined approach to grants and programs: AV Proving Grounds
- Shared expertise and best practices solutions
- Comprehensive data strategy focus

TxDOT Peer Exchange
25 March 2019
12

- There are many ongoing efforts related to CAV that can be utilized by state DOT's. A handout attached to this report provides a comprehensive list of NCHRP 20-102 efforts in this area at the time of the peer exchange. Further, 11 state research programs related to CAV's were mentioned and National CAV efforts were noted to include:
 - Connected Vehicle Pooled Fund Study (CV PFS)
 - AASHTO Connected & Automated Vehicle Working Group (CAV WG)
 - Cooperative and Automated Transportation (CAT) Coalition
 - NCHRP Projects
 - 08-116 "Framework for Managing Data from Emerging Transportation Technologies to Support Decision-Making"
 - 20-24 "Connected Road Classification System (CRCS) Development"
 - 03-137 "Algorithms to Convert Basic Safety Messages into Traffic Measures"

- The TxDOT team shared draft considerations of what will become their CAV/CAT - Strategic Plan/Program Plan/Business Plan to help guide deployment and deployment of CAV technologies.

- TxDOT reiterated the importance of interstate corridor coalitions, similar to I-95, to advance multistate initiatives, especially targeting freight and work zone interoperability.

- TxDOT highlighted unique issues relating to CAV's:
 - Lack of knowledge, how do we best serve new vehicle types and emerging technologies?
 - What technologies will become standardized?
 - Awareness/adoption of affected populations

❖	Pooled Fund Idea: AV Pooled Fund
❖	Pooled Fund Idea: Freight CAV Pooled Fund
❖	Pooled Fund Idea: Cross Border Pooled Fund

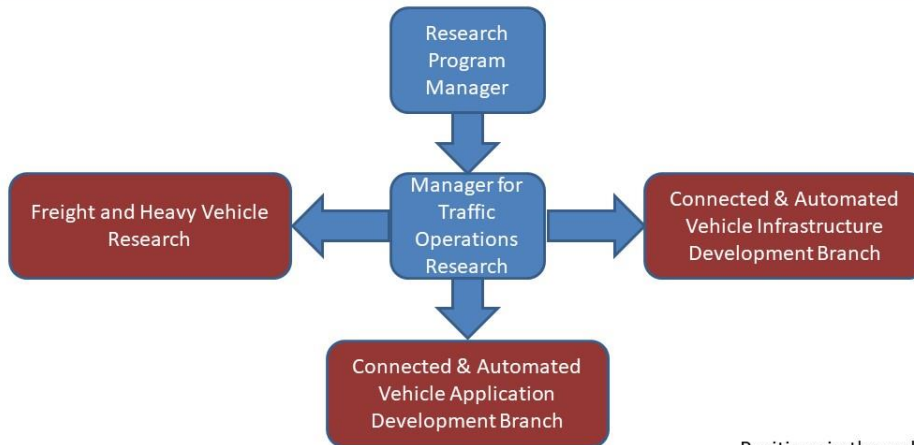
Caltrans

Presenter: Gurprit (Pete) Hansra

Pete's presentation provided an overview of resources dedicated to CAVs within the Caltrans organization. Key takeaways follow.

- Caltrans active projects include:
 - Partial Automation for Truck Platooning (FHWA Discretionary Grant)
 - I-10 Connected Corridor (Pooled Fund)
 - Low Speed CACC (Cooperative Adaptive Cruise Control) Development (SP&R II)

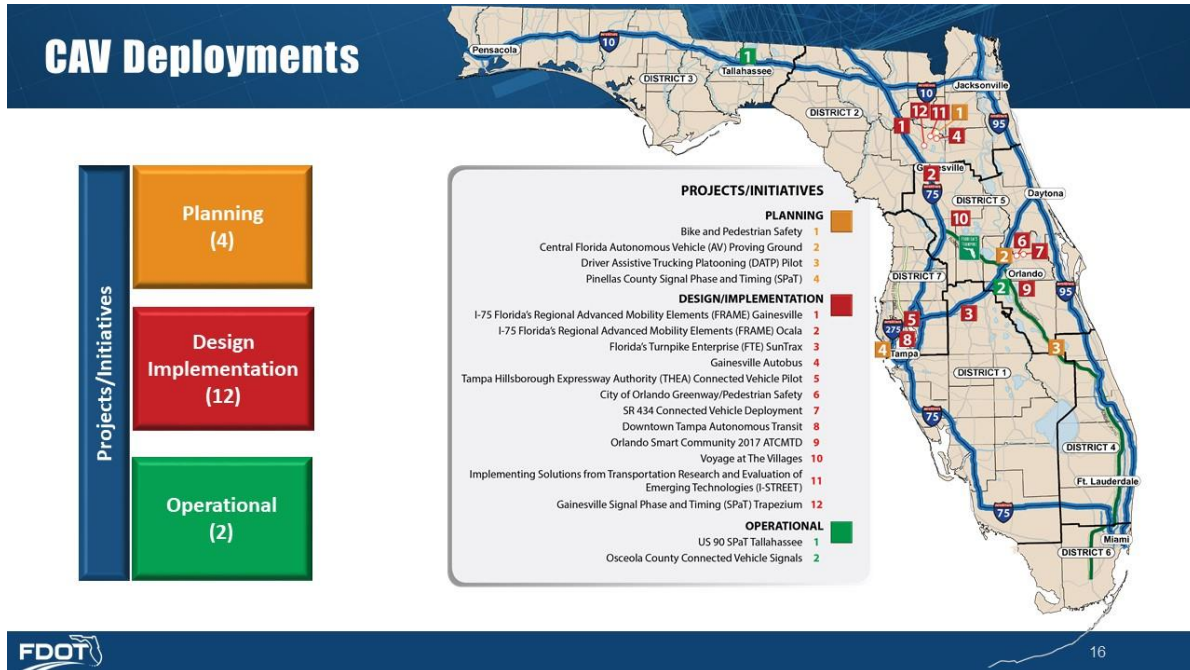
Caltrans DRISI Organization for Passenger Vehicle and Freight CAV



Positions in the red boxes are partially involved with CAV related activities

- Caltrans is heavily involved in Truck Platooning research and have been awarded a pair of FHWA Discretionary Grant's. They have partnered with Volvo for some of their research, and have tested a three-truck platoon. With the University of California Berkeley (UCB) PATH Program, they are currently engaged in planning and team building for an Early Deployment Assessment.
- Other notable academia projects include:
 - DSRC Test Bed Development with University of California Riverside (UCR) CE-CERT Program
 - Roadway Survey and Feature Extraction Application Development
 - Eco Approach and Departure Application Development
- Challenges moving forward:
 - DSRC vs C-V2X (they are launching a project to compare the two)
 - Lack of Standards for Hardware and Software
 - Cybersecurity
 - Standardizing and Harmonizing State Regulations: Vehicle Code, Enforcement and Compliance

Raj’s presentation provided the group with an overview of the 17 active CAV initiatives in Florida as well as the State DOT’s approach based on cost/benefit analysis work which led to creating a CAV Business Plan. Key takeaways follow.



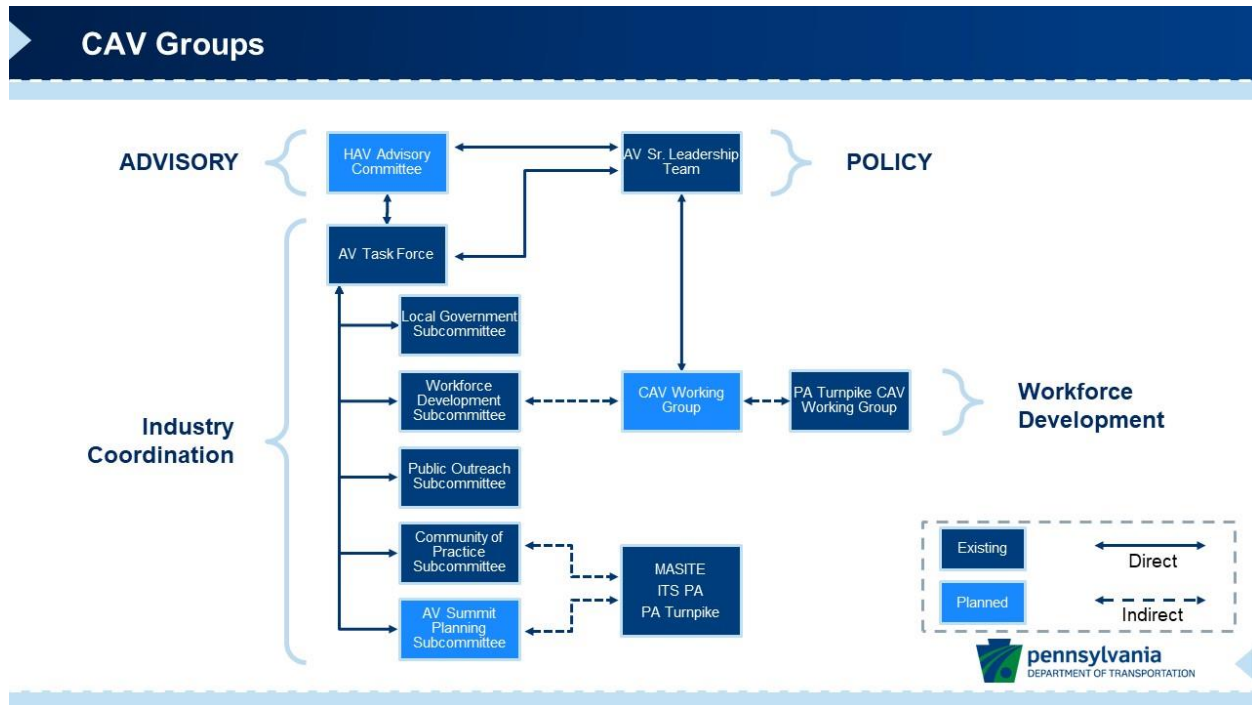
- Florida performs cost/benefit analysis for proposed projects, particularly those that are submitted for federal assistance. Since the impacts of any given new technology are as of yet unproven, they try to draw conservative estimates based on existing related data. Even if the projects are not selected for federal assistance, FDOT is able to justify their project internally and are allocated FDOT funding.
- As defined by the [CAV Business Plan](#), Florida’s CAV Program has the following objectives:
 - Safety
 - Operations/Mobility
 - Economic Development
- FDOT has performed extensive testing of market available RSUs and OBUS. Further, they have generated a set of in-house testing procedures. To date, 6 products have been approved.
- FDOT has issued two design build projects that have included specifications for connected vehicle technology. In one the equipment was specified, in the other, the equipment was left to the contractor to evaluate and procure.
- Notable listed challenges include:
 - Interoperability

- Secrecy among private sector companies hinders cooperation and standardization of technology and specifications

PennDOT

Presenter: Mark Kopko

Mark’s presentation provided an overview of the resources that PennDOT has dedicated to AVs and CAVs, and the new structure within PennDOT created to address CAV. The following CAV Groups infographic provides insight to the existing and planned CAV coordination. Key takeaways follow.



- PennDOT is in the process of formalizing an “Office of Transformational Technologies”
- The PennDOT Strategic Plan is very mature and covers the following:
 - Maintenance and Operations
 - Workforce Requirements
 - Outreach and Collaboration
 - Policy and Legal
 - Modal Considerations
 - Driver Licensing and Motor Vehicles
 - Design and Construction
 - Planning and Research
 - Information Technology and Security

- With proximity to many of the partnering industry headquarters, and vast pilot programs throughout the commonwealth, Pennsylvania has an extensive list of AV task force members as shown in the following:

AV Task Force










Public Sector:	Academia:	Advocacy:	Industry:
			



- Notable challenges Include:

Challenges

 <p>Legislation</p> <ul style="list-style-type: none"> • AV Testing Guidelines • Coordination with General Assembly 	 <p>Funding</p> <ul style="list-style-type: none"> • Act 101 of 2016 • Grants 	 <p>Uncertainty</p> <ul style="list-style-type: none"> • Foundational Improvements • Signal Specifications • Classify Roadways 	 <p>Backhaul</p> <ul style="list-style-type: none"> • Fiber Deployment Policy • P3 Opportunities 	 <p>Asset Mgt.</p> <ul style="list-style-type: none"> • Compile Existing Databases • Policies 	 <p>Ownership</p> <ul style="list-style-type: none"> • Pilot Program • Command & Control Integration • Specifications
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MDOT

Presenter: Andre Clover and Joe Gorman

Andre and Joe co-presented for Michigan's DOT, with Joe participating remotely. The MDOT Research Committee Org chart was shown and introductions were made to the research team, several of whom were also on the telephone. Key takeaways follow.

- MDOT stressed the idea that CAV is just an extension of TSMO and they have compiled a [TSMO ITS Strategic Plan](#) to address the entire program.
- The following MDOT research priorities were relevant to the CAV discussion:

Research Priorities

- Utilizing Connected & Automated Vehicle (CAVs) Data to Enhance and Optimize Freeway Operations Strategies, Algorithms and Performance Measures G05)
- Improving Traffic Incident Management in an Automated Vehicle Environment (G16)
- Applications of RFID and Wireless Technologies for Highway Construction (G21)

- Participants were encouraged to follow the PlanetM initiative, a partnership of mobility organizations, communities, educational institutions, research and development, and government agencies that are working together to develop and deploy mobility technologies driving the future.
<https://planetm.michiganbusiness.org/>
- Even with access to auto manufacturers, private sector privacy remains a challenge. When private sector entities are testing on University of Michigan facilities, a black fence encircles the test track blocking the view of any onlookers.

ADOT

Presenter: Marty Lauber

Marty's presentation highlighted elements of Arizona's state CAV programs and the progressing executive orders from Governor, Doug Ducey. Key takeaways follow.

- A series of executive orders have shaped Arizona's program, they were:
 - 2015 Support Testing and Operations of Self-Driving vehicles on Arizona Roads
 - 2018 Require all Automated Driving Systems to comply with Federal and State Safety Standards
 - 2018 Established the Institute of Automated Mobility (IAM)
- Marty was recently assigned broad duties related to CAV development to play a lead role for ADOT.
- A list of ADOT Partners and Issues are as follows:



Partnering

- MCDOT, Maricopa County - Pooled Fund Studies, CV Test Bed & SWZ
- The University of Arizona (U of A) – Pooled Fund Studies & CV Test Bed
- Arizona State University (ASU) – IAM Center and CV Research Projects
- VDOT – Pooled Fund Studies
 - MMITSS(AZ) – Multi-Model Intelligent Traffic Signal Systems
 - CTCS – Connected Traffic Control Systems
 - Using Third Parties to Deliver I2V
 - V2I Queue Advisory / Warning

Issues

- Developing an ITS Master Plan
- Developing ADOT Standards for CV Communication
- Reviewing existing legislation regarding road blocks to CV & AV Implementation
- Discussions regarding special licensing and insurance requirements for CV
- Setting up a new procurement process for testing innovation solutions

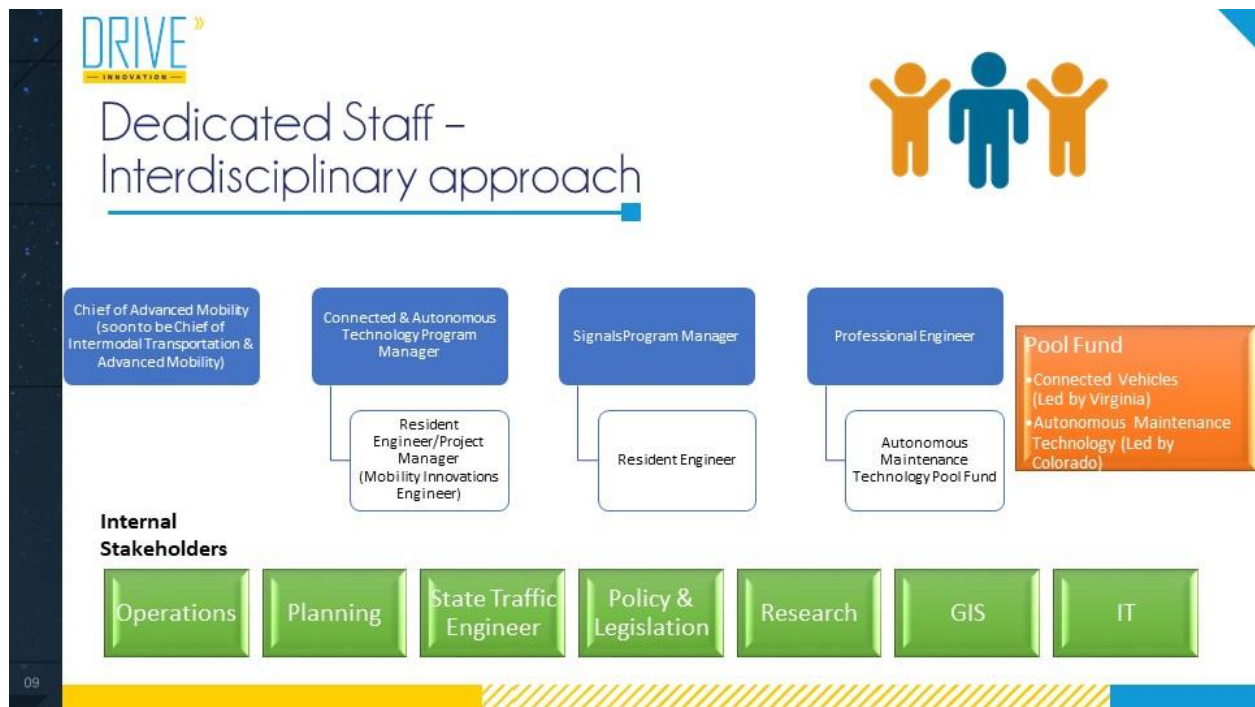
ARIZONA DEPARTMENT OF TRANSPORTATION

- Arizona utilizes AZ511 <https://www.az511.com/> as a method of providing information to general public and truckers regarding road and traffic information. ADOT has done a lot in the area of truck parking.

CDOT

Presenter: Ashley Nylen

Ashly's presentation provided an overview of the organizational structure that Colorado has in place to facilitate the developments of CAV in the state. Further, she covered various data and connected vehicle initiatives being pursued by CDOT. Key takeaways follow.



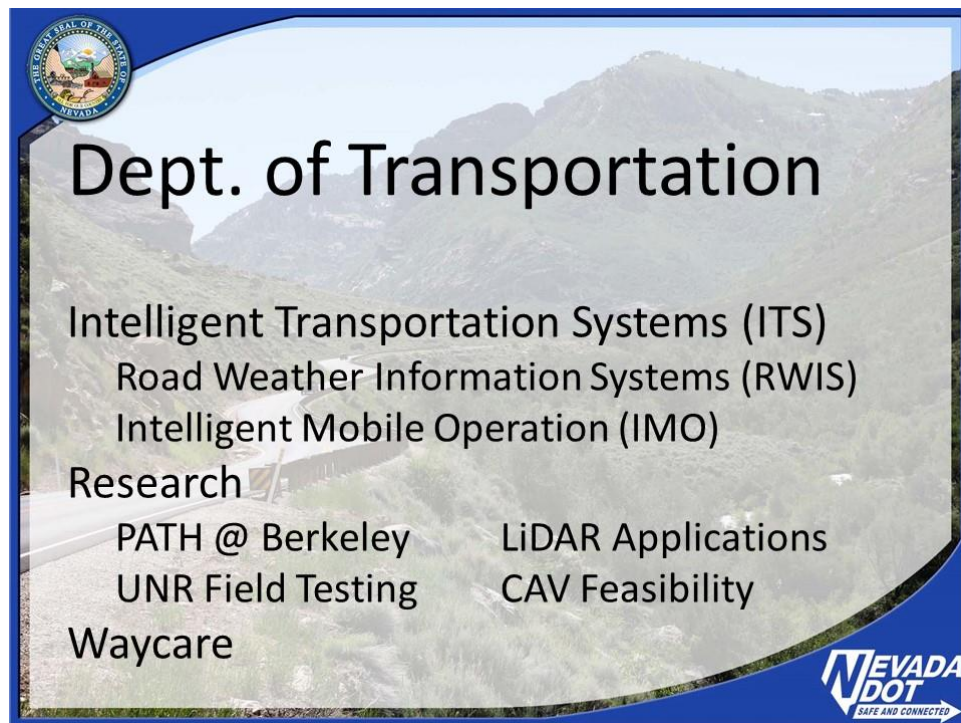
- The RoadX program was developed to use 21st century technology and ingenuity to solve our current infrastructure challenges. <https://codot.gov/programs/roadx>. However, CAV programs are housed on the Division of Mobility (formerly TSMO section)
- CDOT is equipping over 560 miles of roadway with RSUs and supporting Data Analytics Intelligence System (DAISy)
- CDOT expressed concern regarding vast amounts of data captured by the AV/CAV projects and proper data management
- CDOT explained managing the public's expectations with regards to CAV's was identified as a significant challenge.

NDOT

Presenters: Ken Chambers and Kandee Bahr Worley

Ken and Kandee presented on the NDOT organization and what resources are dedicated to the AV/CAV advancement in the state. Key takeaways follow.

- Regional Transportation Commission (RTC) of Southern Nevada has several programs relating to AV/CAV deployment and NDOT maintains a close relationship with them. They also have a lot of activity in Nevada from private entities, such as work at the Tahoe-Reno Industrial Center.



- State Legislation provides definitions and governance for the advancement of AV/CAV testing and implementation in Nevada. <https://www.leg.state.nv.us/nrs/nrs-482a.html>
- NDOT is focused on a variety of technologies: LIDAR Applications, Pikalert and Telematics Opportunities. They are also a pilot jurisdiction for Waycare, which uses artificial intelligence to predict accident zones and has seen improvements in response time, crash reductions and costs.

DAY 2 - (CAV Track) – Freight and Passenger CAV Projects, Challenges, Procurement of New Technology and Implementation

Overview

On Day 2, during the CAV session, a representative from CARMA presented first and then each participating state was asked to present for 15-minutes, with Q&A to follow, based on these prompts:

- Please provide a technical in-depth overview of your Freight and Passenger Vehicle CAV projects.
- What do you believe are the critical technical challenges to overcome?
- What does your procurement process for new technologies look like?
- What can be implemented now, in any state? How do other states obtain the blueprint information?
- What is coming soon that will be implementable in any state?

Key Takeaways

- One of the focuses of FHWA's CARMA program is to begin the research on inter- vehicle coordination. Currently, there is uncertainty as to the effect CAV technology will have on congestion, but optimization of the system will require coordinated movements. CARMA is seeking partners around the nation to develop the technology needed to enable vehicle cooperation within discrete scenarios.
- Work zones remain a focus across all states. A uniform solution to communicate changes to the roadways as work zones change should be a goal. One solution could be standardized mapping data for AV's, so that one map can be shared after every change, both to private and public sector entities.
- There is a lot of different projects happening around the United States, with a fair amount of overlap. Meeting up to learn and discuss is very helpful for state programs.
- More federal frameworks for collaboration, information sharing and pooled funds are welcomed by these programs.

Presentation Highlights

FHWA (CARMA)

Presenter: Chris Stanley

Chris explained the CARMA program and presented details on some of the 35 CARMA projects. Key takeaways follow.

- FHWA developed the innovative **Cooperative Automation Research Mobility Applications (CARMA)** platform to encourage collaboration with the goal of improving transportation efficiency and safety. FHWA's interest in advancing TSMO strategies with automated driving technology focused on how infrastructure can move traffic more efficiently.

- CARMA is seeking to utilize a network of researchers to tackle roadway scenarios one by one. It has broken down a number of roadway scenarios into the following use case areas:

Cooperative
Automation
USE CASE
AREAS

TSMO PROOF OF CONCEPT
TESTING AND EVALUATION



U.S. Department of Transportation
Federal Highway Administration

1 Basic Travel	2 Work Zones	3 Weather	4 Traffic Incident Management (TIM)
 <small>Source: FHWA.</small> Example scenarios: <ul style="list-style-type: none"> ▪ Engage in a platoon defined by a geofence. ▪ Leader maintains safe time gap. ▪ Followers maintain interplatoon time gap. ▪ Platoon size of two to five cars per lane. ▪ Possible maneuvers with other CADS-equipped vehicles. 	 <small>Source: FHWA.</small> Example scenarios: <ul style="list-style-type: none"> ▪ Reduced command speed entering work zone. ▪ Defined by a stationary geofence. ▪ Lane change assignment prior to entering work zone. ▪ Maintain safe time gap through the work zone. ▪ Possible maneuvers with other CADS-equipped vehicles. 	 <small>Source: FHWA.</small> Example scenarios: <ul style="list-style-type: none"> ▪ Reduced command speed entering low visibility weather. ▪ Defined by a dynamic geofence. ▪ Engage in larger time gap. ▪ Maintain lane guidance. ▪ Possible maneuvers with other CADS-equipped vehicles. 	 <small>Source: FHWA.</small> Example scenarios: <ul style="list-style-type: none"> ▪ Reduced command speed entering traffic incident event. ▪ Determined by infield geofence. ▪ Lane change to provide space for first responders. ▪ Possible maneuvers with other CADS-equipped vehicles.

- Chris highlighted programs the testing/growth of V2V and V2I communications and some of the benefits that can be implemented such as vehicle platooning, speed harmonization, SPaT, and MAP data transfers. CARMA cloud and the connectivity of traffic management between vehicles and infrastructure is a key focus for CARMA.

- Tech “nimbleness” is needed.

- CARMA is a software platform that will be made publicly available for integration with existing AV software. One vendor has already been working with CARMA to allow for direct integration. Open source software is made available via the CARMA GitHub Repository. <https://github.com/usdot-fhwa-stol>

Caltrans

Presenter: Gurprit (Pete) Hansra

Pete presented on further details regarding the truck platooning testing that Caltrans has participated in. Key takeaways follow.

- Caltrans testing of partial automation for truck platooning using CACC Demonstrations included over 20,000 miles of testing without incident (with over 11,000 of those miles were on the state highway system) and various demonstrations to show benefits to stakeholders. The research also looked at:

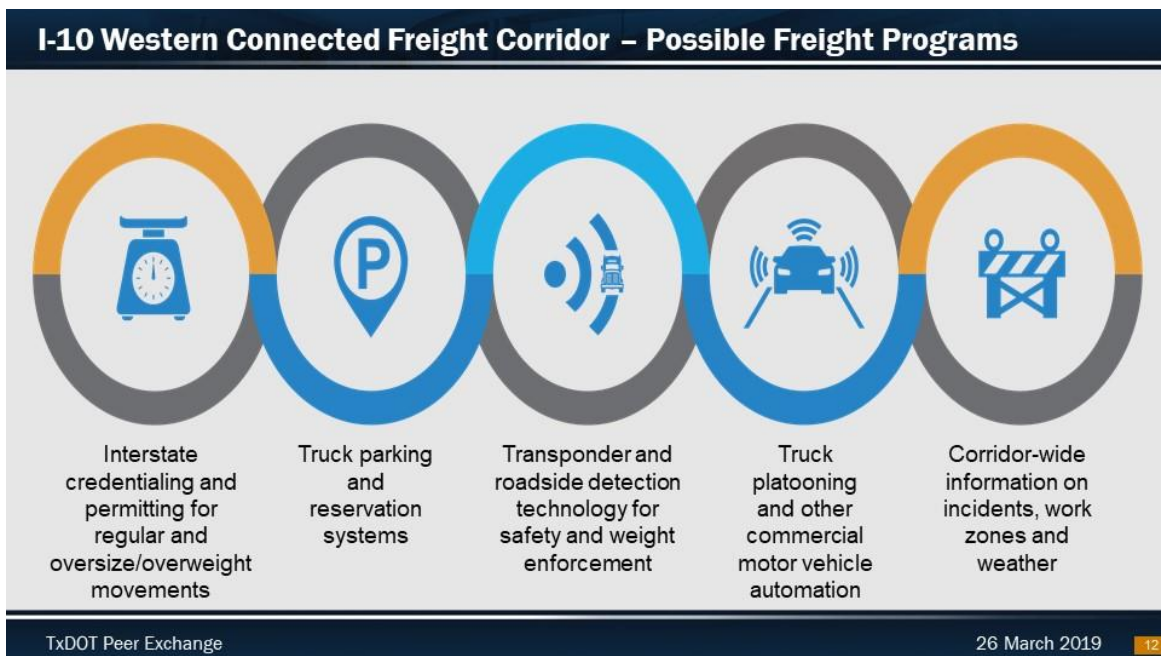
- Fuel consumption
 - Models and simulation to estimate system benefits
 - Driver acceptance
- Caltrans has just funded a \$250K project to evaluate DSRC vs C-V2X in direct head to head comparison.
 - Caltrans has begun a transition from 4" to 6" striping on state highways.
 - A good resource for developing a DSRC test bed can be found at this NOCoE page.
<https://transportationops.org/spatchallenge>
 - Additional safety testing is needed and policymakers will be looking for additional data to make decisions.

TxDOT

Presenters: James Kuhr, Jianming Ma and Caroline Mays

TxDOT's co-presentation included details several of the related projects currently underway in Texas. Key takeaways follow.

- The I-10 Western Connected Freight Corridor is a partnership with Caltrans, ADOT, NMDOT and TxDOT with the goal of producing a concept of operations for implementing operations and technologies that create a streamlined, connected vehicle experience for safe carriers across the I-10 corridor, reducing friction for goods movement and expanding economic development in the West.



- TxDOT is working on a Freight Network Technology and Operations plan:

Freight Network Technology and Operations Plan	
PURPOSE	Position TxDOT as a leader in preparing for and implementing freight network technology and operation solutions
GOALS	<ul style="list-style-type: none"> • Develop a detailed plan and an actionable set of Concepts of Operations (ConOps) that will: <ul style="list-style-type: none"> • Conceptualize and begin the systems engineering definition • Leverage at-grade rail crossing information • Provide implementation guidance for a statewide freight traffic and information system
OBJECTIVES	<ul style="list-style-type: none"> • Provide comprehensive freight traveler data • Leverage technology and data from existing traffic management centers • Align with new and planned ITS, as well as emerging and future Connected and Automated Vehicles (CAV) data • Assess and forecast future developments in connected vehicle and truck automation technology • Leverage new and emerging programs such as truck platooning, Freight Advanced Traveler Information System (FRATIS), connected trade corridor information, and commercial vehicle enforcement

TxDOT Peer Exchange 26 March 2019 17

- TxDOT is also working the Texas Connected Freight Corridors project to provide connected vehicle support to freight moving between the metropolitan areas of the state. Some of the ITS programs in TX were covered:
- TxDOT has also tested Connected Work Zones along I-35. Major challenges that have come out of that project include creating and maintaining high-resolution maps for workzones and procurement of the latest technology

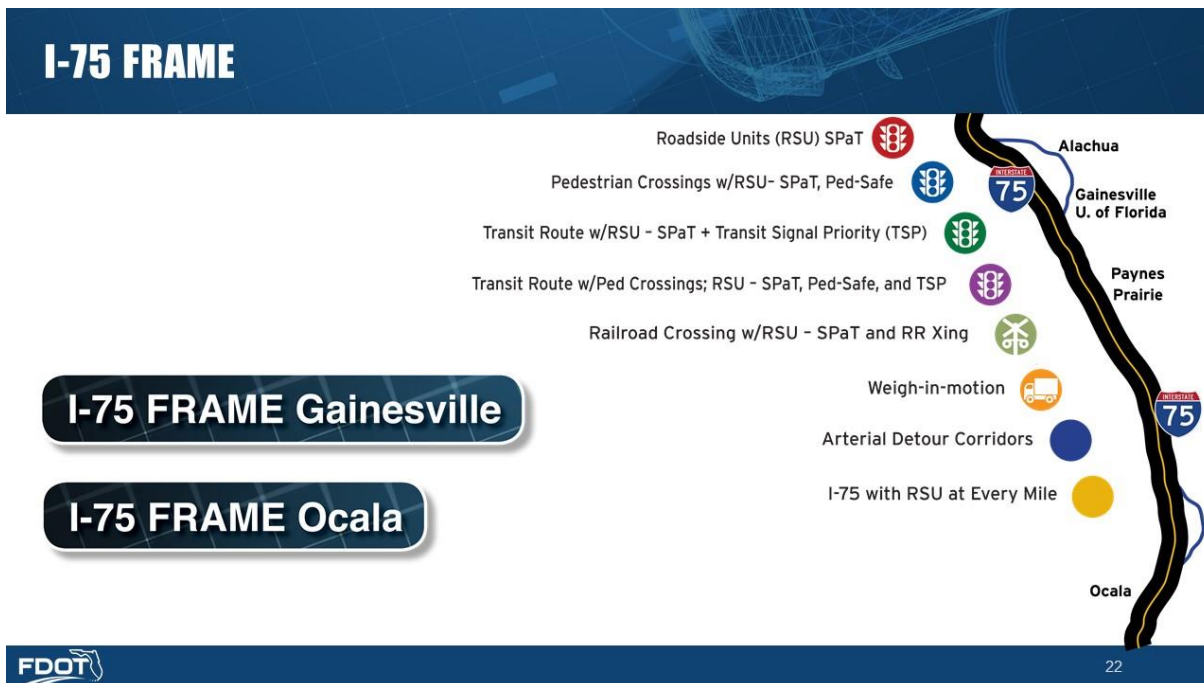
FDOT

Presenter: Raj Ponnaluri

Raj presented on the many CAV deployments in Florida. Per their business plan they are in the early implementation stage and targeting full scale implementation and operations of some of these programs by 2020+. Key takeaways follow.

- CAV deployments include:
 - SPaT deployments in Tallahassee, Gainesville and Pinellas County.
 - Implementing Solutions from Transportation Research and Evaluation of Emerging Technologies (I-STREET)
 - Pedestrian Safety (Ped-Safe)

- Raj explained Florida’s Regional Advanced Mobility Elements (FRAME) with each of the 4 FRAMEs consisting of area specific elements. For instance I-75 FRAME elements are:



- FDOT brands their CAV working group as ACES – Autonomous Connected Electric Shared, which encompasses more shareholders and brings more division to the table. FDOT has also held in-house CAV “workshops” for district staff which have been well attended and well received.
- FDOT offered many lessons learned, particularly related to connected vehicles. For instance, when using RSU’s for DSRC providing line of sight is very important. FDOT is happy to share lessons and draft of testing procedures.

SPaT Lessons Learned

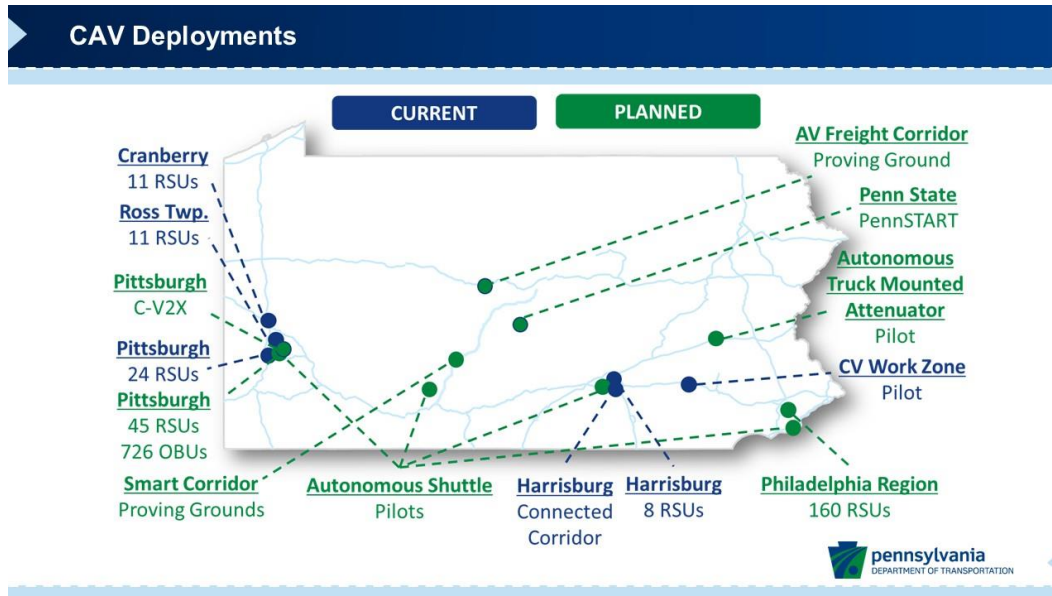
- CAV technology procurement at a public agency
- Value-added services in the Request for Proposal document
- Equipment testing prior to vendor selection
- USDOT Map Data Tool requires field refinement
- Roadside Units/On-Board Units require field fine tuning
- Data collection, storage and maintenance
- SPaT-Plus...? What’s next for safety and mobility?

PennDOT

Presenter: Mark Kopko

Mark presented to the group details on a few of the many CAV deployments in Pennsylvania. Key takeaways follow.

- Pittsburgh continues to be a major center for testing due to Carnegie Mellon, but there is work being done throughout the state, and across state borders with the Smart Belt Coalition (Michigan and Ohio).



- PennSTART is a partnership with the PA Turnpike and Penn state to offer training for public sector agencies and a test track. <https://www.pennstart.org/>
- PennDOT has investigated significant funding in open-end agreements with consultants for support with CAV technologies.
- In Pennsylvania, AV Testing is non-restrictive but Pennsylvania has a voluntary DOT certification, and to date all testers have applied for it. The certification is something that the public looks for and is good for public relations for the private sector.
- PennDOT's Technical Challenges include:
 - Integration
 - Interoperability
 - Information Harvesting
 - Legality
- PennDOT's upcoming activities are mapped out below.

Upcoming Activates



- **Automated Work Zone Vehicles Policy**
 - April 2019
- **Platooning Policy**
 - April 2019
- **District DSRC Coordination Plan**
 - July 2019
- **AV Testing Guidance 2.0**
 - July 2019
- **AV Incident Response Plan**
 - December 2019
- **PennDOT/PA Turnpike Test Bench**
 - August 2019
- **CAV Infrastructure Deployment Policy**
 - September 2019
- **CAV “Hotspots” Mapping**
 - March 2020
- **BAA Platooning**



MDOT

Presenter: Joe Gorman

Joe explained MDOT’s initiatives and their relationships with auto manufacturers and universities.

- Efforts of the University of Michigan and their #Mcity initiative include: <https://mcity.umich.edu/>
 - Research
 - Early Stage Testing
 - Education and Outreach
 - Test Track
- Joe highlighted cybersecurity systems for V2X communications, and explained that the ITS-JPO is currently procuring a Security Credential Management System (SCMS) solution.
<https://www.its.dot.gov/resources/scms.htm>
- MDOT has explored cross border operations with Canada and have completed a successful test.
<https://www.michiganbusiness.org/news/2018/12/michigan-driverless-auto-techs-cross-border-breakthroughs/>
- The Michigan Council on Future Mobility is a 21 member council created via Public Act 332 of 2016 provides the governor and legislature with recommendations regarding changes to state policy to ensure Michigan continues to be the world leader in automated, driverless, and connected vehicle technology.

Innovations in Freight Data



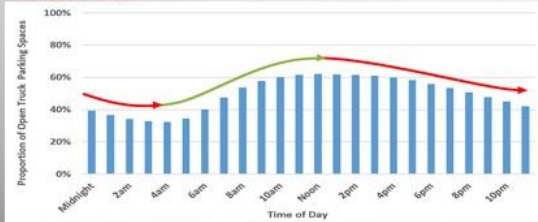
Leverage the Crowd

- ▶ We used what the truckers use - crowdsourced app
- ▶ Enabled a time series data for over the entire year
- ▶ Coverage of public and private locations

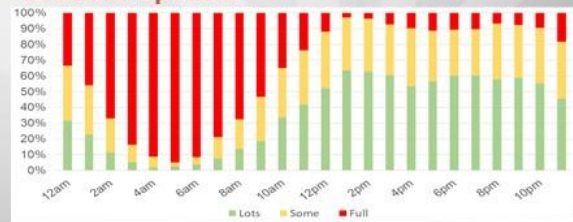
Supply, Demand, and Usage Insights

- ▶ Hourly, daily, and seasonal variation in parking demand
- ▶ Demand for public & private truck parking without instrumentation

Statewide



Location Specific

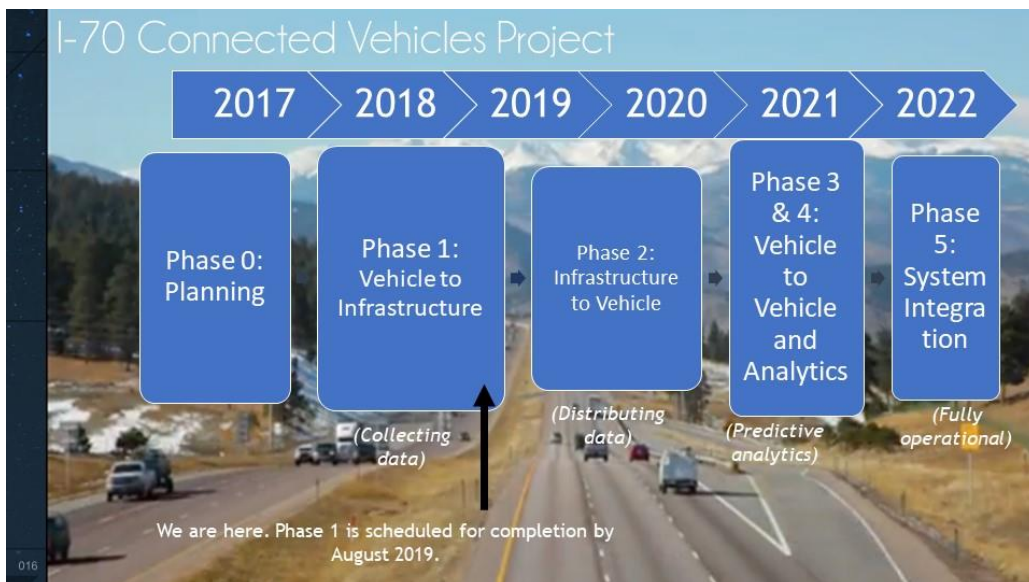


CDOT

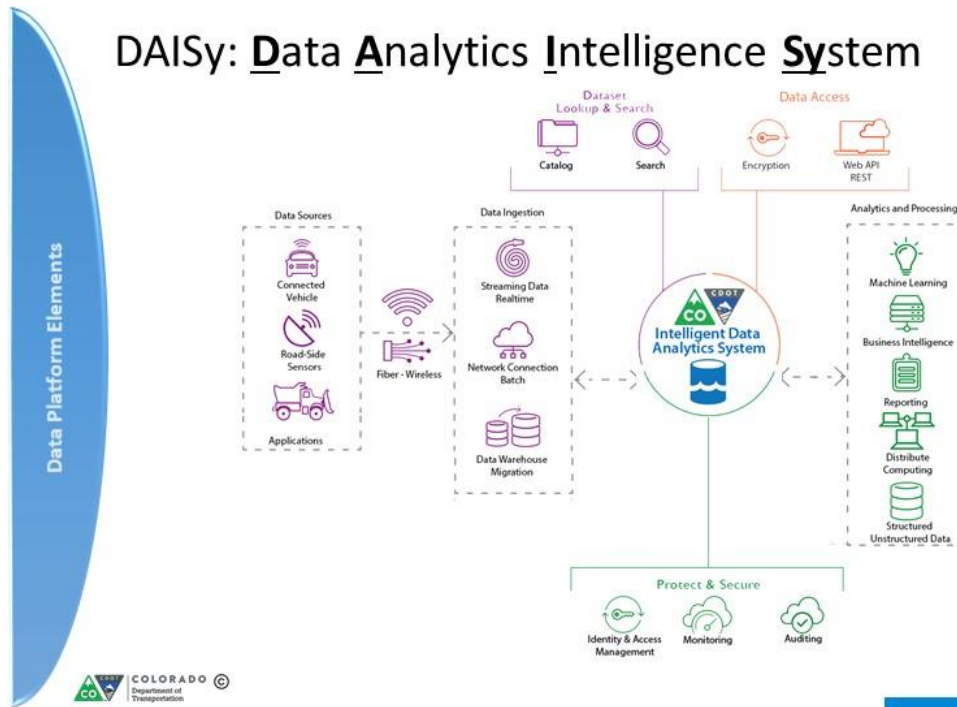
Presenter: Ashley Nylan

Ashley presented to the group an overview of the policy and legislation guiding Colorado's CAV programs.

- CDOT must report to the Transportation Legislative Review Committee by Sept 1 of each year concerning testing of ADS in Colorado
- CDOT has developed a 5-10 year fiber and network strategy to support the future transportation network with connected and autonomous vehicles. They Identify routes based on a series of weighted factors, which include CDOT Region input, economic development and public safety needs.
- I-70 is a significant CV project for CDOT:



- Data management is handled through DAISy, which uses a master agreement and task orders with Google.



NDOT

Presenter: Kandee Bahr Worley

Kandee presented on the various freight and passenger vehicle AV projects currently in Nevada. With their non-restrictive legislative framework and proximity to northern California and their ability to adapt quickly, they have a number of private sector companies testing there.

- Sparks, NV is seeing tremendous growth and talks are underway for an AV only highway connecting it to an industrial park east of city.
- Some of the challenges to AV/CAV adoption include:
 - Public buy-in
 - Public education and involvement
 - Standardization
 - Cybersecurity
- Shared use lanes will be coming soon to NV.

Day 2 - (Research Track) – Research Program Discussions

Overview

The Research Track was given the following topics for their round-table discussions:

- University Contracting, service centers and indirect/direct costs
- Implementation in a big state, getting research from report to the field
- Project Selection, Value of Research and Performance Metrics for the Project and the Program
- Communication and outreach

Below is a summary of the key takeaways of the group discussions.

Key Takeaways

- Service Centers are methods of routing costs to research. However, they present their own challenges.
- Maintain a strong audit process, if disallowable costs slip through, they can add up over time .
- Consider implementation metrics based around TRL levels, additionally, consider defining uniform packages of information and media so that completed research products can be handed to someone in another state and they will be able to adapt and implement the research.
- DOTs should work to define the Value of Research of their program to demonstrate the benefits of research. A nationwide standard for defining the Value of Research may be beneficial.
- Take advantage of existing opportunities (state-wide DOT meetings, video advertisements throughout state offices) and new ones (webinars) to communicate about the program.

University Contracting

- There is no universal way to advertise, procure, and manage research project contracts, therefore these peer exchanges are important to learn best practices.
- Some universities are implementing “Service Centers” which provide rates based on time or supplies. These are allowable, but DOTs should consider adding language to contracts to require the documentation needed when “Service Centers” perform work.
- DOTs should verify with HHS/cognizant agency for approval on the Service Center Rates.
- DOTs should have a strong audit process in place. If any given set of incorrect charges passes through, they can stack up over time. When these charges are finally identified as incorrect, this final compiled amount can be significant.

- DOTs should negotiate overhead/indirect costs, CO for example has in their contract that indirect costs must not exceed 20%.

Implementation

- DOTs should consider apply FHWA’s Technology Readiness Level (TRL) to research proposals and deployment plans. This may help with tracking metrics and establishing benchmarks based around project development. <https://www.fhwa.dot.gov/publications/research/ear/17047/17047.pdf>
- DOTs should consider requiring the framework of an implementation plan as part of a research proposal. Michigan has an initial implementation plan that other states could copy.
- Implementation would benefit from uniform documentation, training and media packages expected at the close of research. Some may be in-depth, such as a draft technical specification for an engineer to understand. Some may be more high level, such as a 2-5 min video to aid in communicating research recommendations and inspiring implementation.
- Engage decision-makers/engineers/stakeholders early during the research phase, keep them updated and consider them the research customer as they will be responsible for buy-in and implementation. AZ engages their engineering leadership to confirm the problem statements and gain early support for the project.

Value of Research/Performance Metrics

- Showing program value can be as simple as maintaining a spreadsheet on VOR and metrics of the research program
- There should be regular reviews of the overall program value and mid-course corrections if needed. At the very least there should be a review at end of every fiscal year.
- All costs associated with projects should be tracked, including capital expenditures and any costs added or subtracted due to contract modifications. (initial vs. actual on modifications)
- Work with other state agencies to quantify VOR and develop a national template for determining VOR

❖ Pooled Fund Idea: Value of Research
Consistent
Feasible
Transparent
Applicable across all states

- The 2018 WisDOT Peer Exchange covered this topic and participants were encouraged to see their summary. <https://wisconsindot.gov/documents2/research/2018-peer-exchange-final-report.pdf>

Communication

- Take advantage of opportunities at DOT gatherings to advertise and appreciate:
 - Florida presents awards to SMEs at a Leadership Meeting
 - Nevada presents program information during Leadership Academy type meetings to recruit participants
 - TxDOT could present program information at internal conferences (such as Maintenance and Traffic)
- Take advantage of new technology to reach far-flung participants. For instance, Florida is currently hosting webinars for state-wide participation.
- Use other available channels. For instance, create a 90 second video on the program that can be displayed on TVs across the agency

Conclusion

All participants appreciated the opportunity to gather and share their experiences related both to CAV and to Research Program improvement. There is optimism that the requests made of all the entities among each other will be followed up on and will lead to further fruitful interactions. There is also optimism that further studies to help establish national cooperation among the states will emerge.



TxDOT Peer Exchange Agenda

3/25/19 8:00 AM to 4:30 PM - Combined Session

8:00 AM	Shuttle from Hotel
8:30 AM	Introductions/Breakfast - 125 E 11th St.
9:00 AM	Welcome <ul style="list-style-type: none">• Rocio Perez, TxDOT
9:10 AM	Opening Remarks <ul style="list-style-type: none">• Darran Anderson, TxDOT
9:30 AM	FHWA National Dialogue Summary <ul style="list-style-type: none">• John Corbin, FHWA
10:00 AM	Texas <ul style="list-style-type: none">• Caroline Mays, TxDOT• Jianming Ma, TxDOT• James Kuhr, TxDOT
10:30 AM	State by State Program Overview <ul style="list-style-type: none">• Pennsylvania• Florida• Nevada
12:00 AM	Lunch
12:30 PM	State by State Program Overview <ul style="list-style-type: none">• California• Arizona• Michigan• Colorado
2:30 PM	Discussion of multi-state initiatives <ul style="list-style-type: none">• Identification of short term challenges and opportunities• Identification of long term challenges and opportunities
3:30 PM	Thinking ahead <ul style="list-style-type: none">• Brainstorm/Draft multi-state pooled funding opportunities/research statements
4:15 PM	Discuss messages to FHWA and State DOT Governance
5:30	Dinner









3/26/19 8:00 AM to 4:30 PM - CAV Track

8:00 AM	Shuttle from Hotel
8:30 AM	Introductions/Breakfast - 125 E 11th St.
9:30 AM	Technical Presentations <ul style="list-style-type: none">• CARMA• Texas• Pennsylvania• Florida• Nevada
12:00 AM	Lunch
1:00 PM	Technical Presentations <ul style="list-style-type: none">• Arizona• Michigan• Colorado• California
3:00 PM	How do we gather momentum and move forward setting standards
4:00 PM (return to hearing room)	General Remarks

3/26/19 8:00 AM to 4:30 PM - Research Track

8:30 AM	Introductions/Breakfast - 125 E 11th St.
9:00 AM	University Contracting, service centers and indirect/direct costs
10:30 AM	Implementation in a big state, getting research from report to the field
12:00 AM	Lunch
1:00 PM	Project Selection, Value of Research and Performance Metrics for the Project and the Program
2:30 PM	Communication and outreach
4:00 PM (return to hearing room)	Recap

Appendix B. Participants Contact Information

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Appendix C. Resources

Table of Acronyms

Abbreviation	Explanation
ACC	Adaptive Cruise Control
ADS	Automated Driving Systems
ADS-DV	ADS – Dedicated Vehicle
AV	Automated Vehicles
AVR	Automated Vehicle Research
CACC	Cooperative Adaptive Cruise Control
CAMP	Crash Avoidance Metrics Partnership
CAT	Connected and Automated Transportation
CAT-C	Connected and Automated Transportation Coalition
CAV	Connected and Automated Vehicles
CTR	Center for Transportation Research
C-V2X	Cellular – Vehicle to Everything
DDT	Dynamic Driving Task
DSRC	Dedicated Short-Range Communications
DRISI	Division of Research, Innovation and System Information
IHE	Institutions of Higher Education
IOO	Infrastructure Owners and Operators
ITS	Intelligent Transportation System
LTAP	Local Technical Assistance Program
LTE	Long Term Evolution
MUTCD	Manual on Uniform Traffic Control Devices
NCHRP	National Cooperative Highway Research Program
NOCoe	National Operations Center of Excellence
NPO	National Program Officer
ODD	Operational and Design Domain
OEDR	Object and Event Detection and Response
OMB	Office of Management and Budget

OBU	On Board Units
PI	Principal Investigator
PMP	Project Management Professional
RD&T	Research, Development & Technology
RDAC	Research and Deployment Advisory Committee
ROC	Research Oversight Committee
RPMD	Research Program Management Database
RSU	Road Side Units
RTI	Research & Technology Implementation
SCMS	Security Credential Management System
SHARP	Strategic Highway Research Program
SHARP 2	Strategic Highway Research Program 2
SPaT	Signal Phase and Timing
SPR	State Planning and Research
STIC	State Transportation Innovation Council
TRB	Transportation Research Board
TRL	Technology Readiness Level
TSMO	Transportation Systems Management and Operations
TTI	Texas A&M Transportation Institute
UTA	University of Texas - Arlington
UTC	University Transportation Center (UTC) Program
UVC	Uniform Vehicle Code
V2I	Vehicle to Infrastructure
V2V	Vehicle to Vehicle
VOR	Value of Research

Resources

At the Peer Exchange, participants distributed or referred to the following resources:

FHWA Guidelines for Peer Exchange:

<http://www.fhwa.dot.gov/publications/research/spr/10048/index.cfm>

Published Research Peer Reports:

<http://research.transportation.org/Pages/RACPeerExchangeReports.aspx>

NCHRP Project 20-102 (Handout)

http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-102_CV-AV-Summary.pdf

Cooperative Automated Transportation (CAT) Coalition

<https://transportationops.org/CATCoalition>

Resources for Connected and Automated Vehicles

<https://transportationops.org/resources-connected-and-automated-vehicles>

FDOT CAV Business Plan 2019

https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/traffic/doc_library/pdf/fdot-cav-business-plan-2019.pdf?sfvrsn=45b478ff_0

Michigan Planet M Initiative

<https://planetm.michiganbusiness.org/>

CARMA website

<https://highways.dot.gov/research/research-programs/operations/CARMA>

CARMA GitHub Repository

<https://github.com/usdot-fhwa-stol>

SPaT Challenge Overview (NOCoE)

<https://transportationops.org/spatchallenge>

I-10 Connected freight Corridor (Study Overview)

<https://i10connects.com/sites/default/files/2017-0609-I-10-Western-Connected-Freight-Corridor-Study-Overview.pdf>

PennSTART (Pennsylvania Safety Transportation and Research Track)

<https://www.pennstart.org/>

M City – at University of Michigan

<https://mcity.umich.edu/>

A Security Credential Management System (SCMS) for V2X Communications

<https://ieeexplore.ieee.org/document/8309336>

FHWA - Technology Readiness Level Guidebook

<https://www.fhwa.dot.gov/publications/research/ear/17047/17047.pdf>

WisDOT – Peer Exchange Report, 2018

<https://wisconsindot.gov/documents2/research/2018-peer-exchange-final-report.pdf>

Impacts of CVs and AVs on State and Local Transportation Agencies NCHRP Project 20-102 and Other Efforts

The **National Cooperative Highway Research Program** (NCHRP) is funded by the state departments of transportation and managed by the Transportation Research Board, part of the National Academies of Sciences, Engineering and Medicine. **NCHRP Project 20-102** began in Dec. 2014 to tackle CV/AV issues and is being coordinated with the U.S. DOT, private sector, and other efforts. Contact Ray Derr (rderr@nas.edu) for more information.

Reports Available

[Updating Regional Transportation Planning and Modeling Tools to Address Impacts of Connected and Automated Vehicles](#) [NCHRP Report 896] addresses transportation supply, road capacity, and travel demand. [Executive Summary](#) and [Presentation](#) are also available.

[Dedicating Lanes for Priority or Exclusive Use by Connected and Automated Vehicles](#) [NCHRP Report 891] evaluates opportunities, constraints and guiding principles for implementing dedicated lanes.

[Implications of Connected and Automated Driving Systems](#) [NCHRP Web-Only Document 253] helps states identify laws and regulations that may need to be changed for these vehicles. It includes six volumes: [Legal Landscape](#), [State Legal and Regulatory Audit](#), [Legal Modification Prioritization and Harmonization Analysis](#), [Autonomous Vehicle Action Plan](#), [Developing the Autonomous Vehicle Action Plan](#), and [Implementation Plan](#).

[Advancing Automated and Connected Vehicles: Policy and Planning Actions for State and Local Transportation Agencies](#) [NCHRP Report 845] presents potential societal outcomes of these technologies along with 18 policy and planning strategies that could advance public policy interests. The [briefing document](#) provides a good introduction to the issues.

[Impacts of Regulations and Policies on CV and AV Technology Introduction in Transit Operations](#) [NCHRP Web-Only Document 239] presents a roadmap of activities by industry, legislatures, federal government, and others to facilitate automated transit deployment and accelerate the societal benefits.

[Challenges to CV and AV Application in Truck Freight Operations](#) [NCHRP Web-Only Document 231] describes freight environments and challenges for connected and highly automated technologies, identifies barriers to implementation, and proposes next steps for addressing challenges.

[A Look at the Legal Environment for Driverless Vehicles](#) [NCHRP Legal Research Digest 69]

[Shared Mobility and the Transformation of Public Transit](#) [TCRP Report 188], [Broadening Understanding of the Interplay Between Public Transit, Shared Mobility, and Personal Automobiles](#) [TCRP Report 195], and [Private Transit: Existing Services and Emerging Directions](#) [TCRP Report 196] explore how transit agencies are adapting to shared mobility services, microtransit, and other emerging modes.

[Transportation Network Companies: Challenges and Opportunities for Airport Operators](#) [ACRP Synthesis 84] compiles experiences and effective practices by airports in facilitating access to transportation network companies.

[State CEO Leadership Forum on Connected & Autonomous Vehicles and Transportation Infrastructure Readiness](#) [NCHRP 20-24(11.1) Final Report]

Work Underway

Institutional & Policy

- [Business Models to Facilitate Deployment of CV Infrastructure to Support AV Operations](#) [NCHRP 20-102(12)]
- [Support of the Cooperative Automated Transportation Coalition \(CAT\) Executive Committee](#) [NCHRP 20-24(119)]
- [Guidance on Roles and Responsibilities in Operation of Automated Vehicles](#) [NCHRP 20-24(116)]
- [Workforce Capability Strategies for State and Local Agencies](#) [NCHRP 20-102(20)]

Transportation Planning

- [Connected Road Classification System \(CRCS\) Development](#) [NCHRP 20-24(112)]
- [Impact of Transformational Technologies on Land Use and Transportation](#) [NCHRP 08-117]
- [Mobility-on-Demand and Automated Driving Systems: A Framework for Public-Sector Assessment](#) [NCHRP 20-102(11)]
- [Potential Impacts of Highly Automated Vehicles and Shared Mobility on Traveler Behavior](#) [NCHRP 20-102(23), includes TCRP B-47, [Mobility Inclusion for Un\(der\)served Populations with the Emerging Technologies](#)]

Infrastructure Design & Operations

- [Road Markings for Machine Vision](#) [NCHRP 20-102(06)]
- [Analysis of Low-Speed Automated Vehicle \(LSAV\): Pilots and Deployments](#) [TCRP J-11/Task 27]
- [Impacts of Connected and Automated Vehicle Technologies on the Highway Infrastructure](#) [NCHRP 20-102(15)]
- [Determining State DOT Maintenance Program Implications of Connected and Automated Vehicles](#) [NCHRP 14-42]
- [Initiating the Systems Engineering Process for Rural CV Corridors](#) [NCHRP 08-120]
- [Preparing Traffic Incident Management \(TIM\) Responders for CVs and AVs](#) [NCHRP 20-102(16)]
- [Deployment Guidance for CV Applications in the Open Source Application Development Portal](#) [NCHRP 20-102(17)]

- [Assessing the Impacts of Connected, Automated, and Autonomous Vehicles on the Future of Transportation Safety](#) [NCHRP 17-91, includes NCHRP 20-102(18) and BTSCR-07]
- [Infrastructure Modifications to Improve the Operational Domain of Automated Vehicles](#) [NCHRP 20-102(21)]
- [Infrastructure Enablers for Connected and Automated Vehicles and Shared Mobility—Near-Term and Mid-Term](#) [NCHRP 20-102(24)]

IT Infrastructure & Data

- [Cybersecurity of Traffic Management Systems](#) [NCHRP 03-127, includes 20-102(10)]
- [Framework for Managing Data from Emerging Transportation Technologies to Support Decision-Making](#) [NCHRP 08-116, includes 20-102(04)]
- [Algorithms to Convert Basic Safety Messages into Traffic Measures](#) [NCHRP 03-137]
- [Developing Data Standards and Guidance for Transportation Planning and Traffic Operations—Phase 1](#) [NCHRP 08-119]
- [Planning Data Needs and Collection Techniques for CV/AV Applications](#) [NCHRP 20-102(13)]
- [Data Management Strategies for CV/AV Applications for Operations](#) [NCHRP 20-102(14)]

Modal Applications

- [Collaborations and Partnerships between Public Transportation and Transportation Network Companies](#) [TCRP J-11/Task 26]
- [Advanced Ground Vehicle Technologies \(AGVT\) for Airside Operations](#) [ACRP 03-48]
- [Redesigning Public Transportation Networks for a New Mobility Future](#) [TCRP H-56]
- [Workplace Implications of Autonomous Vehicles on the Transit Workforce](#) [TCRP J-05/Topic 18-03]
- [State and Local Impacts of Automated Freight Transportation Systems](#) [NCHRP 20-102(22)]

Other

- [Update AASHTO's Connected Vehicle/Automated Vehicle Research Roadmap](#) [NCHRP 20-102(19)]

Appendix D. Follow Up Survey Results



Question #1: Please rate the following

Topic	Excellent	Good	Average	Fair	Poor	N/A
Facilitation	66.67%	25%	8.33%	0%	0%	0%
Preparation	41.67%	50%	8.33%	0%	0%	0%
Agenda	66.67%	25%	8.33%	0%	0%	0%
Topics/Content	75%	16.67%	8.33%	0%	0%	0%
Meeting Facilities/Logistics	58.33%	33.33%	8.33%	0%	0%	0%

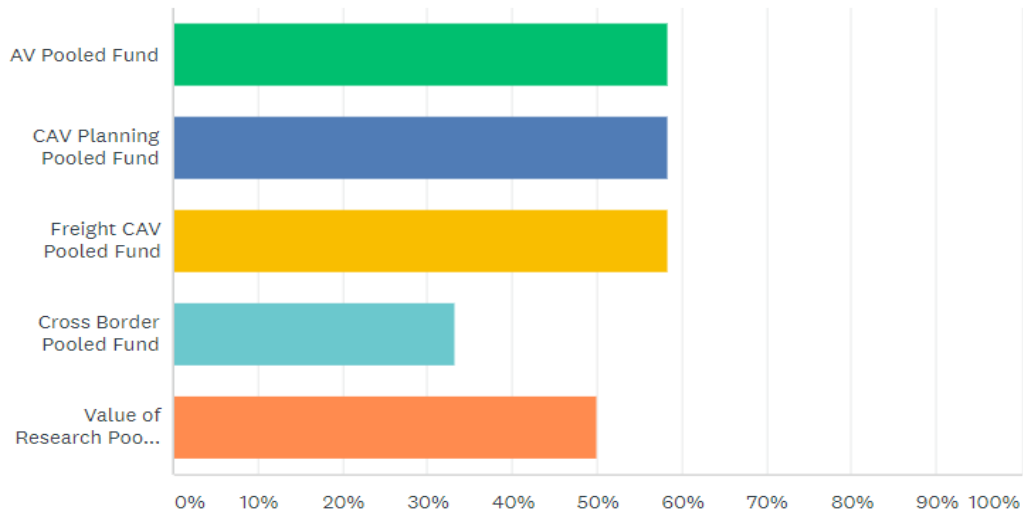
Question #2: Please rate the following topic areas

Topic	Excellent	Good	Average	Fair	Poor	N/A
State by State Presentations Day One	66.67%	33.33%	0%	0%	0%	0%
FHWA Presentation	58.33%	33.33%	0%	0%	0%	8.33%
CARMA Presentation	41.67%	25%	0%	0%	0%	33.33%
AV Track Day Two	41.67%	25%	0%	0%	0%	33.33%
University Contracting	25%	58.33%	0%	0%	8.33%	8.33%
Implementing in a Big State	41.67%	41.67%	0%	0%	0%	16.67%
Project Value of Research	25%	50%	0%	8.33%	0%	16.67%
Communication and Research	41.67%	41.67%	8.33%	0%	0%	8.33%

Question #3:

During the Peer Exchange, the possibility of pooled fund studies was discussed. Which of the following pooled fund studies do you believe your state would be willing to participate in? (Please select all that apply)

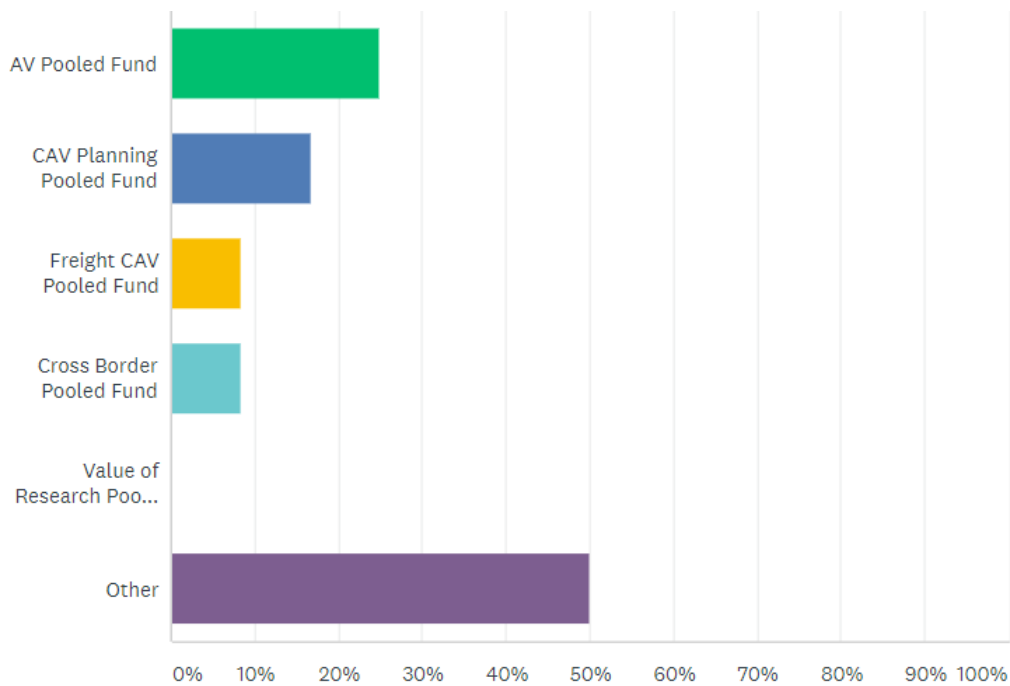
Topic	Selected
AV Pooled Fund	58.33%
CAV Planning Pooled Fund	58.33%
Freight CAV Pooled Fund	58.33%
Cross Border Pooled Fund	33.33%
Value of Research Pooled Fund	50%



Question #4:

During the Peer Exchange, the possibility of pooled fund studies was discussed. Which of the following pooled fund studies do you believe your state would be willing to LEAD? (Please select all that apply)

Topic	Selected
AV Pooled Fund	25%
CAV Planning Pooled Fund	16.67%
Freight CAV Pooled Fund	8.33%
Cross Border Pooled Fund	8.33%
Value of Research Pooled Fund	0%
Other	50%



Question #5:

Please list any other pooled fund ideas you believe your state would be interested in. Additionally, please note if you would consider being the lead state for any of these proposed studies.

Responses
Electrification of highways. 5g availability even in rural areas.
Implementing a test bed for CV and AVs.
I think a clearly defined objective must be presented for any of the topics to be considered for a pooled-fund solicitation to be taken seriously. Our pooled-fund money competes directly with our intrastate research (RDT) projects for funding.
I selected two pooled fund topics that I am estimating my state may be interested in, but there may be others or none. To know for certain, I would need details about the anticipated project and would need to discuss with appropriate colleagues here.
Cooperative Automation Pooled Fund. FHWA's Saxton Lab should be able to manage the pooled fund and conduct research or project work as needed.
Moving from Research Results to Implementation. Measuring implementation efforts.
no other topics come to mind at present
Multi-state Corridor AV Testing & Operations
Implementation efforts
N/A
None
Not sure. We currently lead the autonomous truck mounted attenuator pool fund.

Question #6:
What about this Peer Exchange was most useful to you?

Responses
Value of Research
The face to face value from each state is most important. Open dialog and the open forum of being able to ask questions.
The resources that are available from States that have CV programs that are more advanced than ours.
The idea of the statewide CAV Task Force (Texas). That type of interdepartmental coordination is a brilliant strategy. Also, the TXDOT RTI forms for determining the value of research.
Learning the status of CAV at the other state DOTs. Discussing potential pooled fund topics.
Learning the activities, projects, road maps, issues, and solutions other states had encountered. This provided resources to enable other states to learn from and avoid repeating, and also the areas where states would most benefit from pooling resources.
University Direct/Indirect Cost Rates.
Day 2, Research Track topics and discussion were extremely useful to me, particularly state's project selection/RFP/Contracting processes.
Direct access to state agencies that are supporting AV testing. Insights into ADS based on these state-industry relationships.
Many states sharing their program detail.
Networking and discussion lessons learned with other states
Collaborating with other states and understanding CAV in their state and each of their partner relationships in their state.

Responses

N/A

Nothing

Nothing, I found everything very useful.

The content was all positive. All I would recommend is to increase the communication to us out-of-towners about where to meet, the basic logistics, etc.

The research portion of the second day may have been more effective if there were fewer topics on the agenda and we could have delved deeper into them. Participants were engaged and offered helpful input, nevertheless.

Everyone involved seemed to add value. Splitting the group the second day felt like there may be people missing out. I may have missed the discussion on university contracting, but would have found that helpful.

The diversity of experiences and sharing successful practices for rating research efforts and measuring its value.

The Value of Research topic seemed underdeveloped. But this is understandable, as many states are struggling with it.

The Connected Vehicle topic had limited interest.

Extremely useful.

The research discussions on Day 1 because I am the AV lead, so it was not that applicable

All of it was great.

Appendix E. Presentations

See RAC website