Impacts of Automated Vehicles (AVs) on Highway Infrastructure

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AASHTO Committee on Traffic Engineering

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Outline

- Background
- Project Goal
- Infrastructure Focus Areas
- Industry Interviews
- Upcoming Workshops
USDOT Automation Policy

- **Automated Driving Systems 2.0 (ADS 2.0): A Vision for Safety (September 2017)**
  - Clarifies Voluntary Safety Self-Assessment process.
  - Emphasizes motor vehicle safety.

- **Automated Vehicles 3.0 (AV 3.0): Preparing for the Future of Transportation (October 2018)**
  - Clarifies multimodal surface transportation.
  - Broadens considerations to reflect multimodal responsibilities (e.g., operations).
Preparing for the Future of Transportation

Principles:

• Prioritize safety.
• Remain technology neutral.
• Modernize regulations.
• Encourage a consistent regulatory and operational environment.
• Prepare proactively for automation.
• Protect and enhance the freedoms enjoyed by Americans.

Source: USDOT
Select Themes

• Greater **Uniformity and Quality** in road markings and traffic control devices would enable automation.

• FHWA should take a **Leadership role** in convening stakeholders to encourage collaboration.

• Certain **Data Elements** about the roadway environment are useful for industry, State, and local DOTs to share and could improve automation operations.

• Conducting **Pilots** and supporting pilot testing are important for facilitating learning and collaboration.

• **Uncertainty** in infrastructure investment and allocation of limited resources are key concerns for State and local agencies.

**FHWA Released RFI in March 2018**
Automation Has Implications for Roadways

Physical Infrastructure

Roadway Operations

Digital Infrastructure

Programs and Practices
The Federal Highway Administration (FHWA) initiated a national conversation with diverse stakeholders to discuss automated vehicles.

The National Dialogue on Highway Automation is a series of meetings held across the country to facilitate information sharing, identify key issues, and support the transportation community to safely and efficiently integrate automated vehicles into the road network.
# National Dialogue Schedule in 2018

<table>
<thead>
<tr>
<th>Month</th>
<th>Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>June 7</td>
<td>National Dialogue Launch Workshop</td>
<td>Detroit, MI</td>
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<td>June 26-27</td>
<td>National Workshop 1: Planning and Policy</td>
<td>Philadelphia, PA</td>
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<td>July 12</td>
<td>Automated Vehicle Symposium</td>
<td>San Francisco, CA</td>
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<td>FMCSA-FHWA Truck Automation Listening Session</td>
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<td>August 1-2</td>
<td>National Workshop 2: Digital Infrastructure and Data</td>
<td>Seattle, WA</td>
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<td>September 5-6</td>
<td>National Workshop 3: Freight</td>
<td>Chicago, IL</td>
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<td>October 24-25</td>
<td>National Workshop 4: Operations</td>
<td>Phoenix, AZ</td>
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<td>November 13-15</td>
<td>National Workshop 5: Infrastructure Design and Safety</td>
<td>Texas</td>
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Themes from Physical Infrastructure Workshop

- Infrastructure **standards** should be updated to respond to AV technology.
- AV and non-AV **interaction** needs to be understood to ensure safe roadways.
- Automated vehicle **data** can provide new uses for safety and infrastructure management.
- **Communication** to and between stakeholders is critical for safe and successful AV.
- Infrastructure requirements and **funding** needs remain unclear.
GOAL
To develop practicable documentation and webinars to educate and inform DOT stakeholders about AV-related infrastructure needs.

OBJECTIVES
1) To assess and understand the demands and potential impacts of AVs on our current & future infrastructure assets.
2) To guide and assist DOTs on how to determine their “Readiness” for AV use on its highways.
Infrastructure Focus Areas

Highway Infrastructure Categories

Traffic Control Devices
- Barriers, Channelizing Posts, Pavement Markings, Traffic Signs, Traffic Signals, Work Zones

Pavements and Structures
- Asset Management, Condition + Performance, Design, Innovative Technologies, Maintenance, Materials

TSMO and ITS Infrastructure

Multimodal Infrastructure
- Bicycle/Pedestrian Infrastructure, ADA Accessibility, Multimodal Traffic Control Devices, Curb design, Street design, Parking

TSMO = Transportation Systems Management and Operations
ITS = Intelligent Transportation Systems
Key Considerations

• What should DOTs be doing right now with existing infrastructure to prepare for the needs of increasing AV use?
• What will the impacts be of AV use on the existing highway infrastructure, and how does the concept of “state of good repair” play into these impacts?
• Based on input from the AV sector, what will the design and maintenance needs of future highways be?
• How should DOTs be preparing their physical infrastructure for the future needs of potentially high levels of AV usage on the national highway network?
• How should a DOT determine its “Readiness” for AV use on its highways?
Industry Interviews

- ADS Computation (1)
- ADS Sensors (2)
- Tier 1 Auto Supplier (1)
- Heavy truck industry (1)
- OEM (3)
Industry Interviews: Key Observations

- **Implications of Sensor Evolution:** The rapid evolution and regular maintenance needs of sensors favors fleet operations in the near-term and presents challenges to future proofing infrastructure.
- **Quality and Uniformity of Physical Infrastructure:** Physical infrastructure should be well-maintained and consistent, especially with regard to road markings and signage.
- **Digital Information Standards:** Digital information relayed to AVs should be standardized, secure, and specific to AV operational challenges (such as work zones).
- **Urban Fleet Operations:** Urban fleet operations will be an important early application of AV and will offer near-term and non-traditional partnership opportunities between fleet operators and IOOs.
Industry Interviews: Key Observations (cont.)

- **Operational Design Domains**: Original Equipment Manufacturer (OEMs) are responsible for defining their operational design domain (ODD) and assume ultimate responsibility for safe operation within the ODD regardless of Infrastructure Owner Operator (IOO) actions.

- **Connectivity Between Vehicle and Infrastructure**: CV applications such as V2I can alert AVs to the presence of humans, however, industry is not relying on IOO support and is skeptical that V2I deployments will occur widely.

- **IOO Role of Traffic Systems Management and Operations**: AVs may exacerbate congestion in the short term, making it increasingly important that IOOs implement advanced traffic systems management and operations strategies.

- **Freight**: Freight is an early and incremental adopter of lower-level AV with its own path to deployment.

- **Governmental and Institutional Issues**: Clear guidance and policies are needed at the federal level, while interagency and intergovernmental coordination are needed at the state and local levels.
Technical Proposed Approach

- **Framework: Risk, Opportunity, Adaptation and Readiness (ROAR)**
- **Summary of Findings**
  - Literature
  - Industry Interviews
- **Stakeholder Engagement**
  - Workshop findings (AASHTO and AVS)
- **Risk**
  - Risk management protocol
- **Opportunity**
  - List opportunities and talk about likelihood and contributing factors
- **Adaptation**
  - Sort by categories (e.g., data and physical infrastructure)
- **Readiness**
  - Checklist of things for IOOs to do
Workshop Updates

• **AASHTO Committee on Maintenance**
  – Date: Wednesday, July 17
  – Location: Grand Rapids, MI
  – Duration: 2 hours

• **AV Symposium**
  – Date: Thursday, July 18
  – Location: Orlando, FL
  – Requested duration: 2 hours
Research Highlights

- Cooperative Automation Research Mobility Applications (CARMA) Research Program: https://highways.dot.gov/research/research-programs/operations/CARMA


- Data for AV Integration (Work Zone Data Exchange) https://www.its.dot.gov/research_areas/enterprise.htm

- CV Pilot Deployment: https://www.its.dot.gov/pilots/

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