Strategies to Advance Automated and Connected Vehicles: A Primer for State and Local Decision Makers

NCHRP Report 845

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Vehicles that are increasingly automated and connected have the potential to profoundly change personal, freight and public transportation
NCHRP CV & AV Research

- $6M invested by state DOTs through NCHRP since Dec. 2014
- Project selection guided by a Research Roadmap developed in 2014, will be updated this year
- Selection of research tasks by NCHRP 20-102 panel considering input from U.S. DOT, V2I Deployment Coalition, AASHTO & TRB Committees, ITE CV/AV Steering Committee, and Automated Vehicle Symposium

Source: www.its.dot.gov
NCHRP CV/AV Completed

- Challenges to CV and AV Application in Truck Freight Operations
- Road markings for Machine Vision (phase 1)
- Impacts of Regulations and Policies on CV and AV Technology Introduction in Transit Operations
- Advancing Automated and Connected Vehicles: Policy and Planning Actions for State and Local Transportation Agencies

Source: en.wikipedia.org
NCHRP CV/AV Products Coming Next Year

• Dedicating Lanes for Priority or Exclusive Use by CVs and AVs
• Implications of Automation for Motor Vehicle Codes
• Providing Support to the Introduction of CV/AV Impacts into Regional Transportation Planning and Modeling Tools
• Connected Road Classification System Development

Source: en.wikipedia.org
NCHRP CV/AV Work In the Pipeline

- Business Models to Facilitate Deployment of CV Infrastructure to Support AV Operations
- Cybersecurity of Traffic Management Systems
- Impact of Mobility-on-Demand Services and Highly Automated Vehicles on the Transportation System
- Understanding the Impacts of the Physical Highway Infrastructure Caused by the Increased Prevalence of Advanced Vehicle Technologies
- Planning Data Needs and Collection Techniques for CV/AV Applications
- Data Management Strategies for CV/AV Applications for Operations

Source: www.econolite.com
New NCHRP CV/AV Projects
Panel nominations welcomed! (rderr@nas.edu)

• Preparing Traffic Incident Management Responders for Connected Vehicles and Automated Vehicles
• Deployment Guidance for Connected Vehicle Applications in the Open Source Application Development Portal
• Minimum Safety Data Needed for Automated Vehicle Operations and Crash Analysis

Source: http://www.news-press.com
Our Research Study:

Objective

Assess potential **policy and planning strategies** for use by state and local governments that guide the deployment of AV and CV to create **positive outcomes for society**
Context: Technology

Automated Vehicle (AV)
One that takes control of aspects of the driving tasks

- For this research, only higher levels of automation are considered
Connected Vehicle (CV)
Internal devices connect vehicles to other vehicles, to infrastructure, to cloud, and to other road users
- Provide driver alerts but do not control the operation of the vehicle
Context: Regulatory

• New guidance September 2017
• NHTSA regulates vehicle safety and equipment
  – Scaled back safety assessments required for testing
  – Level 2 no longer considered AVs
• States responsible for licensing, registration, rules of the road
  – Model state policy replaced by best practices
Effects of AV and CV

- Traffic Crashes
- Congestion
- Pollution
- Land Development
- Mobility
### Potential Benefits of Connectivity and Automation

<table>
<thead>
<tr>
<th>Driving Externality</th>
<th>Connectivity (Full V2X)</th>
<th>Autonomy* (L4,5)</th>
<th>Shared Autonomy (L4,5)</th>
<th>Electrification**</th>
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<td>Safety</td>
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*Autonomy is defined for this purpose as individually owned vehicle.

**While not a focus of this NCHRP research, the team provides assumptions of potential benefits of electrification based on known literature.

- **Strong benefits**
- **Some expected benefits**
- **Weakest benefits/no impact**
- **Uncertain impact**
Policy and Planning Strategies

OUTCOME: To mitigate safety risks through testing, training and public education
- Enact legislation to legalize AV testing
- Enact legislation to stimulate CV or AV testing
- Modify driver training standards and curricula
- Increase public awareness

OUTCOME: To encourage shared AV use (and mitigate increased VMT and vehicle emissions)
- Subsidize SAV use
- Implement transit benefits
- Implement a parking cash-out strategy
- Implement location-efficient mortgages
- Implement land use policies and parking requirements
- Apply road use charging

OUTCOME: To address liability issues that may impact market development
- Implement a no-fault insurance approach
- Require motorists to carry more insurance

OUTCOME: To enhance safety, congestion, and air quality benefits by influencing market demand
- Subsidize CV-equipped vehicles
- Invest in CV infrastructure
- Grant AV- and CV-equipped vehicles privileged access to dedicated lanes
- Grant signal priority to AV- and CV-equipped vehicles
- Grant parking access to AV- and CV-equipped vehicles
- Implement new contractual mechanisms with private service providers
Viability Assessments

- Effectiveness and efficiency of strategy
- Political acceptability
- Implementation considerations
- Geographic impact
- Challenges
Enact Legislation to Legalize Testing

Mitigate safety risks and accelerate development, adoption and implementation by enacting legislation to establish legality of AV testing.

Key hurdle: Passing legislation

Outcome: Mitigate Safety Risks
Enact Legislation to Stimulate Testing

Mitigate safety risks and accelerate development, adoption and implementation of CV and AV by enacting legislation to directly fund testing.

Key hurdle: Passing legislation

Outcome: Mitigate Safety Risks
Modify Driver Training Standards and Curricula

Mitigate safety risks by addressing the requirements for operating vehicles by establishing, codifying and enforcing operator/owner/passenger requirements.

Key hurdles: Operational (how and when)

Outcome: Mitigate Safety Risks
Increase Public Awareness of Benefits and Risks

Mitigate safety risks, stimulate consumer action and public support through education, communication and outreach on benefits and risks.

Key hurdles: Expense, Trusted messages given uncertainties

Outcome: Mitigate Safety Risks
Subsidize Shared AV Use

Subsidize shared AV (SAV) to ensure alternatives to individually owned AV and to support ridesharing / transit services.

Outcome: Encourage shared AV use
Implement Transit Benefits

Encourage SAV by extending transit benefits to cover fares for SAV, either as a direct subsidy or a pre-tax benefit.

Outcome: Encourage shared AV use
Implement Parking Cash-Out Strategy

Use parking cash-out benefits (employers to employees) to encourage SAV use.

Key hurdle: Institutional

Outcome: Encourage shared AV use
Implement Location-Efficient Mortgages

Encourage SAV by extending LEM strategy to persons purchasing homes in denser urban areas, where SAV fleets would likely operate first.

Outcome: Encourage shared AV use

No evidence LEMS make a difference
Implement Land Use Policies and Parking Requirements

Implement land use policies and parking requirements to support market penetration of SAV at transit nodes and other activity centers.

Limited evidence of success in promoting share mobility

Outcome: Encourage shared AV use
Apply Road Use Charging

Achieve specific objectives related to AV and CV impacts by employing direct pricing of AV and CV for use of roadway infrastructure.

Key hurdles: Public and political opposition

Outcome: Encourage shared AV use
Implement a No-Fault Insurance Approach

Spur market development by reducing manufacturer liability.

Key hurdle: Political feasibility

Address liability issues
Require Motorists to Carry More Insurance

Raise mandatory insurance minimums to cover a higher proportion of harms associated with serious crashes, thereby incentivizing the purchase of safer AV and CV and encouraging market development.

Unintended consequences: Increase of consumer not purchasing insurance

Address liability issues
Subsidize CV-Equipped Vehicles

Encourage market adoption by providing subsidies for CV equipment.

Not needed for new vehicles if V2V mandate

Influence market demand
Invest in CV Infrastructure

Encourage development and adoption of CV and AV by supporting investment into required physical and digital infrastructure.

Key hurdles: Funding availability and ROI

Influence market demand
Priority Access to Dedicated Lanes

Incentivize market development by offering reduced travel times.

Effectiveness depends on willingness to dedicate lanes to AVs and CVs.

Influence market demand
Signal Priority to AVs and CVs

Incentivize market development by offering reduced delay at signalized intersections.

Limited effectiveness: Travel time benefits minimal

Influence market demand
Priority Access to Parking

Incentivize market development by granting reserved parking to AV and CV.

Limited effectiveness: AVs can park themselves
Use New Contractual Mechanisms with Private Sector

Incentivize market development by pursuing arrangements with the private sector.

Effectiveness depends on finding suitable revenue stream
Conclusions

• Strategies offer considerations for decision makers based on best information available
  – Technology direction may change
  – Consumers may not adopt certain products

• Public policy making for AV and CV will be informed through a cycle of learning

• Early-adopter agencies will support knowledge creation through support of testing, research and evaluation
NCHRP 20-102(01)
Policy and Planning Actions to Internalize Societal Impacts of CV and AV Systems into Market Decisions

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