

Highway Infrastructure Impacts of Automated Vehicles

CAT Coalition AV Infrastructure-Industry Working Group
Webinar – March 25, 2021

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Agenda

- AV Impacts on Highway Infrastructure
 - New FHWA research report (March 2021)
 - <https://www.fhwa.dot.gov/publications/research/operations/21015/index.cfm>
- Proposed MUTCD (open for comments 12/15/20 through 5/14/21)
 - 647 major changes, 2000+ total changes
 - Includes new TCD provisions to support to AV deployment
 - <https://www.federalregister.gov/documents/2020/12/14/2020-26789/national-standards-for-traffic-control-devices-the-manual-on-uniform-traffic-control-devices-for>

AV Impacts – Highway Infrastructure

- Project concluded with 3 webinars
- Links to recorded webinars:
 - [AV Impacts Webinar 1: Traffic Control Devices \(October 9, 2020\)](#)
 - [AV Impacts Webinar 2: Physical Infrastructure and Operations \(October 16, 2020\)](#)
 - [AV Impacts Webinar 3: Agency Readiness \(October 23, 2020\)](#)

Impacts of Automated Vehicles on Highway Infrastructure

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MARCH 2021



U.S. Department of Transportation
Federal Highway Administration

Research, Development, and Technology
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, VA 22101-2296

Approach



Scope of Project



Gather stakeholder
feedback

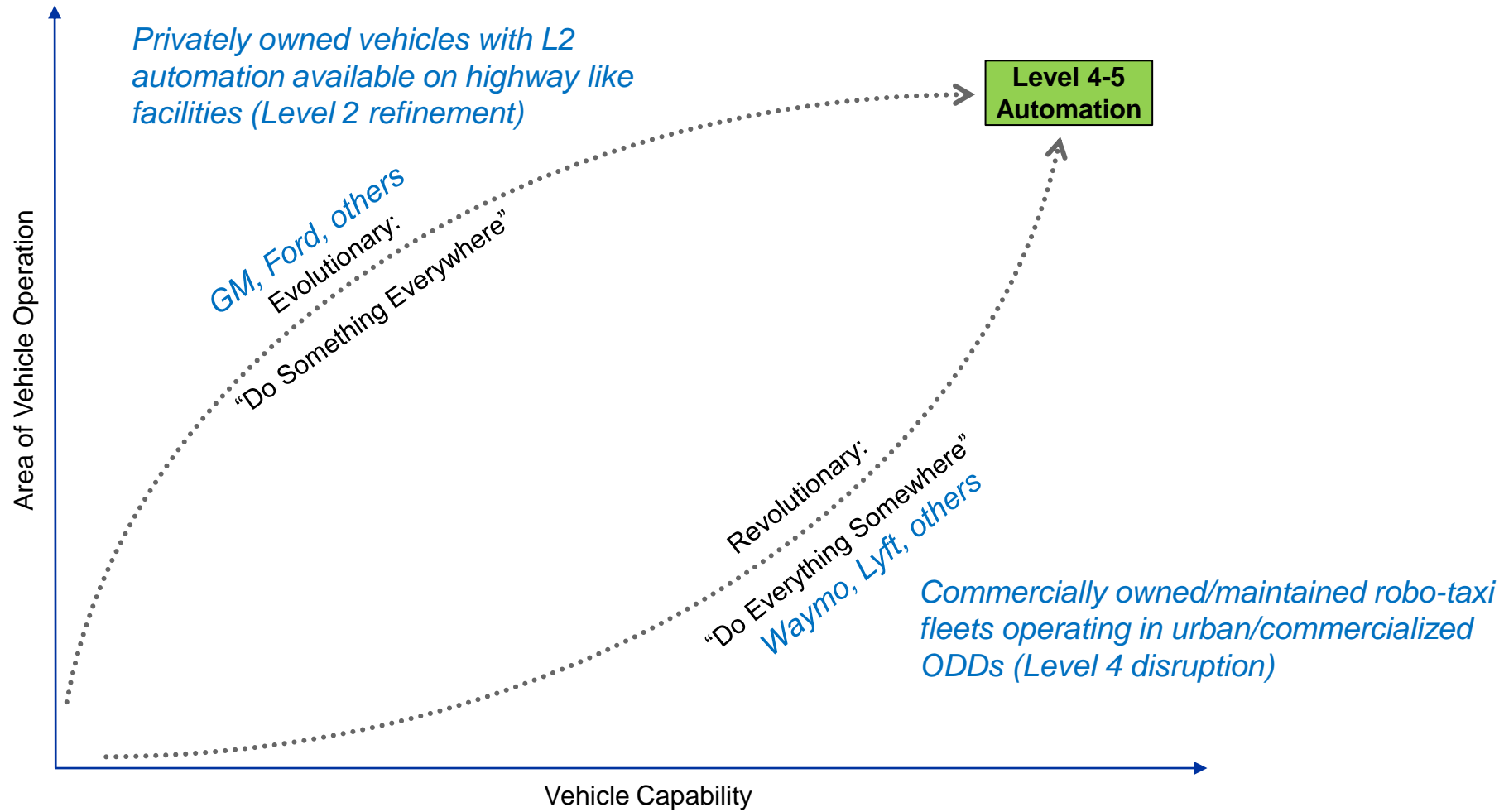


Synthesize available
information

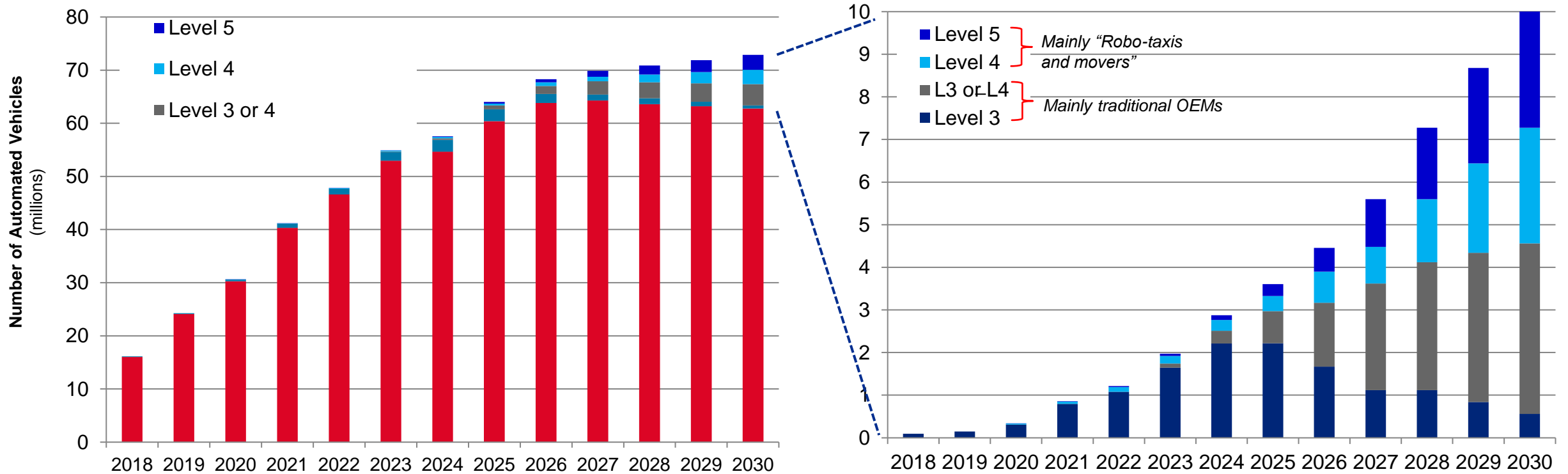


Develop official
guidance,
recommendations or
policy for FHWA

AV Development – Two Converging Paths?



Global ADAS / ADS Market Growth



Source: Automotive Safety Council

- Majority of AV market for the next 15 years will be ADAS-equipped, Level 2-capable vehicles
 - By the end of 2022, 99% of new light vehicles sold in the USA will be equipped with camera and / or radar-based AEB systems
- Highly automated vehicle market expected to grow steadily to about 10% of the global vehicle market by 2030
 - Split between dedicated low-speed shuttles and passenger vehicles with use-case specific automation (e.g. full access-controlled, divided highway driving)
- Certain infrastructure and TCD enhancements can benefit both segments of the ADAS / ADS market

Findings



Traffic Control Devices - Review of Findings

Prioritizing opportunities to support AV deployment

- Pavement markings and their role in both ADAS and ADS deployment
 - Uniformity in application and appearance
 - More consistent maintenance practices
 - Standard for contrast marking patterns on light-colored pavements
- Careful sign positioning to avoid confusion
 - Speed Limit signs on parallel routes (e.g. frontage roads)
 - Stop signs at the nose of Freeway entrance ramps

Hard Infrastructure & Operations - Review of Findings

Focus: Pavements, Bridges, and Operations

- Heavy vehicles equipped with lane-centering technologies may accelerate pavement rutting
- Early AV deployment may lead to increased congestion increasing need and role of TSMO
- Digital signing can be problematic for some in-vehicle camera systems
- Approaches and exits from toll booths can be challenging



LED Flicker issue

Agency Readiness - Review of Findings

State DOTs concerns

- What is needed, when, and how to maximize return on investment (ROI)?
- More guidance and standards needed
- Existing road condition inadequate
- Additional funding will be needed
- Lack of maintenance plan/funding
- AV industry is not stable (rapidly developing solutions/technology)
- Public confidence is low

Agency Readiness - Review of Findings

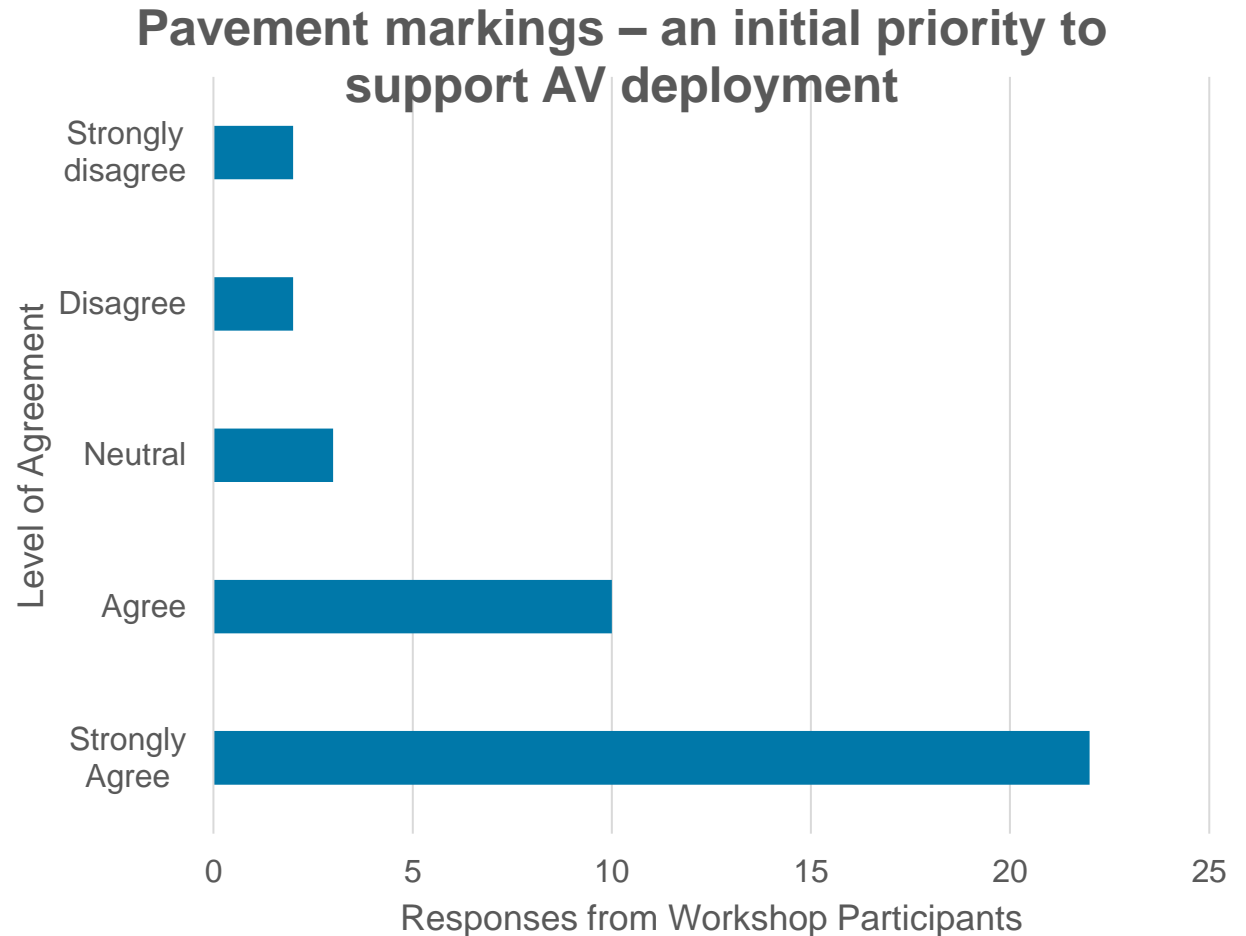
State DOT actions

- Already started with early stages of planning
- AV champion at executive level
- Existing AV position/office
- Engagements with AV developers/automotive original equipment manufacturers (OEMs)
- Agency is beginning to train staff
- Updating standards and policies
- Conducting targeted research

Examples of AV Preparation Underway

As reported by State DOTs

- Upgrading pavement marking policies
- Initiating internal task forces
- Engaging with automotive OEMs
- Supporting legislation
- Updating traffic control
- Upgrading intelligent transportation system (ITS) equipment
- Funding State-level research
- Nothing (wait and see)



Proposed MUTCD – 11th Edition

- Announced rule-making activities (NPA) regarding a new edition of the Manual on Uniform Traffic Control Devices (MUTCD).
- The MUTCD is the national standard for traffic signs, signals, pavement markings, and work zone devices that guide us on our nation's streets and highways. *Last major update was 2009.*
- “The proposed updates to the manual smartly envision the future of transportation by considering the **preparedness of our nation's highways for automated vehicles**,” said Federal Highway Administrator Nicole R. Nason. “They also renew attention on safety for our most vulnerable road users, including the nation's highway workers, emergency responders, cyclists, and pedestrians.”
- ...the proposed updates reflect state-of-the-art traffic research to **help transportation agencies prepare for automated vehicles** and other cutting-edge technologies.



Major Changes

1. General	Items 1 – 28	
2. Signing	Items 29 – 315	
3. Pavement Markings	Items 316 – 381	
4. Traffic Signals	Items 382 – 447	
5. Automated Vehicles	Items 448 - 460	← (All new material)
6. Work Zones	Items 461 – 516	
7. School Areas	Items 517 - 527	
8. Railroad Grade Crossings	Items 528 – 581	
9. Bicycle Facilities	Items 582 – 647	

Getting to the information

- Federal Register link:
 - <https://www.federalregister.gov/documents/2020/12/14/2020-26789/national-standards-for-traffic-control-devices-the-manual-on-uniform-traffic-control-devices-for>
- Agency/Docket Number:
 - www.federalregister.gov
 - Search using: FHWA Docket No. FHWA-2020-0001

New Part 5A – Automated Vehicles

- Proposed MUTCD includes a new chapter (Part) – Automated Vehicles
- 5A.01 Purpose and Scope
- 5A.02 Overview of CAVs
- 5A.03 Definitions and Terms
 - Reference to SAE J3016 and use of definitions and automation levels
- 5A.04 Traffic Control Device Design and Use Considerations

New Part 5B – Automated Vehicles

Agencies should consider...

- 5B.01 – Signs
 - The illuminated portion of electronic-display signs using LEDs should have a standard refresh/flicker rate. The refresh rate of the LEDs should be greater than 200 Hz to be easier for the camera to detect.
- 5B.02 – Markings
 - Normal-width longitudinal lines on freeways, expressways, and ramps of at least 6 inches wide (see Section 3A.04).
 - Edge lines of at least 6 inches in width on roadways with posted speeds greater than 40 mph (see 28 Section 3B.09).
- 5B.03 – Highway Traffic Signals
 - The refresh rate of the LED traffic signals should be consistent throughout the jurisdiction and be greater than 200 Hz to allow greater consistency in machine vision detection.

New Part 5B – Automated Vehicles

Agencies should consider...

- 5B.04 – Temporary Traffic Control (Work Zones)
 - To better accommodate machine vision used to support the automation of vehicles, channelizing devices should be at least 8 inches wide with retroreflective material for reliable machine detection in all weather conditions. Markings entering the work zone and through lane shifts should be made with highly visible and continuous materials, not intermittent buttons and reflectors.
- 5B.05 – Railroad Crossings
 - For passive and active grade crossings, placement of signs and markings should be consistent along a corridor to promote uniformity and to improve the ability of machine vision technology to recognize highway-rail grade crossings.
- 5B.06 – Bicycle Facilities
 - To better accommodate machine vision used to support the automation of vehicles, bicycle facilities should be segregated from other vehicle traffic using physical barriers where practicable.

Questions

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Chair, SAE ORAD Committee, Highway Infrastructure Task Force