

CAT Coalition Infrastructure-Industry Working Group Quarterly Meeting

July 31, 2019

3:00-4:30 pm (Eastern)

Agenda

- Welcome and Introductions
- Co-Chairs' Remarks
- Overview of Phase 2 – Year 2 Work plan
- FHWA Updates
- Guest Presentations
 - ***Smart Bases CPI AV Pilot***
 - CAT/CAV Capacity & Funding Approaches in the States
 - Impacts of AVs on Highway Infrastructure
- Action Items and Next Steps

Co-Chairs' Remarks

Tracy Larkin Thomason, Nevada DOT

Steve Gehring, Global Automakers

Infrastructure-Industry Working Group

- Welcome to new Co-Chair: Steve Gehring
- Role of this Working Group is to:
 - Lead adoption of pre-competitive industry research in driving infrastructure development and maintenance
 - Connect IOOs with industry
 - Pursue natural evolution of infrastructure to accelerate CAVs
 - Clarify terms, definitions and target audiences

Overview of Phase 2 – Year 2 Work Plan

Dean Deeter, Athey Creek

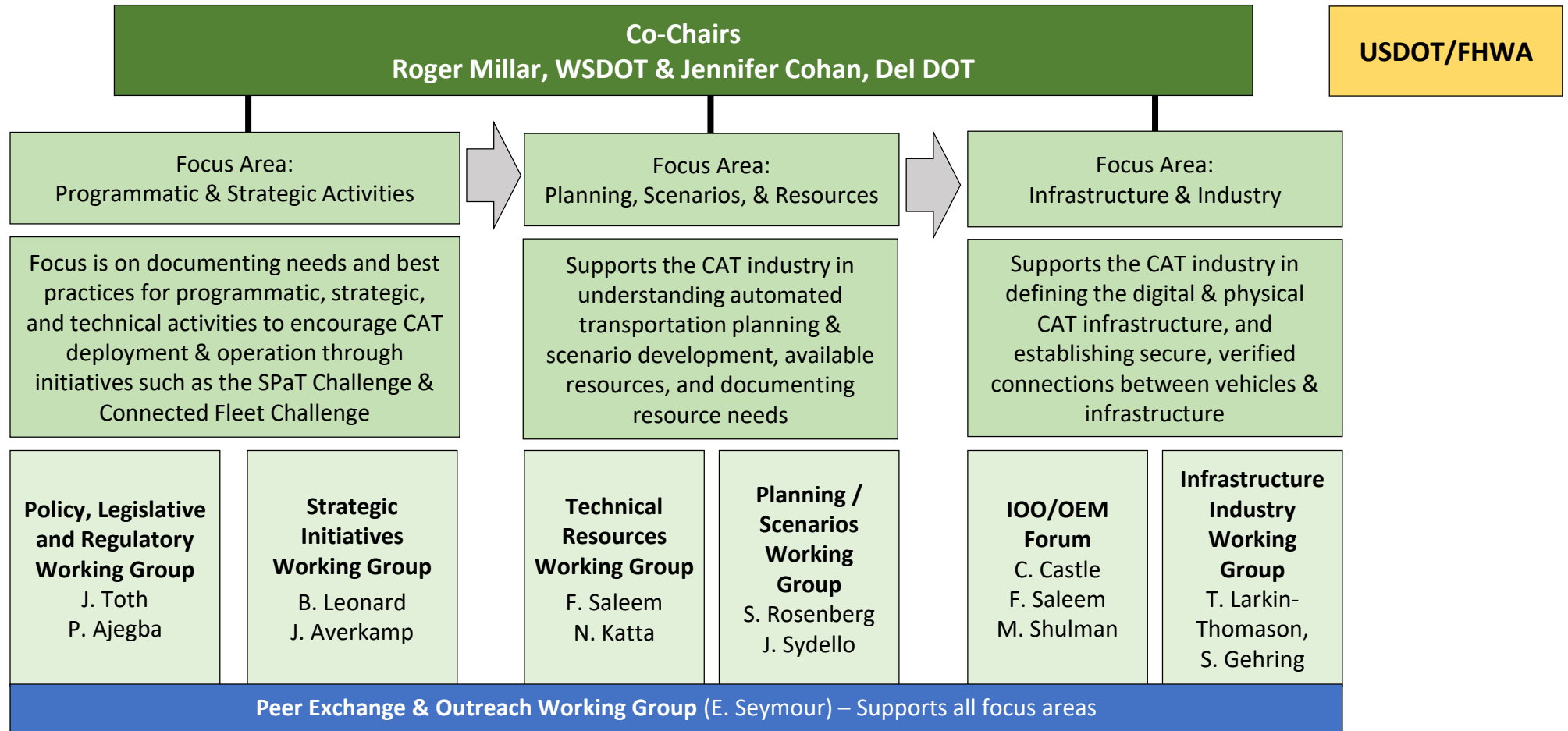
Tracy Larkin Thomason, Nevada DOT

Venkat Nallamotheu, AASHTO

CAT Coalition Status & Work Plan

- New Coalition Co-Chairs
 - Roger Millar, WSDOT
 - Jennifer Cohan, DeIDOT
- Coalition is 8 months into Year 2 (Nov 2018 – Nov 2019)
- Current Organization Chart on the Next Slide

Current Org Chart – Aug 2019



Year 2 Work Plan – General

Summary of Year 2 Work Plan:

There is a need to evolve the focus from solely V2I deployment details to include higher level topic areas that surfaced in the National Dialogue, that were documented in the AV 3.0 document, and that will be the focus of the National Strategy on Highway Automation developed over the coming years.

Year 2 Work Plan – Coalition Wide

6 Recommendations & Related Focus Areas

#	Recommended Year 2 Work Plan Activities	Infrastructure & Industry	Prog. & Strategic Activities	Planning Scenarios & Research
1	Harmonization with the National Dialogue on Highway Automation	✓	✓	✓
2	Support early activities of the AASHTO CTSO National Strategy for Highway Automation			✓
3	Continue to support the ongoing efforts of the SPaT Challenge and the Connected Fleet Challenge		✓	✓
4	Support a dialogue regarding the wireless spectrum for V2V & V2I communications	✓	✓	✓
5	Support members in understanding and benefitting from USDOT activities and deliverables	✓	✓	✓
6	Re-examine working group activities and continue key activities	✓	✓	✓

Year 2 Work Plan – Infrastructure-Industry WG

#	Recommended Year 2 Work Plan Activities	Infrastructure & Industry	Prog. & Strategic Activities	Planning Scenarios & Research
1	Harmonization with the National Dialogue on Highway Automation	✓	✓	✓
2	Support early activities of the AASHTO CTSO National Strategy for Highway Automation			✓
3	Continue to support the ongoing efforts of the SPaT Challenge and the Connected Fleet Challenge		✓	✓
4	Support a dialogue regarding the wireless spectrum for V2V & V2I communications	✓	✓	✓
5	Support members in understanding and benefitting from USDOT activities and deliverables	✓	✓	✓
6	Re-examine working group activities and continue key activities; I-I WG specific recommendations: <ul style="list-style-type: none"> Discuss options for expanding membership in quarterly webinars Introduce MaaS/MOD & discuss relation to this WG 	✓	✓	✓

Infrastructure-Industry WG Activities

- Communications 101
- Primer of Terms
- Exercise about bigger picture for CAT infrastructure
- Expand membership

Infrastructure-Industry WG Activities

- Communications 101
 - A priority effort for this working group
 - Audience: IOO staff making investments and new to this realm
 - What: A brief YouTube video or Primer
 - Content will answer:
 - ❖ What are the telecommunications methods?
 - ❖ What do the terms mean?
 - ❖ How does DSRC work?
 - ❖ What is the 5.9 GHz spectrum?
 - ❖ What are the V2X benefits of the 5.9 GHz spectrum?
 - ❖ May discuss how OEMs communicate now, e.g. cellular systems like Sirius XM/OnStar

Infrastructure-Industry WG Activities

- Primer of Terms
 - Previously a focus of this working group
 - Modify scope to leverage nomenclature and follow the lead of the more mature, data-driven organizations to minimize duplication
 - ❖ Similar efforts by other CAT Coalition groups, National Safety Council, IIHS, AAA, Consumer Reports, and NHTSA
- Exercise about bigger picture for CAT infrastructure
 - Discussion with both OEMs and IOOs
 - Understand priorities for planning and implementing IOO infrastructure investments
- Expand membership
 - Increase perspective and better understand issues

FHWA Update

Smart Bases CPI AV Pilot

Col. James Allen, U.S. Army Engineer Research and Development Center (ERDC)



U.S. ARMY

Smart Base CPI Autonomous Vehicles Pilot

Prepared by Jim P. Allen, PE, Researcher

U.S. Army Engineer Research and Development Center (ERDC)
Construction Engineering Research Laboratory (ERDC-CERL)

Prepared for AASHTO and Northern Virginia Regional Commission

July 2019



US Army Corps
of Engineers



DISCOVER | DEVELOP | DELIVER

Outline

- **Project Overview**
- **Research Approach**
- **Fort Carson Overview**
- **Timeline and Phases of JBMHH Project**
- **Outstanding Issues**
- **Questions and Discussions**

Smart Bases: Smart Transportation and Autonomous Vehicles Pilot

PROJECT DESCRIPTION / OBJECTIVE OF PROJECT

Objective: Explore the use of connected and autonomous vehicles (CAV) at military installations integrated with regional communities to lower costs, improve Soldier and family quality of life, and enhance mission readiness. This project will deploy and research CAV's at Joint Base Myer-Henderson Hall (JBMHH), VA and Fort Carson, CO

Project Sponsor: ASA(ALT) and ASA (IE&E)
Partners: US Ignite, Local Motors

PRODUCTS / OUTCOMES

- Plan, develop, demonstrate, and employ CAV technologies at two installations and within the surrounding communities to evaluate commercially-available CAV's and the potential to reduce base operating costs, improve safety and quality of life, and deliver services more efficiently and effectively
- Pilot at Fort Carson, CO with autonomous delivery and a public safety program
- Pilot at JBMHH, VA with autonomous shuttle and base-to-Pentagon service
- Formation of strategic partnerships with a wide range of stakeholders and industry leaders in smart transportation and cyber security
- Identify and assess emerging transportation technologies focused on infrastructure, data analytics, policy, public safety, and optimization



One of Waymo's three lidar systems that shoots lasers so the car can see its surroundings. Waymo says this lidar can detect a helmet two-football fields away.

A forward facing camera works with 8 others stationed around the car to provide 360 degrees of vision.

Radar sensors can detect objects in rain, fog, or snow.

Waymo's self-driving sensors are tightly integrated into the hybrid minivan created by Fiat Chrysler.



NEXT STEPS

- ❑ Research approach
 - PMP approved
 - Six research LOE's with designated area leads in PDT and integration component
 - 2 x AV deployments for comparative case study: JBMHH and Ft Carson
- ❑ Admin and acquisition actions
 - MOA between ERDC-CERL, JBMHH, and MCICOM
 - Sole source contract with Local Motors as AV operator at JBMHH; for \$150K
 - US Ignite BAA proposal for Ft Carson at \$4 million

US Army Corps of Engineers • Engineer Research and Development Center

Technical POC: James (Jim) Allen

Project Overview

- **Title:** Smart Bases: Autonomous Vehicles Pilot

- **FY19 \$5 million Congressional Program Increase in NDAA to ERDC**

- **Objective:** Explore the use of connected and autonomous vehicles (CAVs) at military installations integrated with regional communities to lower costs, improve Soldier and family quality of life, and enhance mission readiness

- **Locations of pilots:**
 - Fort Carson and Colorado Springs, Colorado
 - Joint Base Myer-Henderson Hall and Arlington, Virginia

Autonomous Vehicle Pilot Research Approach

Measures of Effectiveness/Performance (MOE/MOPs) and Smart Installation Guidance

Vision

Military installations leverage connected and autonomous vehicle technologies

Research Lines of Effort

Infrastructure

Energy and Economy

Data Architecture and Cyber Security

Data Analytics

Human Factors

Planning and Policy

Program Integration

Outcomes

Mission Readiness & Mission Assurance

Transportation Services & Costs

Safety & Quality of Life

Anticipated Products

- **Enhanced knowledge and capability to conduct CAV research**
- **Installation guidelines for deploying CAVs**
 - Assessment frameworks, regulation and policy changes
 - Infrastructure, security, and planning requirements
 - Data sharing/analytics standards
 - Cost and energy savings
 - Human interface and education
 - Integration with regional communities
- **Technology transfer through publications and policy**
- **Scenario analysis using the digital infrastructure and digital twin capability within the VTIME platform to further conceptualize and develop Installations of the Future**

Fort Carson / Colorado Springs AV Pilot

- **Deliberate and incremental approach to deploy AVs that support garrison commander use cases: personal, material, and responder mobility services**

- **Key contractor tasks:**
 - Accelerate the launch of a smart technology testbed that will include an autonomous vehicle (AV) pilot program, an autonomous delivery pilot and a public safety program
 - Form and manage strategic partnerships with the wide range of stakeholders and industry leaders in smart transportation and digital security
 - Identify and assess the right emerging transportation technologies on-base, focused on those that will help reduce costs, improve public safety, and deliver faster services
 - Evaluate smart solutions on- and off-base for use in other vital sectors, such as public safety, sustainability and resilience.

- **BAA final proposal from US Ignite at EASB for July 23 review**

- **Refine research assessment templates for LOEs used at JBMHH**

JBMHH / Arlington AV Pilot

- **Target of Opportunity: Greater Washington Olli Fleet Challenge**
 - Joint application of MCICOM, ERDC, JBMHH, and NVRC
 - Selected on March 15, 2019

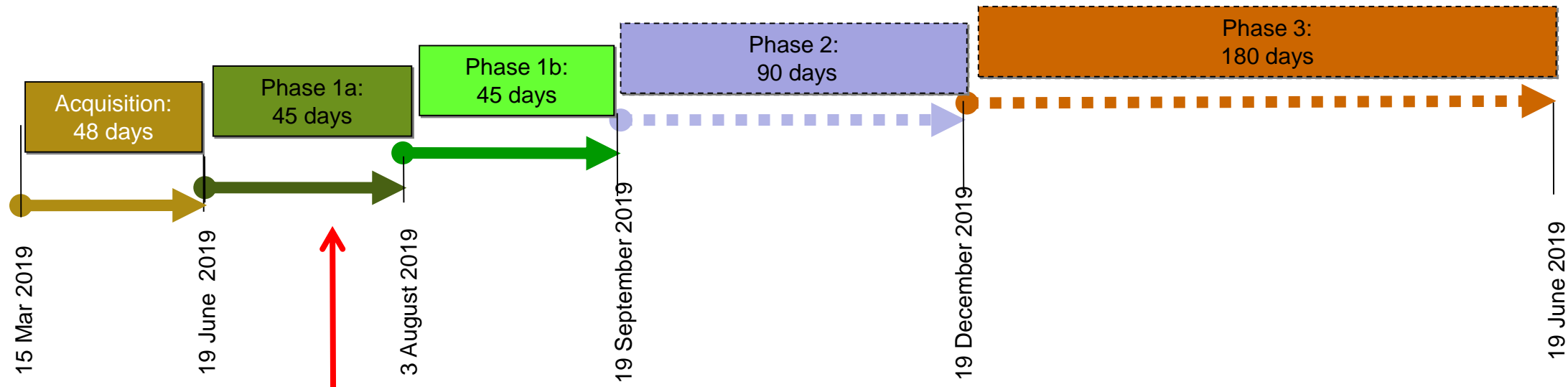
- **Sole source contract with Local Motors to deliver data and reports relevant to research LOEs**
 - Contract method selected as most expedient to meet pilot timetables
 - Robotic Research key contractor partner with 15 years DoD experience in robotics

- **Key contractor tasks: Data capture and process reporting**
 - Deployment planning and site survey
 - Infrastructure set up and operational test
 - Vehicle and route set up and operational test
 - Invitational events and fixed route mobility service

- **Mobility service set up, operation, and maintenance (late May / early June start)**
 - Phase 1 service: internal JBMHH route => 90 days
 - Phase 2 service: addition of route from JBMHH to Pentagon => day 91 to 180
 - Phase 3 service: additional route to 2 Metros => day 181 to 365

Autonomous Vehicle Timeline and Milestones

- Phases: Acquisition: Sole Source solicitation
 - Phase 1a: Event and invitation mobility service at JBMHH
 - Phase 1b: Fixed route and event mobility service at JBMHH
 - Phase 2: Fixed route mobility service from JBMHH to Pentagon
 - Phase 3: Fixed route mobility service between JBMHH, Pentagon, and Pentagon City/Rosslyn metro stations
- Milestones:
 - Data push being received into Azure gov cloud blob storage
 - Identify indicators for success to proceed into Phase 2 by end of July



POLICY - Why JBM-HH?

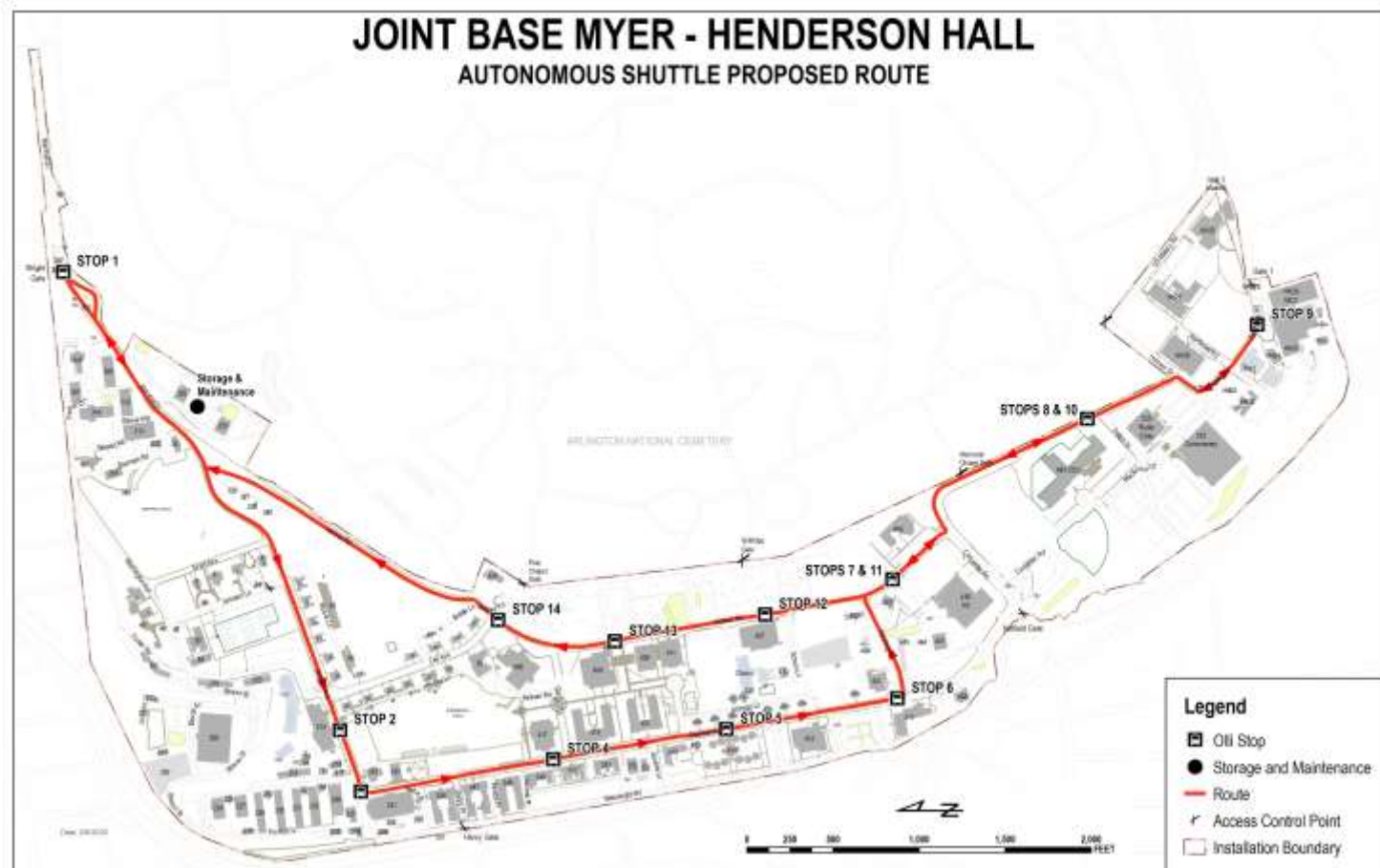
- **JBM-HH – History of Innovation**
 - Previous Pilots have been conducted
 - AV technology has far reaching implications across DOD Community
 - Home to Senior Command and Staff Officers
 - Population of ready customers

- **Ideal Testing Environment for Olli – meets roadway attributes:**
 - Secure Campus with a separate governing structure from State
 - All roadways with a maximum speed of 15 - 25 mph
 - 2-lane roadways, or one-way streets
 - No stop light controlled intersections
 - All intersections are governed by stop signs

Stakeholders

- NVRC
- Joint Base Myer-Henderson Hall, Fort Belvoir, and Quantico
- Arlington County
- Virginia Department of Transportation
- Virginia Department of Rail and Public Transit
- Office of the Secretary Veterans and Defense Affairs for the Commonwealth of Virginia
- Virginia Tech
- Barbaricum
- Booz Allen Hamilton
- Amazon
- JBG (Developers for Amazon HQ2)
- Compass Transportation and Technology

JBMHH Route



Olli Launch Event on June 19, 2019 in Arlington, VA



US Army Corps of Engineers • Engineer Research and Development Center

Olli Launch Event on June 19, 2019 in Arlington, VA



Outstanding Issues

- **Clarity on milestones for stakeholders to move into Phase 2**
- **Funding for Phase 2 and 3**
- **Test to duplicate Route 29 traffic signal and left turn required to Pentagon route from JBMHH**
- **NHTSA Waiver / DMV authorize for Olli to operate on VDOT/Arlington County roads**
- **State police involvement during initial deployment on public roads**
- **Data sharing agreement between DOD and state/local stakeholders**
- **Additional Research Issues**

CAT Coalition PLR WG Survey: CAT/CAV Capacity & Funding Approaches in the States

Daniela Bremmer, WSDOT

SURVEY ON CAT/CAV CAPACITY & FUNDING APPROACHES IN THE STATES

Survey conducted by the CAT Coalition

Working Group on Policy, Legislation, and Regulation (PLR)

Survey Administered: April 2019

Daniela Bremmer, CAT Development Manager, WSDOT

CAT Coalition AV Infrastructure-Industry Working Group Meeting. 07/31/2019



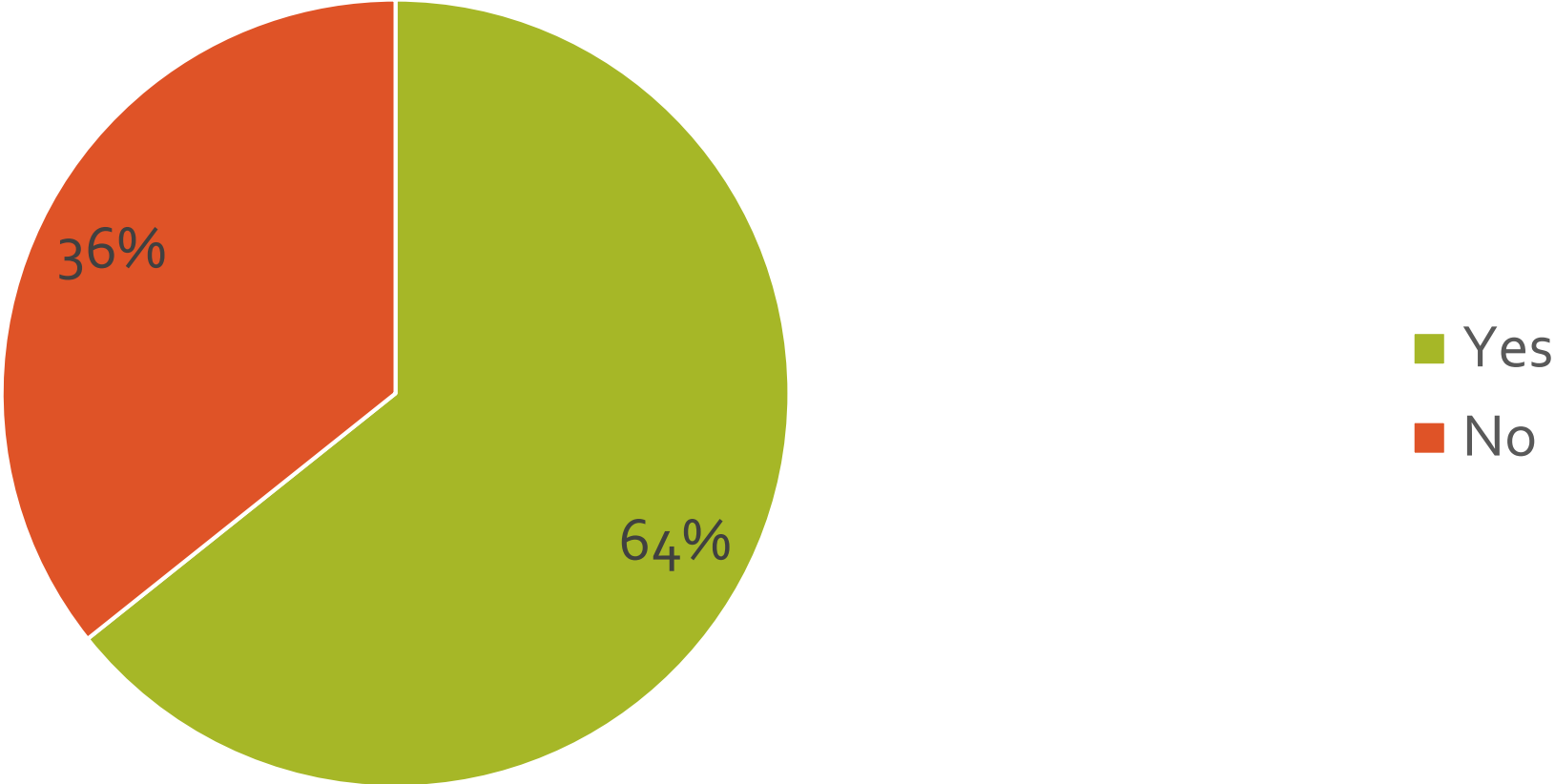
CAT Coalition PLR WG Survey on Funding, Financing, and Organizational Structure

- A key goal of PLR WG's work plan activity #2 was to understand how state and local DOTs are funding their respective CAT activities and the general scale of funding they are investing.
- After examining other, recently conducted surveys (Fall 2018, AASHTO and ITSA), the WG agreed that the questions that members wanted answered had not been asked before. The primary target audience was State DOTs
 - Survey was refined after testing it with a few volunteer states
 - Survey consisted of three, key sections:
 1. Agency Capacity and Organization Section
 2. Agency Funding and Financing Section
 3. Agency Deployment and Partnerships Section

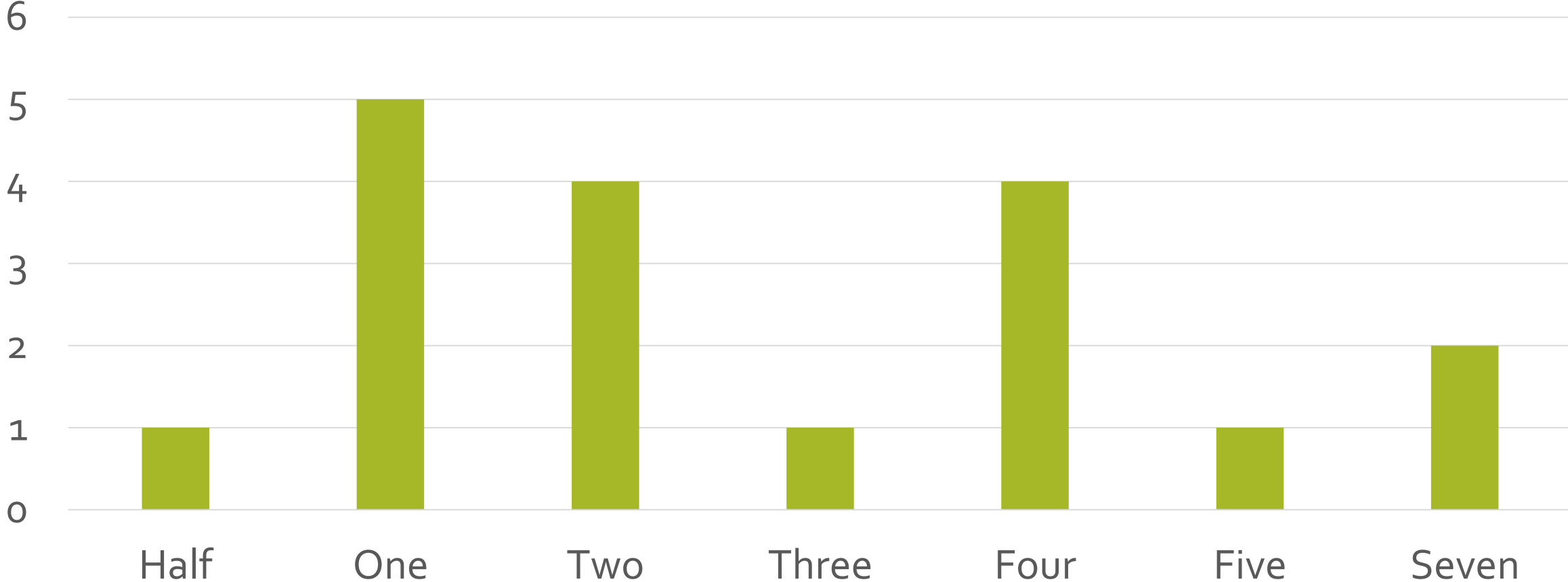
25 State DOTs and 2 Local Agencies responded to the survey (27 total)

- | | | | | | |
|-----|--------------------------------------|----------------|---|------------------------------------|--|
| 1. | AKDOT&PF Central Region | Transportation | 21. | Road Commission For Oakland County | |
| 2. | Arizona Department of Transportation | 12. | Maryland DOT-SHA | 22. | Tennessee DOT |
| 3. | California DMV & DOT | 13. | Michigan DOT | 23. | Texas Department of Transportation |
| 4. | City of Vancouver | 14. | Minnesota DOT | 24. | Utah DOT |
| 5. | Delaware DOT | 15. | Nevada Department of Transportation | 25. | Virginia DOT |
| 6. | Florida DOT | 16. | NH DOT - TSMO | 26. | Wisconsin Department of Transportation |
| 7. | Georgia DOT | 17. | North Dakota Department of Transportation | 27. | WSDOT |
| 8. | Idaho Transportation Department | 18. | Oregon Department of Transportation | | |
| 9. | Iowa Department of Transportation | 19. | PennDOT | | |
| 10. | Maine DOT | 20. | RI Dept. of Transportation | | |
| 11. | Maryland Department of | | | | |

“Does your agency have dedicated positions supporting/leading CAT/CAV initiative/programs?”



The number of FTEs dedicated to the agency's respective CAT/CAV Program ranged from ½ FTE to 7 FTEs



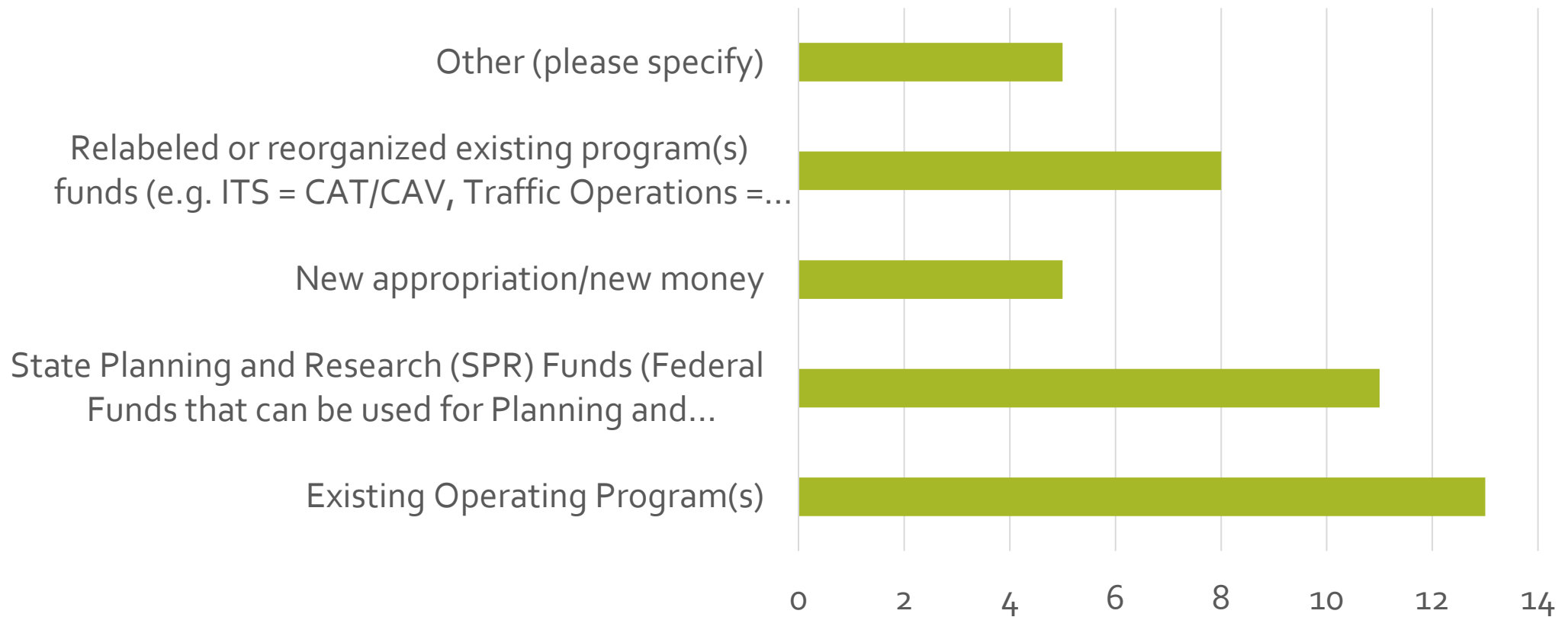
In most agencies the CAT/CAV program is embedded in TSMO/Operation/ITS types of divisions

“Where is the program located in the organization /reporting structure?”

- CAV-X Office Reports to the Operations Division Director
- Central Office / FDOT Head Quarters Traffic Operations
- DMV: Autonomous Vehicle program and Legal DOT: Planning and Modal program
- Office of Innovation in the Director's Office
- Office of Strategic Innovation
- Office of Traffic Operations - Operations Bureau
- Operations
- Planning /Traffic Operations
- Planning Division
- reports directly to the Director of NDDOT
- Reports to the Executive Deputy Secretary
- Secretary's Office
- Strategic planning division
- Traffic Management / Operations
- TSM&O - Systems Technology Group
- TSMO/Region
- under the operations branch of the organization
- Within Traffic Operations

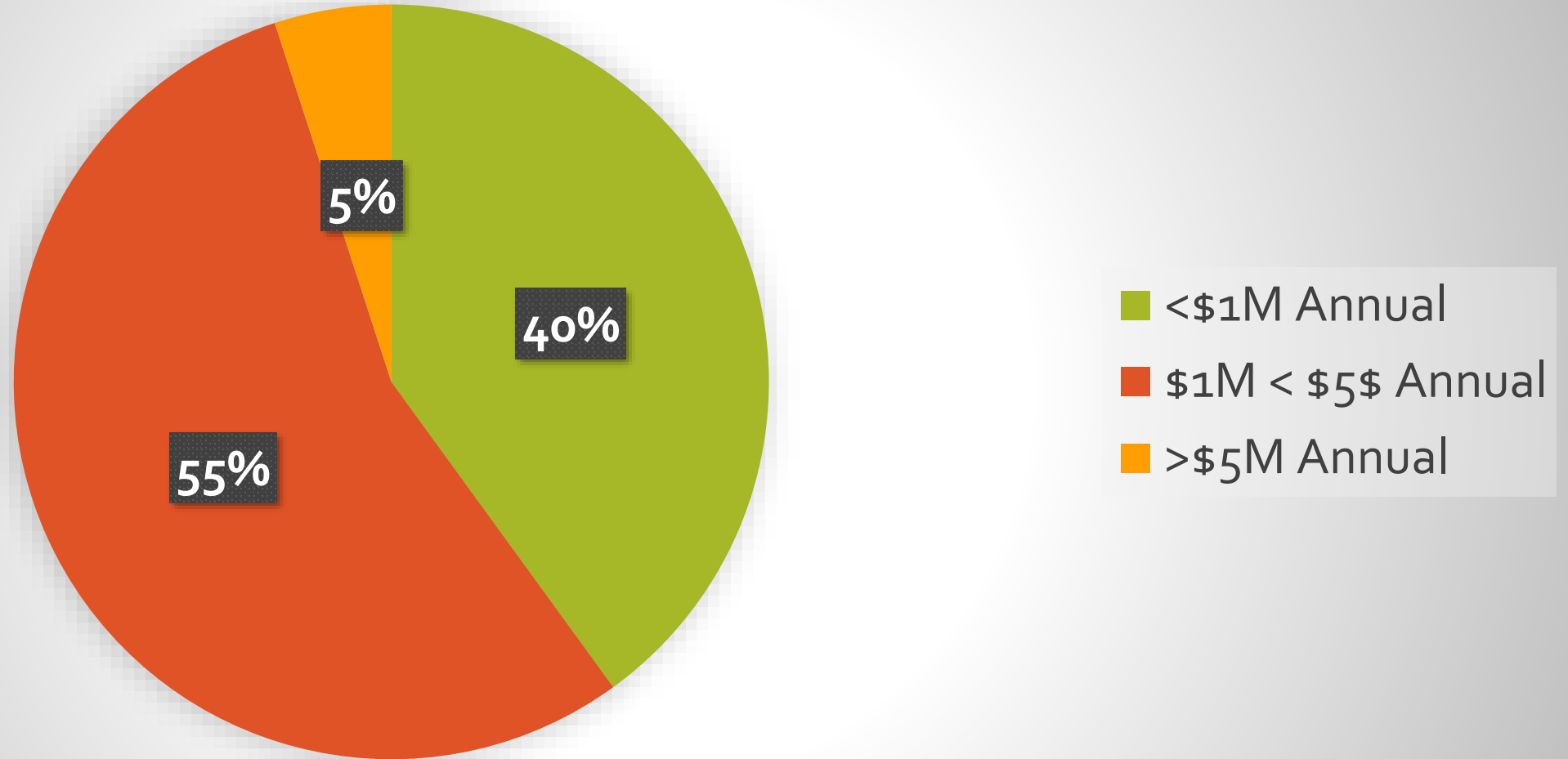
Most CAT/CAV Programs are funded out of existing programs

“If you have a CAT/CAV/AV program, how are you funding deployments, initiatives and or the program today?”



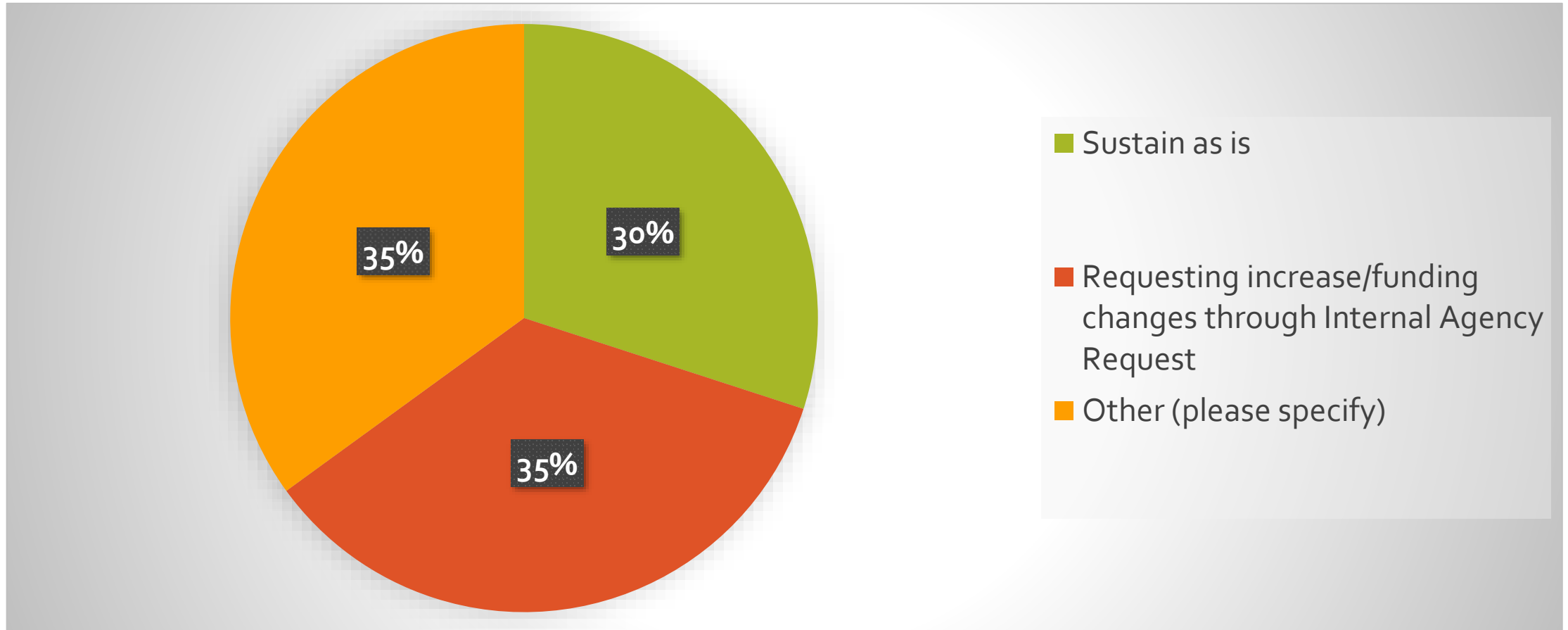
Level of Capital Funds Currently Invested

“Capital Funds: used for field implementation, infrastructure, software development, etc.”



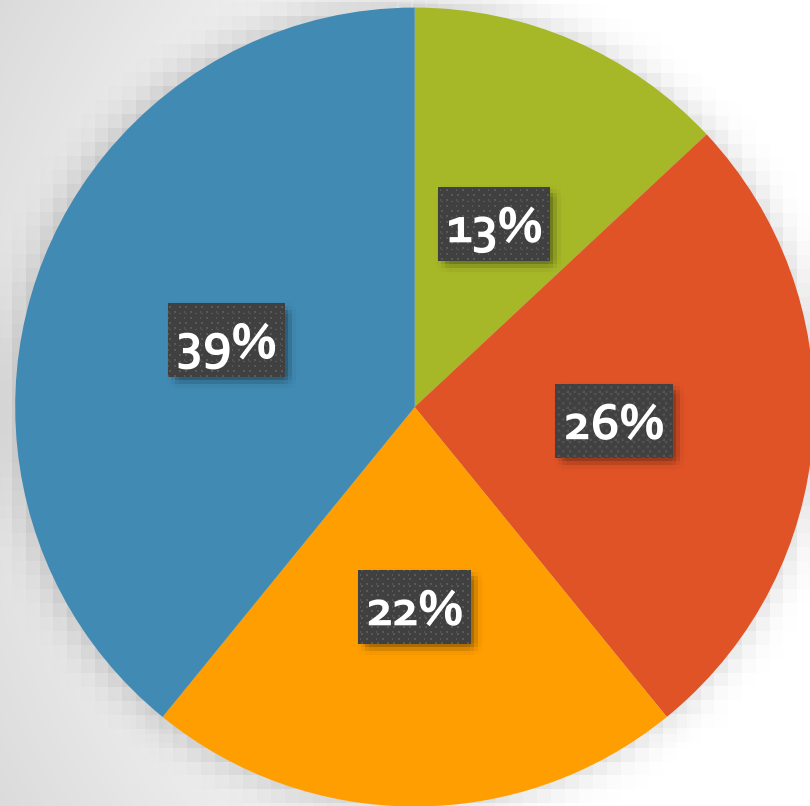
Sustained Funding

“What are your plans to sustain and/or increase either operating or capital funding?”



Innovative Financing

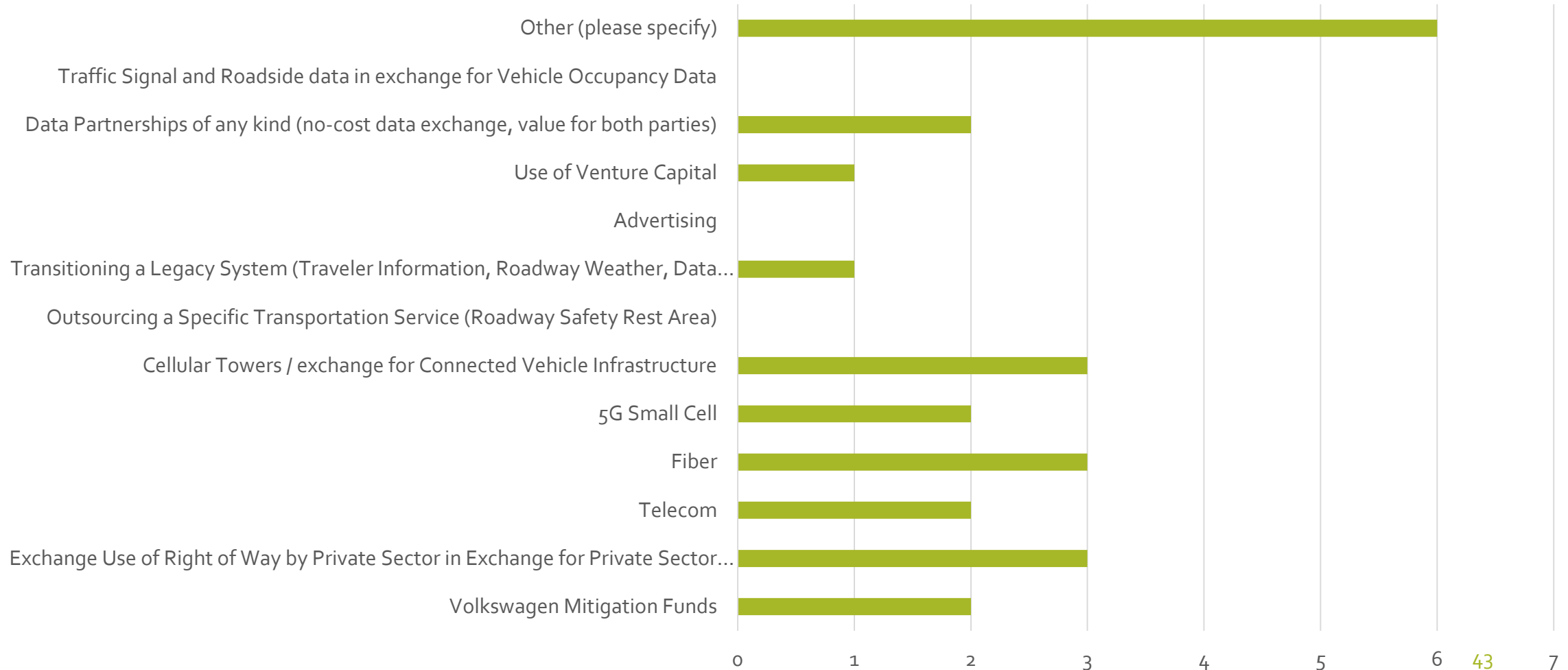
“Is your agency using “innovative financing” / “Public Private Partnership -P3” opportunities right now?”



- Yes, currently using
- No, and we have no plans
- Not currently using but actively planning to use in 2019/2020
- Other (please specify)

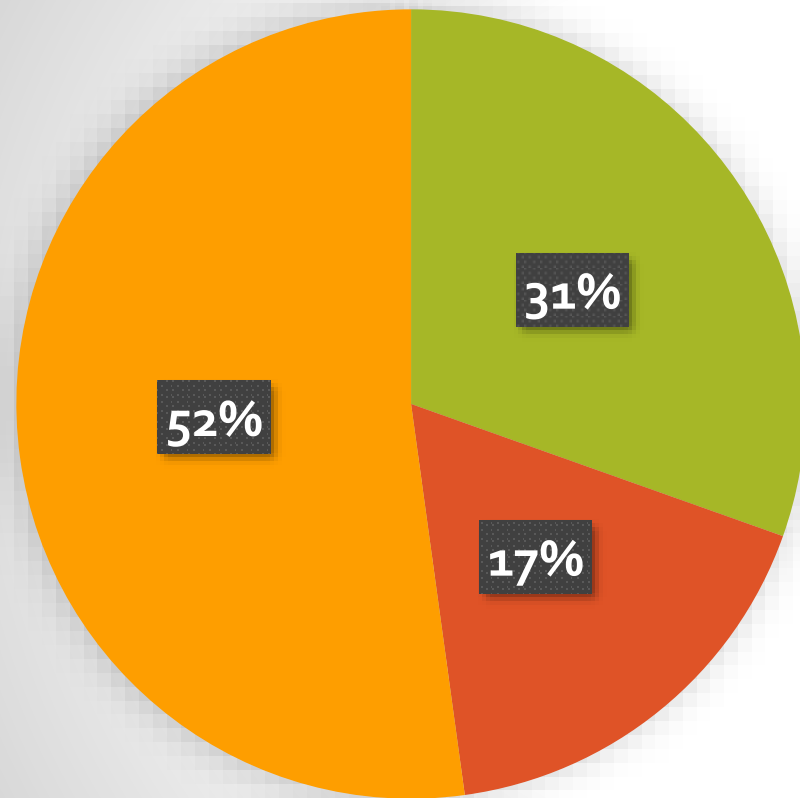
Current Use of Innovative Financing

“If your agency is currently using “innovative financing” / “Public Private Partnership -P3” opportunities right now, please check all those that apply:



Grant Application Barriers

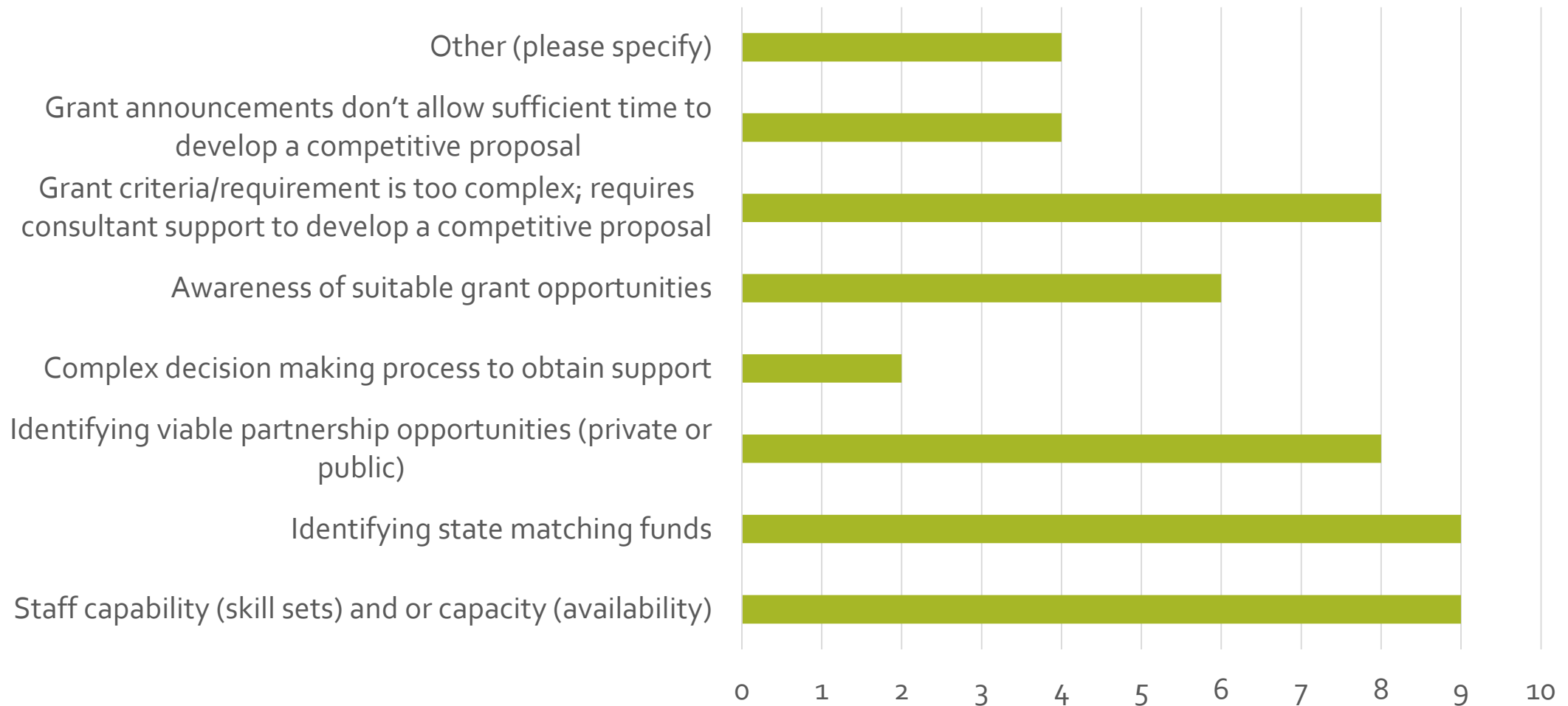
“ In relation to pursuing Federal (or other) Grant Opportunities, what are your top barriers/issues/challenges in being able to develop and submit a competitive proposal?”



- We have no barriers/challenges to date
- We have significant barriers or challenges
- We have some barriers or challenges, but we can manage around it

Grant Application Barriers:

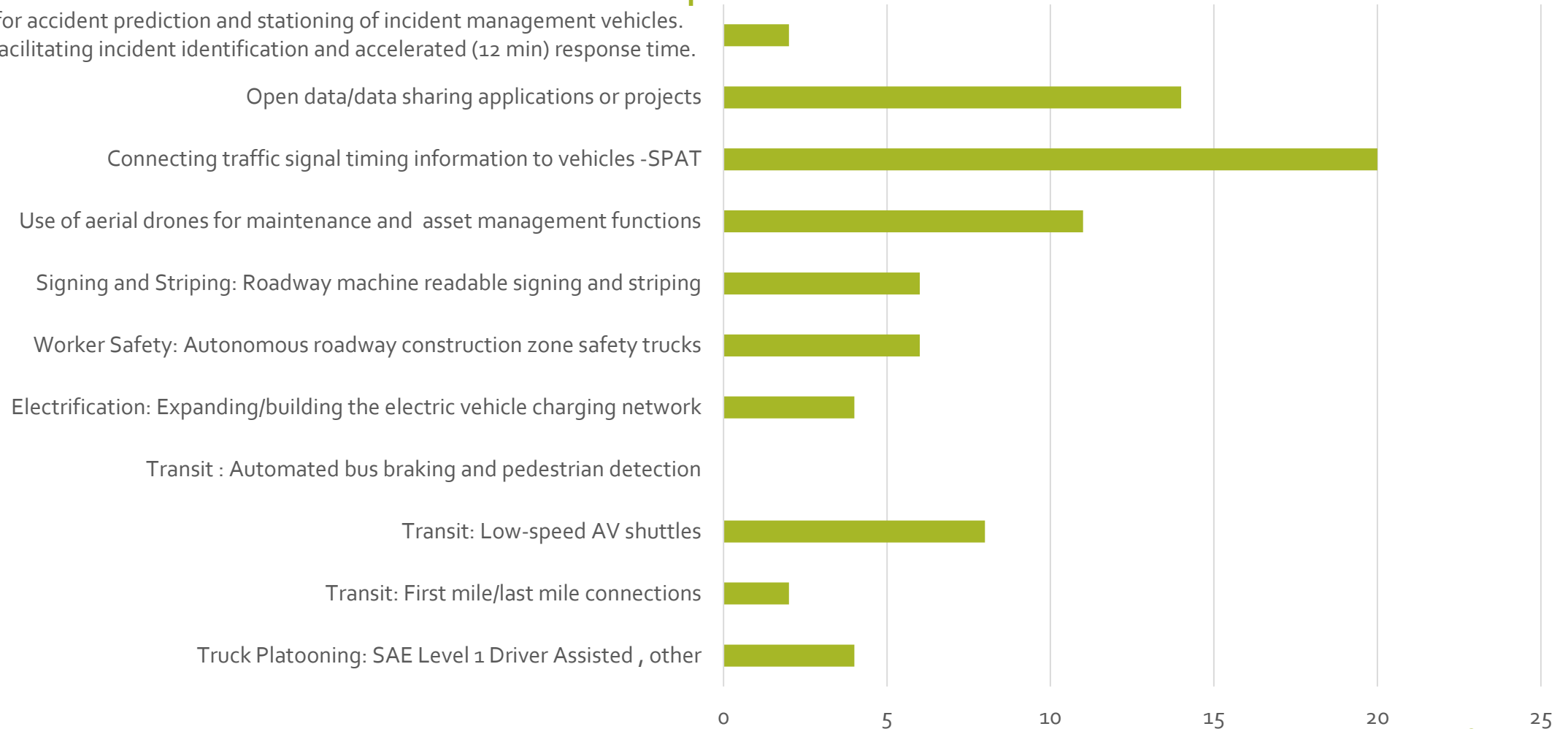
“Please list your top barriers, if any. Check all that apply”.



Current CAT/CAV Deployments (funded):

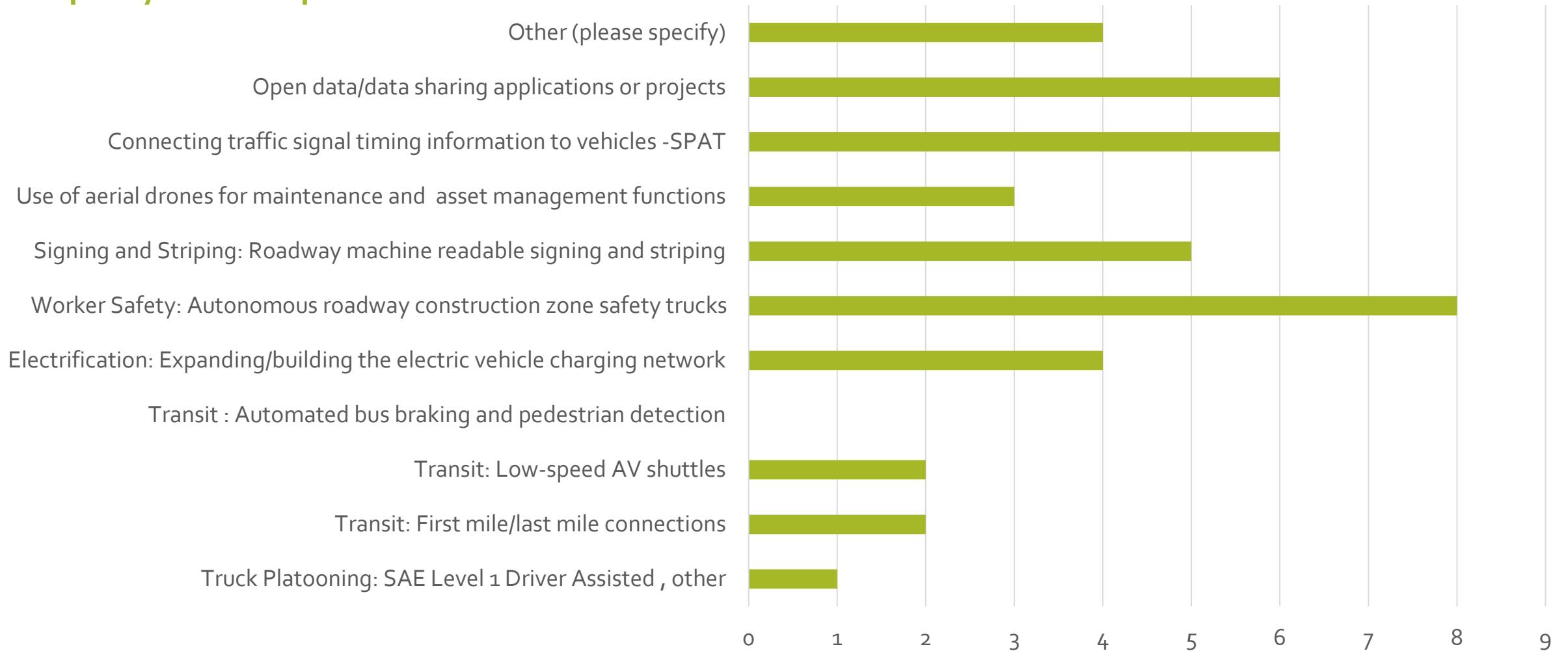
“What CAT/AV/CAV deployments are currently underway, have been implemented or are funded to be implemented near term?”

AI use for accident prediction and stationing of incident management vehicles.
Also AI facilitating incident identification and accelerated (12 min) response time.



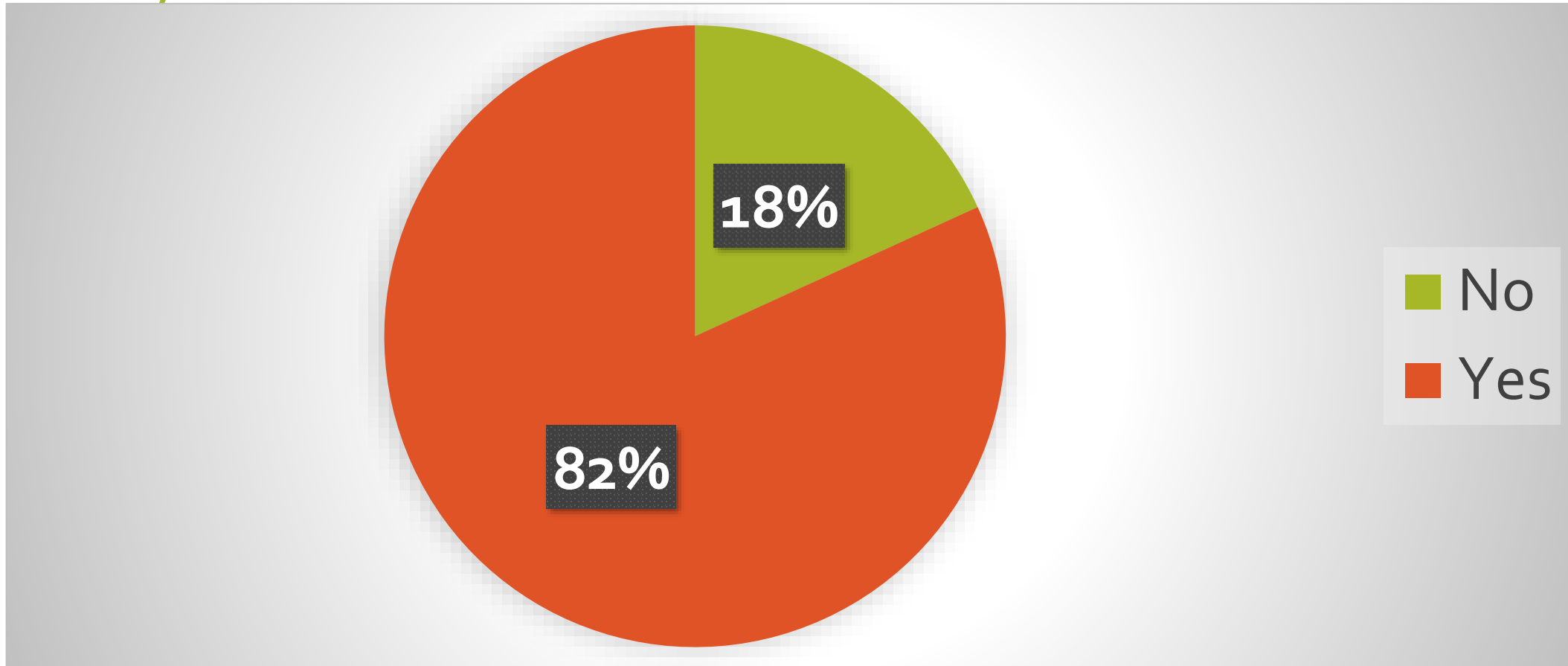
Future CAT/CAV Deployment priorities:

“What are your currently unfunded, near-term CAT/AV/CAV deployment priorities?”



Private/Public Partnerships:

“Are private or public (local, state) organizations partnering with you?”



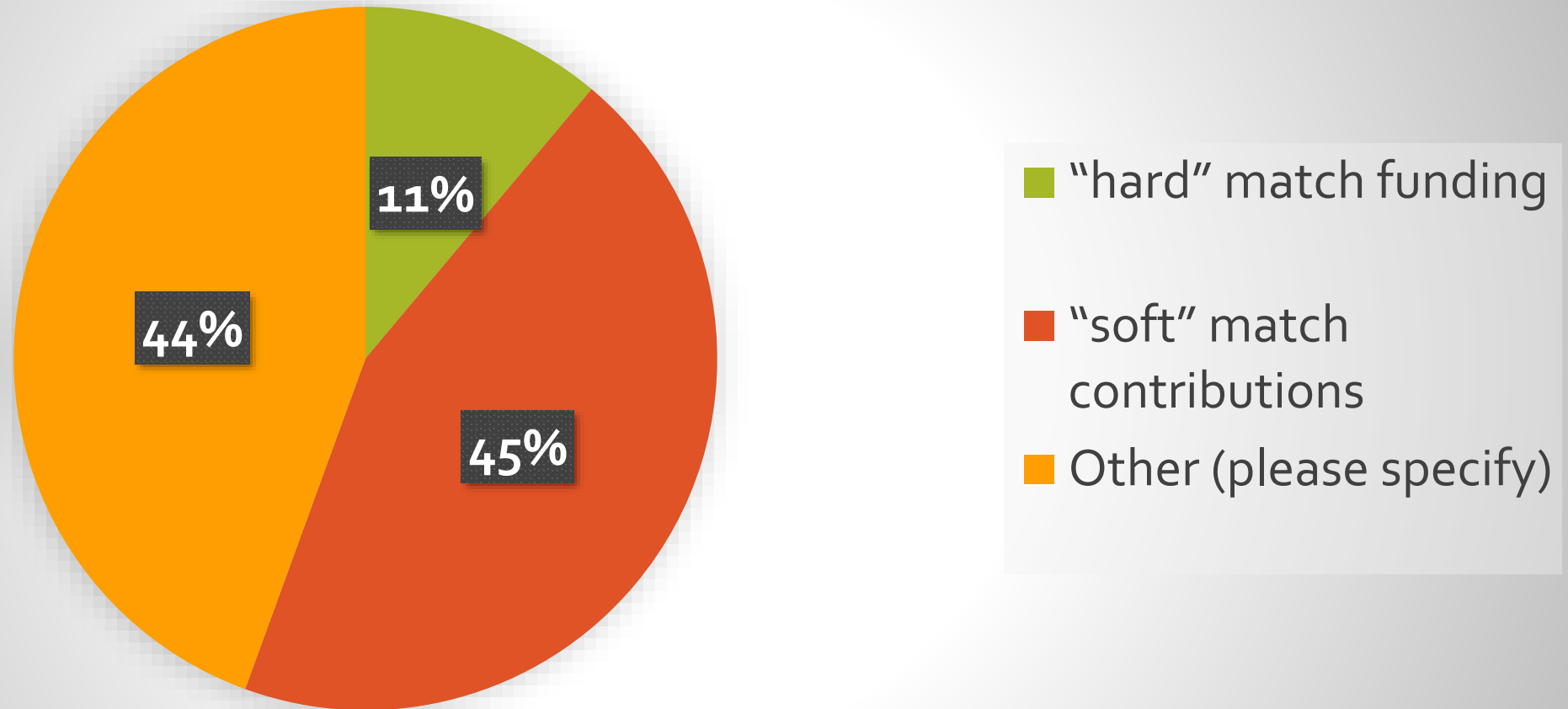
Types of Current Partnership Organizations:

“If other organizations are partnering with you, what type of organizations are these?”

- 1. Transit 2. Coalition of High-Tech companies
- 3M and VSI Labs (AV testing firm) several cities for AV testing, and several counties and cities for SPaT and rural CV corridor applications.
- academia industry local governments associations sister agencies
- academic, business, local government, multi-state organizations
- Data Providers, OEMs, Automotive Suppliers, etc.
- Department of Environmental Protection, Motor Vehicles, Efficiency Maine Trust, City of Portland, UMaine
- Industry, technology companies, universities
- Maricopa County DOT, The University of Arizona
- municipalities transit authority state agencies
- OEM, ITS, telecoms, universities, cities
- Private application developers
- Private companies and local governments, MPO's
- Private Consulting
- Private, Counties and MPOs
- RTC, Cities, Counties, Universities
- Transit agency, universities
- Transit, county government
- We frequently work with local jurisdictions and Daimler.

Types of Partnership Contributions:

“If other organizations are partnering with you, how are they partnering?”



Other Types of Contributions:

If other organizations are partnering with you, how are they partnering? (if “other”, please specify)

- allowing us to learn from their deployments, supporting better deployments in our partners (like how to deploy correctly)
- Both hard and soft matches
- Both of above
- Cost and equipment sharing
- engagement of staff and partnership in the research
- Policy collaboration
- soft match and in-kind services
- We provide data to them

Distribution: Sharing the Results

CAT Coalition website: *to come*

Other:

Questions?

Contact

- Daniela Bremmer, WSDOT, bremmed@wsdot.wa.gov
- Pat Zelinski, pzelinski@aashto.org

Impacts of AVs on Highway Infrastructure

Paul Carlson, Road Infrastructure Inc.



Impacts of Automated Vehicles (AVs) on Highway Infrastructure

Overview – CAT Coalition
July 31, 2019



Project Information

- **Funded by FHWA Office of Infrastructure R&D**
- **Information in this presentation is for discussion purposes only**
- **Final products from research are expected in late 2019**





Project Overview

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.



Session Agenda

- **AASHTO Maintenance Mtg, Grand Rapids, MI, July 17, 1 – 4 PM**
- **TRB AVS Mtg, Orlando, FL, July 18, 4 – 6 PM**

- **FHWA Introduction**
- **Project Overview**
- **Setting the Stage**
- **Discussion of Impacts on Infrastructure Categories**
 - Traffic Control Devices
 - TSMO and ITS
 - Multimodal infrastructure
 - Physical Infrastructure
- **Readiness Actions**
- **Wrap Up**

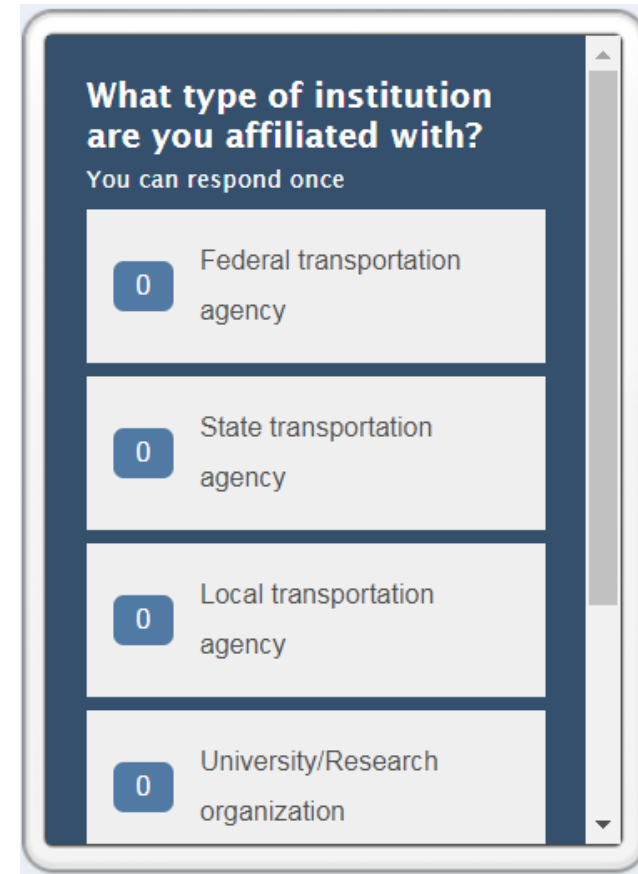


Session Purpose

- **Share what we have learned from AV Industry & AASHTO Maintenance**
 - Now – priorities for today
 - Future – thoughts about the near-term future (in the next 10 years)
 - Readiness – assessing infrastructure readiness
- **Gather feedback in four functional areas of infrastructure**
 - Traffic control devices
 - TSMO/ITS
 - Urban multimodal
 - Physical infrastructure (pavements, bridges, and culverts)
- **Obtain your feedback**
 - Support
 - Concerns
 - Contributions
 - Questions.

Poll Everywhere

- Using Poll Everywhere Tool throughout the session
- Submit responses on your mobile device at Pollev.com/deepakgopala832 or text DEEPAKGOPALA832 to 22333 once to join.



What type of institution are you affiliated with?
You can respond once

- Federal transportation agency
- State transportation agency
- Local transportation agency
- University/Research organization

AASHTO Committee on Maintenance -- Workshop

Current run (last updated Jul 18, 2019 10:47am)

14

Polls

117

Participants

60

Average responses



Average engagement

AVS Session

Current run (last updated Jul 19, 2019 11:11am)

16

Polls

50

Participants

25

Average responses



Average engagement

What type of industry best describes you?

	Count	Percentage
Road Industry: Agency	16	34%
Road Industry: Consultant/Contractor	8	17%
Road Industry: Supplier/Manufacturer	2	4%
Road Industry: Other	3	6%
Auto Industry: OEM	5	11%
Auto Industry: Supplier Manufacturer	1	2%
Auto Industry: Other	5	11%
None of the Above	7	15%

Setting the Stage

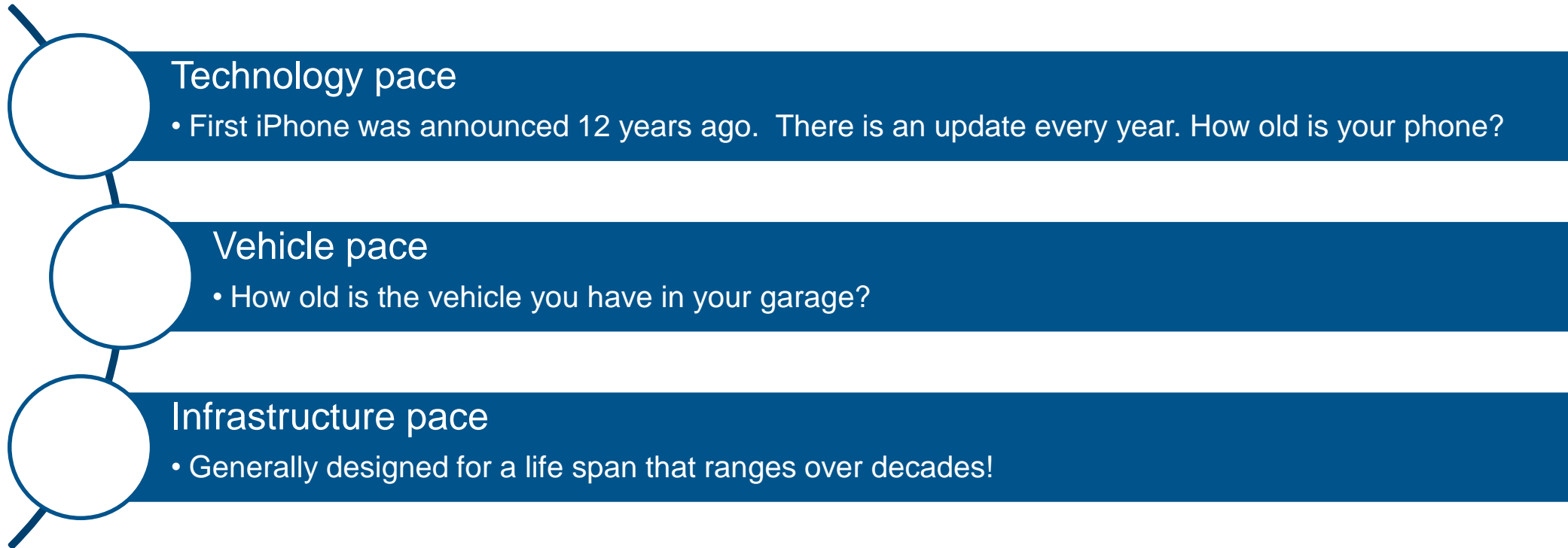


No Rush...Mixed-Fleet

- There are about 250,000,000 cars in the US
- By 2030, there will be close to 100,000,000 cars in the US with some automation (adaptive cruise control, lane departure warning, lane keep assistance, etc.)
- Level 2 cars are only recently available (Super Cruise in the Cadillac, AutoPilot in the Tesla, etc.)
- Audi has a Level 3 vehicle but not in the US
- Most car companies say they will have a Level 4 vehicle before 2030 (they don't say if it will be available for the consumer to purchase)
- The average age of a vehicle in the US is almost 12 years
- It will take decades for significant US fleet penetration

Pacing the Industries

- Can the highway infrastructure industry keep up with the pace of technology and vehicle automation?



Research Questions

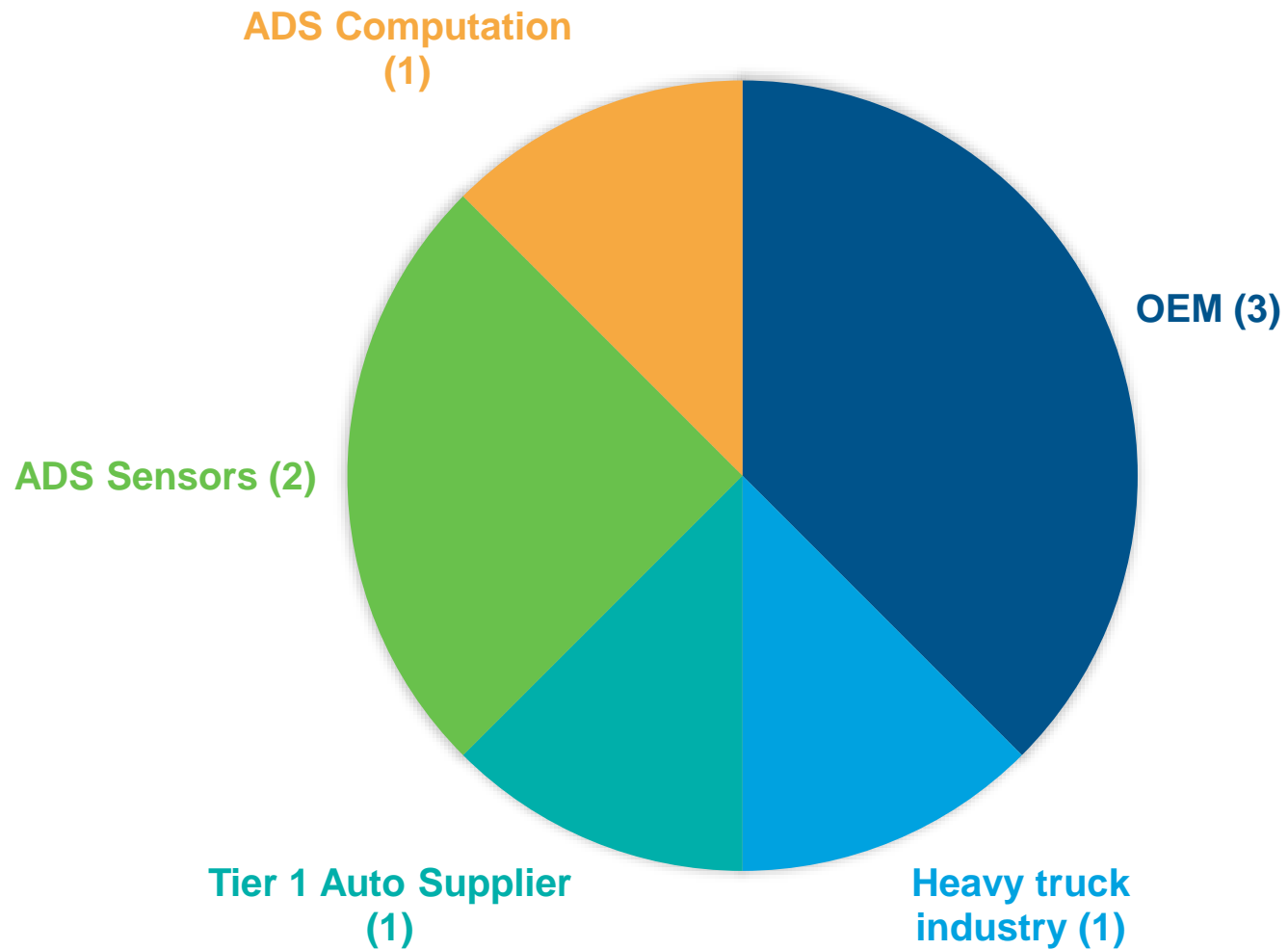


What are the problems today for AV testing, deployment, operations?



What are the risks and opportunities with widespread AV use in the future?

AV Industry Interviews



AV Industry Interviews: Key Observations

Implications of Sensor Evolution

- 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 regarding road markings and signage.

Digital Information Standards

- Digital information relayed to AVs should be standardized, secure, and specific to AV operational challenges (e.g., work zone related issues).

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.

Key Observations (cont.)

Operational Design Domains

- OEMs are responsible for defining their operational design domain (ODD) and assume ultimate responsibility for safe operation within the ODD regardless of IOO actions.

Connectivity Between Vehicle and Infrastructure

- CV applications such as V2I can alert AVs on 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 for IOOs to 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.

Discussion of Infrastructure Impacts



Infrastructure Categories and Definitions

Highway Infrastructure Categories

Physical Infrastructure

Pavements,
Bridges and Culverts

Traffic Control Devices

Pavement Markings,
Traffic Signs,
Traffic Signals,
Temporary Traffic Control,
Roadside Hardware

TSMO and ITS Infrastructure

ITS Roadside Equipment,
TSMO Strategies,
TSMO Systems

Urban Multimodal Infrastructure

Bicycle, Pedestrian,
and Transit Infrastructure,
Curb Space

Category 1: Traffic Control Devices (TCDs)

- Pavement Markings
- Traffic Signs
- Traffic Signals
- Temporary Traffic Control
- Roadside Hardware

Do you agree or disagree that IOOs should prioritize changes to pavement marking practices to support AV deployment?

Strongly Agree

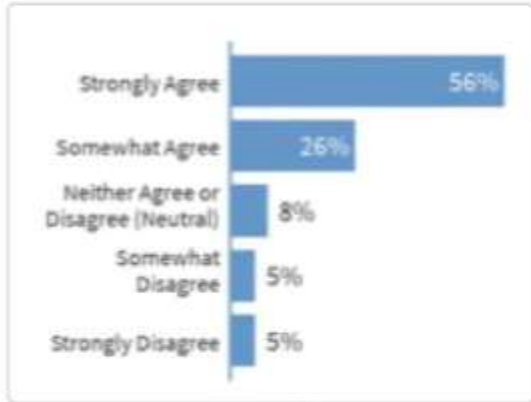
Somewhat Agree

Neither Agree or Disagree (Neutral)

Somewhat Disagree

Strongly Disagree

Do you agree or disagree that IOOs should prioritize changes to pavement marking practices to support AV deployment?



Response options

Strongly Agree

Somewhat Agree

Neither Agree or Disagree (Neutral)

Somewhat Disagree

Strongly Disagree

Count

22

10

3

2

2

Percentage

56%

26%

8%

5%

5%

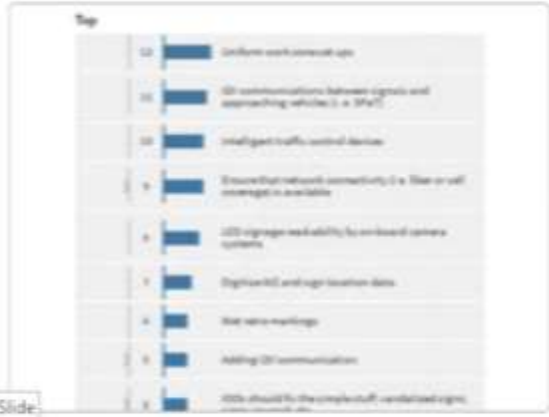


Engagement

39

Responses

What other near-term changes to the TCD infrastructure would best support AV deployment?



Responses

Uniform work zone set ups

I2V communications between signals and approaching vehicles (i. e. SPaT)

Intelligent traffic control devices

Ensure that network connectivity (i.e. fiber or cell coverage) is available

LED signage read-ability by on-board camera systems

Digitize WZ and sign location data

Upvotes

12

11

10

10

9

7

Downvotes

0

0

0

1

0

0



Engagement

36

Responses



Source: USDOT

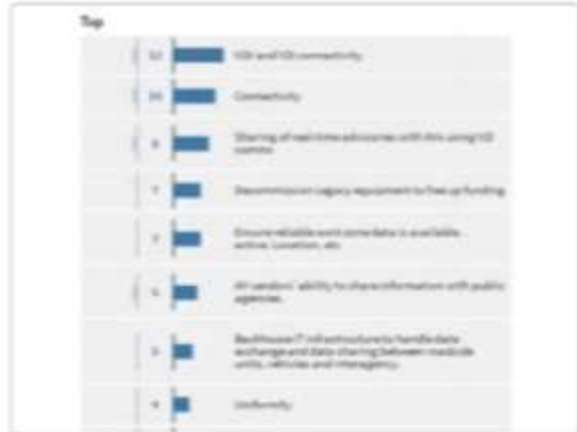
- ITS Roadside Equipment
- TSMO Strategies
- TSMO Systems

Category 2: TSMO and ITS



Source: FHWA

What near-term changes to TSMO/ITS infrastructure would best support AV deployment?



Responses

V2V and V2I connectivity

Connectivity

Sharing of real-time advisories with AVs using V2I comms

Ensure reliable work zone data is available... active. Location, etc

Decommission Legacy equipment to free up funding

AV vendors' ability to share information with public agencies.

Backhouse IT infrastructure to handle data exchange and data sharing between roadside units, vehicles and interagency.

Creation of Manual of Uniform Digital TCDs

Upvotes

Downvotes

13

1

11

1

9

1

7

0

7

0

6

1

5

0

4

0



Engagement

28

Responses



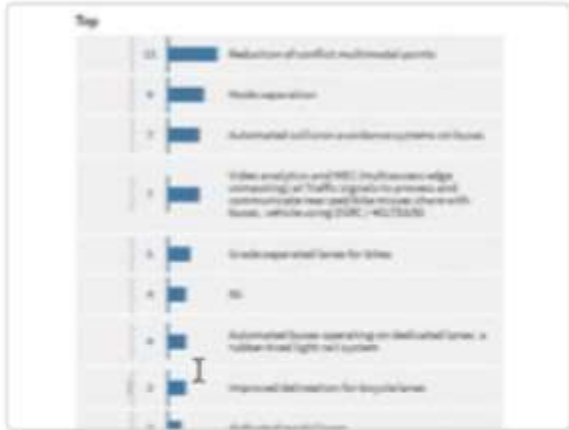
- Bicycle, Pedestrian, and Transit Infrastructure
- Curb Space

Category 3: Urban Multimodal Infrastructure



Source: : [www.pedbikeimages.org/Ann McCrane](http://www.pedbikeimages.org/Ann_McCrane)

What near-term changes to urban multimodal infrastructure would best support AV deployment?



Responses

Reduction of conflict multimodal points

Upvotes

11

Downvotes

0

Mode separation

8

0

Video analytics and MEC (multiaccess edge computing) at Traffic signals to process and communicate near ped/bike misses share with buses, vehicle using DSRC / 4GLTE&5G

7

0

Automated collision avoidance systems on buses

7

0

Grade separated lanes for bikes

5

0

Automated buses operating on dedicated lanes: a rubber-tired light rail system

4

0

5G

4

0

Uniformity of curbs and crosswalks

3

0

Enhanced pedestrian crossing sections

3

0



Engagement

32

Responses

Given the constraints and uncertainties regarding AV interactions with infrastructure, what existing practices for pavements, bridges, and culverts do you think should be prioritized?



Responses	Upvotes	Downvotes
Winter maintenance	21	0
pavement markings	16	0
Additional funding	14	0
Pavement marking maintenance will need to be a priority.	5	0
Pavement condition	5	0
pothole patching	6	1
Use of real time gps data to reduce need for markings, signs, weather, etc	4	0
funding of infrastructure maintenance given current dependency on gas taxes	3	0
Pot holes	3	0
Asset management	3	0
pavement marking b/c without adequate marking, the functionality will not operate	3	0



Engagement

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Responses

Readiness



How ready are IOOs to support AV deployment?



Response options

Very Ready

Somewhat Ready

Neither Ready of Unready

Somewhat Unready

Very Unready

Count

Percentage

2

6%

5

16%

3

10%

11

35%

10

32%

Please indicate why you believe IOOs are ready or unready to support AV deployment.



Responses

Insufficient resources and agencies lack the organizational structure and culture for innovation.

Upvotes

5

Downvotes

0

More advanced IOOs tend to have a champion at the senior management level

5

0

Not ready because of Funding and lack of standards

5

0

Deployment can go now without mods to infrastructure. AV tech developers can and will adapt to serve their market and grow their business.

3

0

Legacy culture

3

0

We don't know what we don't know.

2

0

AASHTO MaC Response to Readiness

▪ How ready is your agency?

▪ Very ready	0	0%
▪ Somewhat ready	8	15%
▪ Neutral	13	24%
▪ Unready	10	18%
▪ Very Unready	23	43%

▪ Common comments

- Lack of resources / funding
- Needs not well defined
- Striping inadequate
- Lack of an understanding

7/18/2019

AASHTO Committee on Maintenance – Workshop

Please indicate why you feel your agency is ready or unready to address AV impacts to highway infrastructure.



Responses

- Striping
- Lack of understanding
- Autos will go airborne
- beginning to train staff.
- Technology keep changing
- Revenue increase
- Early stages of preparation.
- Pavement markings are not ready.
- current revenue source based on mostly gas tax, which will likely decline with AV adoption.
- Our current pavement conditions are driving the funding priorities toward resurfacing and capacity projects. The ability to dedicate funding to this is not there yet.
- Speed of technology changing
- No proven confidence in AV
- Slowly preparing with signs and stripping.
- Pavement condition
- Too much weather
- Striping
- Need to know where to even begin



Engagement

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Responses

Next Steps

- Review Literature **(completed)**
- Engage Stakeholders **(on-going)**
- Conduct AV Industry Interviews **(completed)**
- Develop Draft Findings **(completed)**
- Obtain Feedback **(on-going)**
 - Present, vet, discuss (workshops)
 - AASHTO Maintenance Conference, Grand Rapids, MI
 - TRB Automated Vehicle Symposium, Orlando, FL
- Refine Findings **(next step)**
- Develop Techbrief **(future task)**
- Conduct Webinars **(future task, by EOY)**

Action Items & Next Steps

Future Meetings for Infrastructure-Industry WG

- September 12, 3:00-4:30 (Eastern)
- December 18, 3:00-4:30 (Eastern)