

# Intelligent Transportation Systems Deployment: Findings from the 2019 Connected Vehicle and Automated Vehicle Survey

## Final Report

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<b>16. Abstract</b> This Report presents summary findings from the 2019 ITS JPO Connected Vehicle (CV) and Automated Vehicle (AV) Survey. The survey was administered online to freeway, arterial and transit agencies from 78 large metropolitan areas and 30 medium size cities (the same survey population as previous Deployment Tracking Surveys). Online data collection ran from October 7 <sup>th</sup> to December 31 <sup>st</sup> 2019, and the final response rate was 60 percent, including 66 freeway, 301 arterial, and 108 transit agencies. The survey addressed a range of topics, including deployment levels for CV and AV, the types of CV applications and AV tests being deployed/tested, communication technologies being used to support CV, CV and AV readiness, challenges faced in deploying CV and AV, and resources needed to support CV and AV deployment, among other topics. The Report describes the methodology and presents key findings. The Appendices include additional tables, open-end responses to the questions, and the survey instrument.					
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## Acronyms

<b>ADS</b>	Automated Driving Systems
<b>ARC-IT</b>	Architecture Reference for Cooperative and Intelligent Transportation
<b>AV</b>	Automated Vehicle
<b>BRT</b>	Bus Rapid Transit
<b>ConOps</b>	Concepts of Operation
<b>CV</b>	Connected Vehicle
<b>CVRIA</b>	Connected Vehicle Reference Implementation Architecture
<b>D-RIDE</b>	Dynamic Rideshare
<b>DSRC</b>	Dedicated Short-Range Communication
<b>DTS</b>	Deployment Tracking Survey
<b>IDTO</b>	Integrated Dynamic Transit Operations
<b>I-SIG</b>	Intelligent Traffic Signal System
<b>ITS</b>	Intelligent Transportation Systems
<b>JPO</b>	Joint Program Office
<b>MOU</b>	Memorandums of Understanding
<b>MPO</b>	Metropolitan Planning Organization
<b>OEM</b>	Original Equipment Manufacturers
<b>RAD-IT</b>	Regional Architecture Development for Intelligent Transportation
<b>SET-IT</b>	Systems Engineering Tool for Intelligent Transportation
<b>SME</b>	Subject matter experts
<b>SPaT</b>	Signal Phase and Timing
<b>T-CONNECT</b>	Transfer Connection Protection
<b>T-DISP</b>	Dynamic Dispatch
<b>TNC</b>	Transportation Network Company
<b>USDOT</b>	US Department of Transportation



# Executive Summary

## Introduction

The mission of the US Department of Transportation (USDOT) Intelligent Transportation System's Joint Program Office (ITS JPO) is to lead collaborative and innovative research, development, and implementation of ITS to improve the safety and mobility of people and goods. The ITS JPO supports deployment and technology transfer activities for a broad range of ITS, including Connected Vehicle (CV) and Automated Vehicle (AV) technologies. The ITS JPO has supported the advancement of connected vehicle technologies through its CV Pilot Demonstration Program, as CV applications offer the potential to increase safety, improve personal mobility, enhance economic productivity, reduce environmental impacts and transform public agency operations. Likewise, the ITS JPO's automation research program is a significant component of the USDOT's vision of supporting the safe, reliable, efficient, and cost effective integration of automation into the transportation system.

This report summarizes findings from the 2019 CV/AV Survey, administered by the Volpe National Transportation Systems Center in support of the ITS JPO. The survey was conducted to provide baseline data on the current state of connected vehicle and automated vehicle deployment, with the intention that future surveys will continue to monitor progress in the adoption of these technologies. The survey was also designed to address the following key questions:

- What are agencies' levels of readiness with respect to CV and AV?
- What are the key challenges and barriers to CV and AV deployment?
- What assistance/resources are needed to overcome challenges and barriers?

The findings provide the ITS JPO with a baseline understanding of CV and AV deployment and will be used to respond strategically to ITS deployment gaps and execute technical transfer activities that help states and local agencies plan and execute ITS deployments.

## Methodology

The 2019 Connected Vehicle and Automated Vehicle Survey (CV/AV Survey) was administered online to freeway, arterial and transit agencies from 78 large metropolitan areas and 30 medium size cities. This survey population is the same one used in previous Deployment Tracking Surveys. The research team utilized agency contact lists from the most recent DTS conducted in 2016. Prior to data collection, agencies were contacted by email and phone to notify them of the upcoming survey, and to verify that the contact provided was the appropriate respondent for the CV/AV Survey. Replacement contacts were obtained as needed.

The research team designed the CV/AV Survey questionnaire, with significant input from ITS JPO staff and CV and AV subject matter experts (SME). The updated survey includes a question on connected vehicle deployment, so it is possible to compare findings to the 2016 survey, but the connected vehicle

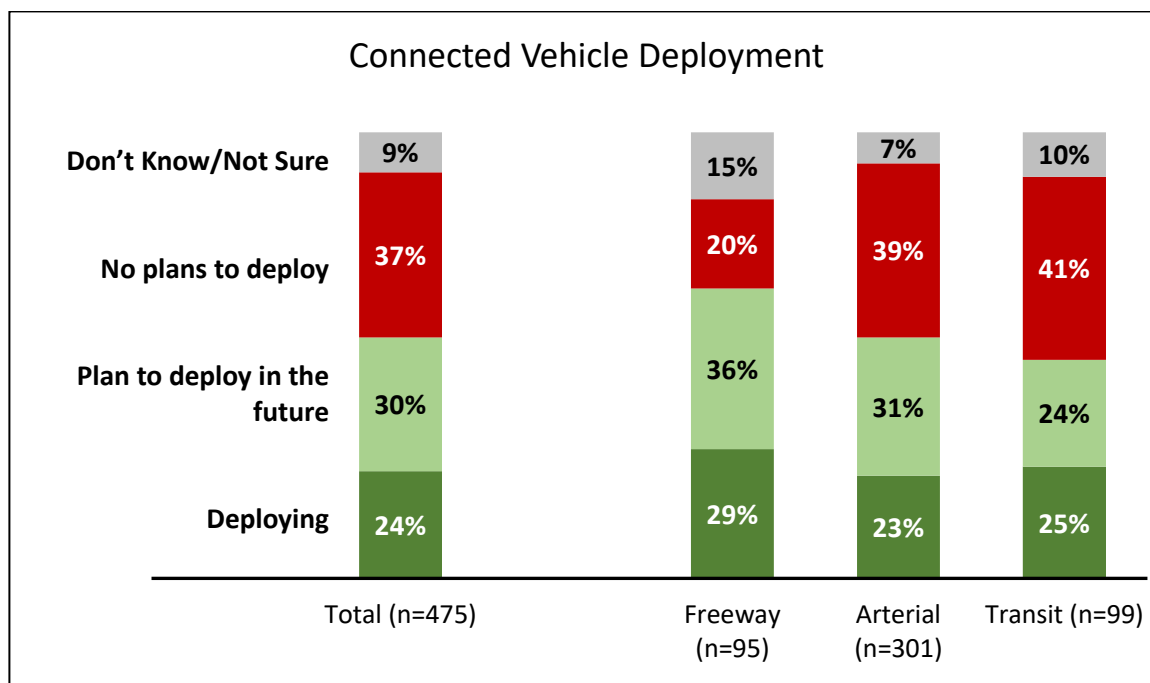
content has been updated and expanded to reflect advancement in this area. Questions related to automated vehicles were added for the first time in the 2019 survey.

The survey was sent to an outgoing sample of 123 freeway, 460 arterial, and 210 transit agencies. Online data collection ran from October 7<sup>th</sup> to December 31<sup>st</sup> 2019. Contacts received several reminders by email and phone to encourage participation. The final response rate was 60 percent, including 66 freeway, 301 arterial, and 108 transit agencies.

## Findings

### General CV Deployment

In 2019, more than half of surveyed agencies (54 percent) indicated they are actively engaged with connected vehicles (CV), with one-quarter reporting they have deployed CV and another 30 percent saying they plan to deploy CV in the future. Among the agency types, freeway agencies currently lead in CV activities, with 65 percent deploying or planning to deploy, compared to around half of arterial and transit agencies. Close to 40 percent of arterial and transit agencies indicated they have no plans to deploy CV, compared to only 20 percent of freeway agencies.



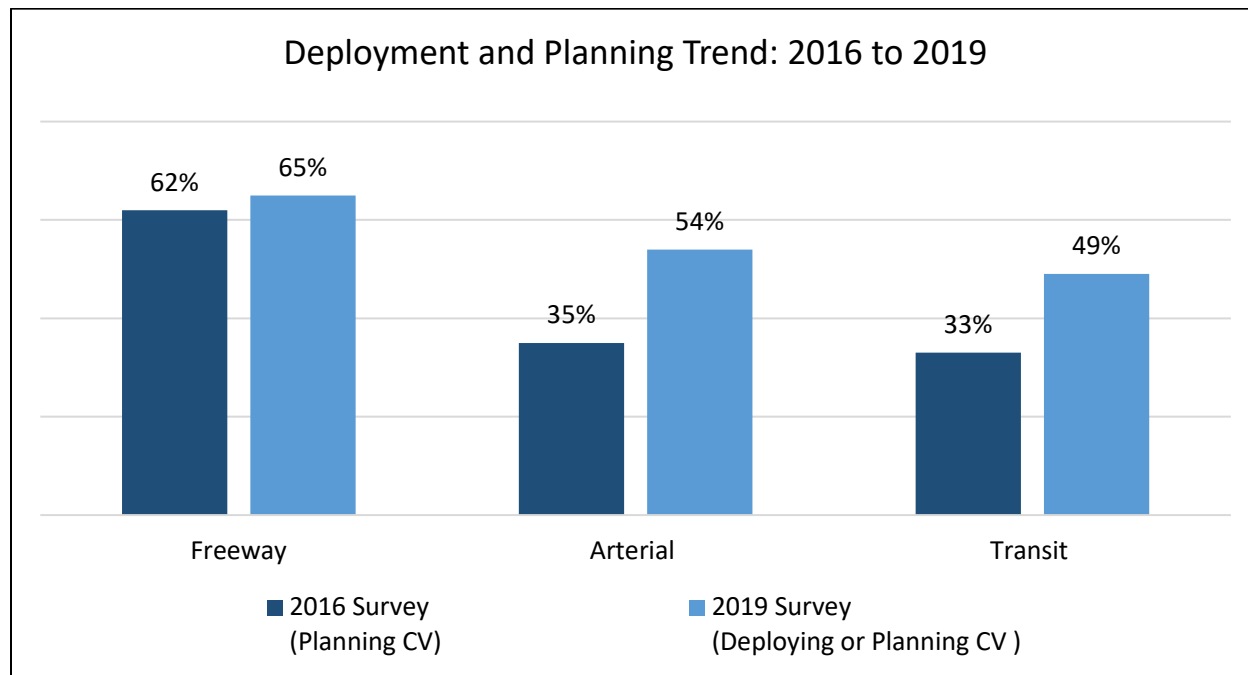
Source: USDOT

Q: Is your agency currently deploying connected vehicle (CV) technology? Base: All Agencies

**Figure 1: Connected Vehicle Deployment**

Arterial and transit agencies made significant progress in the three years since CV activity was first measured, while freeway activity remained steady. The share of arterial agencies planning or deploying CV increased almost 20 percentage points between 2016 and 2019 (35 percent to 54 percent). Transit

agencies saw a similar increase, moving from 33 percent to 49 percent.<sup>1</sup> This progress may have been influenced by advancements in the development and marketing of CV technologies, as well as by USDOT and ITS JPO interventions supporting the deployment of CV technologies (e.g. Connected Vehicle Deployment Program, Advanced Transportation and Congestion Management Technologies Deployment Program, Signal Phase and Timing (SPaT) challenges).



Source: USDOT

Q 2019: Is your agency currently deploying CV technology? Base: Freeway (n=66), Arterial (n=301), Transit (n=108)

Q 2016: Is your agency currently planning CV technology? Base: Freeway (n=99), Arterial (n=274), Transit (n=99)

**Figure 2. Connected Vehicle Deployment/Planning Trend**

<sup>1</sup> Comparisons of 2016 and 2019 should be considered directional only, 2016 asked solely about CV planning while the 2019 offered both deployment and planning as a choice. It is assumed that if CV deployment occurred by 2016, agencies responded that they were planning to deploy CV.

## CV Applications

Active agencies, those that are deploying or planning to deploy CV, were asked a series of questions regarding current and planned deployment of CV applications. Across agency types, signal-based applications are among the most deployed/planned, including *Emergency Vehicle Preemption*, *Transit Signal Priority*, and *Intelligent Traffic Signal Systems*. *Agency Data Applications*, which collect, transmit, analyze, or report transportation data, are also among the top four applications deployed/planned by a majority of surveyed agencies. It should be noted that deployment levels differ by agency type. In particular, among transit agencies, the only application being deployed/planned by a majority is *Transit Signal Priority*; significantly fewer transit agencies report deploying or planning to deploy other CV applications.

**Table 1. Summary Table of Common CV Applications by Agency Type**

CV Application	Total	Freeway	Arterial	Transit
<i>Number of Agencies Responding (Base: Active Agencies)</i>	258	43	162	53
Emergency Vehicle Preemption	61%	51%	75%	26%
Transit Signal Priority	61%	42%	64%	68%
Intelligent Traffic Signal Systems (I-SIG)	53%	44%	62%	34%
Agency Data Applications	50%	58%	52%	38%

Source: USDOT

In addition to the technologies mentioned previously, each agency type has indicated deploying or planning to deploy a unique set of CV technologies to help meet specific transportation objectives.

- Freeway agencies are deploying or planning to deploy mobility applications such as *Queue Warning* (53 percent) and safety applications such as *Reduced Speed/Work Zone Warning* (53 percent), *Curve Speed Warning* (49 percent), and *Road Weather Warnings* (49 percent).
- For arterial agencies, other CV applications being deployed or planned including three additional signal based applications, *Eco-Approach and Departure at Signalized Intersections* (39 percent), *Pedestrian in Signalized Crosswalk Warning* (39 percent), *Red Light Violation Warning* (34 percent), and one safety application, *Reduced Speed/Work Zone Warning* (33 percent).
- Among transit agencies, the other applications being deployed or planned include *Integrated Dynamic Transit Operations* (42 percent), *Forward Collision Warning* (38 percent), *Vehicle Turning Right in Front of Bus Warning* (34 percent), and *Pedestrian in Signalized Crosswalk Warning* (34 percent).



## CV Readiness

The survey included a series of questions related to CV readiness activities. To understand the early steps agencies take to prepare for CV, readiness activities undertaken by agencies planning to deploy CV were compared to those undertaken by agencies not planning to deploy CV. Two readiness activities - *Building or Upgrading Communications Networks* and *Upgrading Physical Infrastructure* - showed the biggest differences between the groups (see

Table 2), suggesting that these are among the first steps agencies take when moving towards CV deployment.

**Table 2. CV Readiness: Initial Steps in Planning for CV**

Readiness Activities (Underway or Complete)	Total	Agencies Planning to Deploy CV	Agencies Not Planning to Deploy CV
<i>Number of Respondents*</i>	475	142	217
Building or Upgrading Communications Networks	48%	61%	26%
Upgrading Physical Infrastructure	32%	44%	7%

Source: USDOT

Q. The US Department of Transportation is trying to understand agencies' readiness to deploy AV technology. For each of the following activities, please indicate your agency's current status.

A similar analysis was conducted to identify later stage readiness activities. In this analysis, readiness activities undertaken by agencies currently deploying CV were compared to those undertaken by agencies planning to deploy CV. Six activities showing the biggest differences are linked to moving from planning CV to deploying CV. These readiness activities include: *Applying for a Federal Grant to Fund CV Deployment*, *Procuring Contractor Support for CV*, *Including CV in Agency Planning Documents*, *Instituting Memorandums of Understanding (MOUs) with Potential CV Partners*, *Developing Concepts of Operation (ConOps)*, and *Applying for DSRC Licenses* (see Table 3).

**Table 3. CV Readiness: Later Steps in Planning for CV**

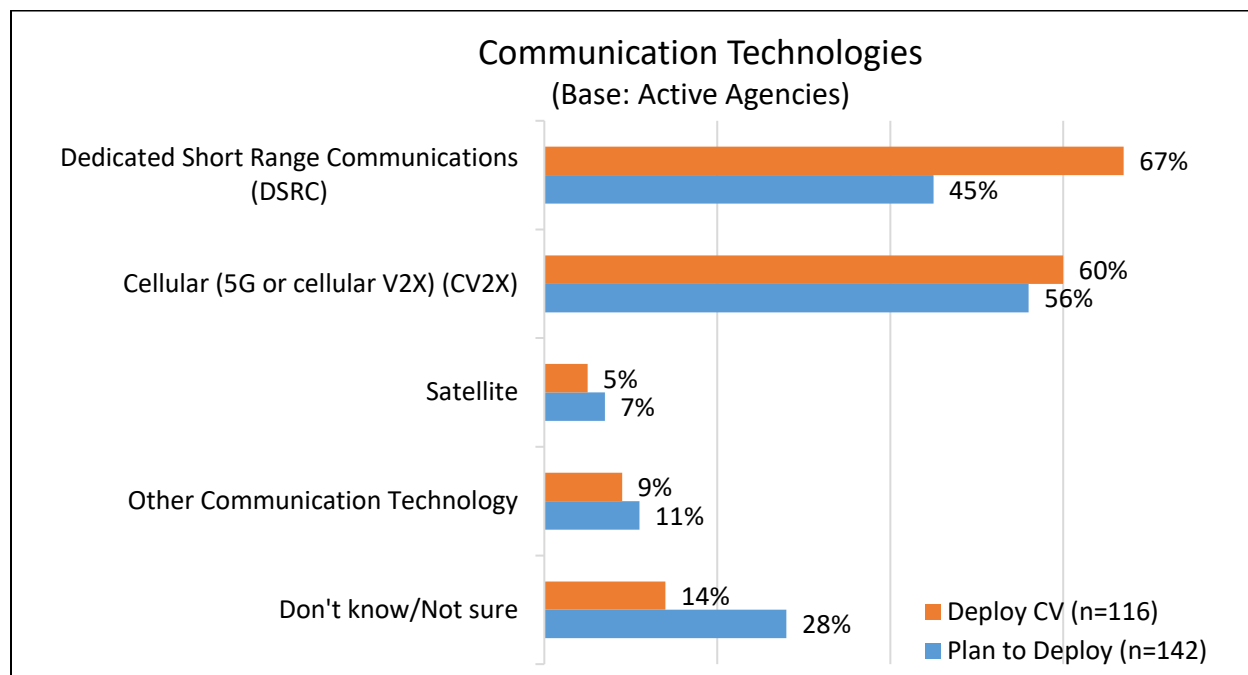
<b>Readiness Activities (Underway or Complete)</b>	<b>Total</b>	<b>Agencies Deploying CV</b>	<b>Agencies Planning to Deploy CV</b>
<i>Number of Respondents</i>	<i>475</i>	<i>116</i>	<i>142</i>
Applied for a Federal Grant to Fund CV Deployment	16%	44%	15%
Procured Contractor Support for CV Technologies	12%	41%	6%
Included CV Technologies and/or Applications in Agency Planning Documents	12%	41%	18%
Instituted MOUs with Potential Partners Regarding Roles and Responsibilities for CV projects	12%	37%	8%
Developed Concepts of Operation (ConOps) or Initial Systems Engineering Documents	11%	34%	10%
Applied for an FCC License to use 5.9 Ghz Frequency Spectrum (Dedicated Short-Range Communications)	11%	32%	6%

Source: USDOT

*Q. The US Department of Transportation is trying to understand agencies' readiness to deploy AV technology. For each of the following activities, please indicate your agency's current status*

## Uncertainty Related to CV Communications Technologies

Uncertainty around spectrum allocation may be causing reluctance in committing to DSRC. Two-thirds of agencies currently deploying CV indicate DSRC use, and a similar number (60 percent) report use of cellular technologies to support CV applications. In comparison, less than half of those planning to deploy CV indicate DSRC (45 percent), with more selecting cellular technologies (56 percent), and 28 percent indicating they are not sure what technologies they will employ (see Figure 3).



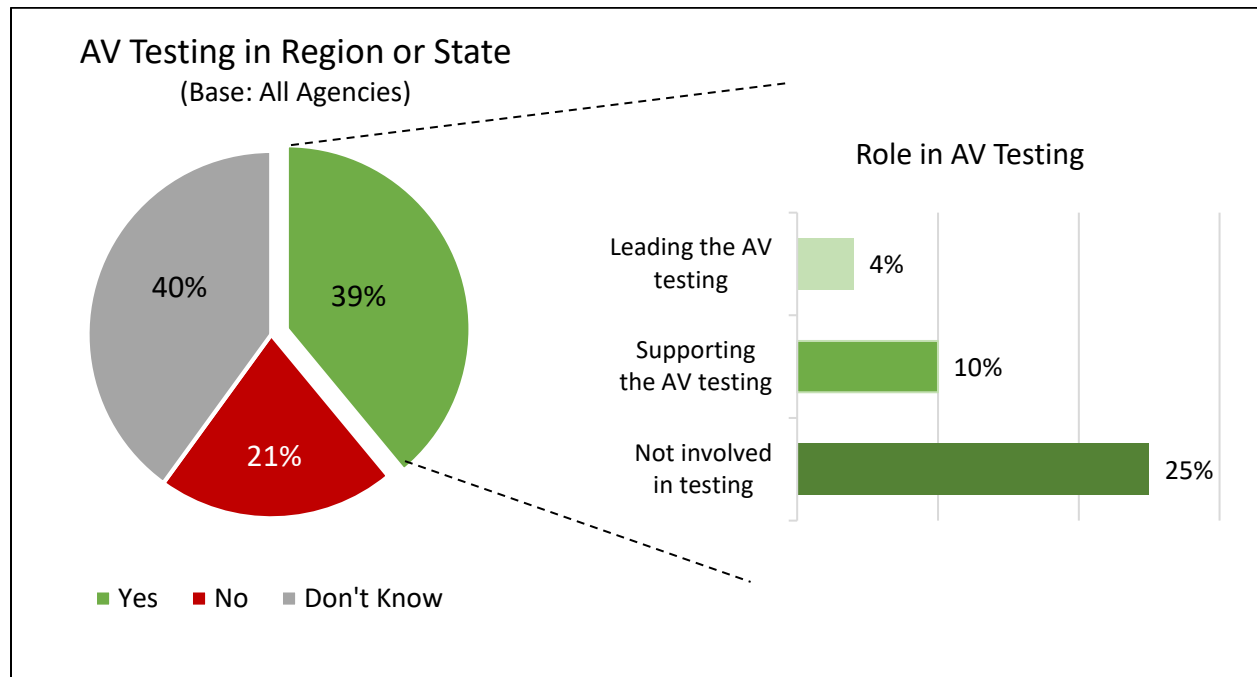
Source: USDOT

Q: What types of communication technologies does your agency currently use (or plan to use in the future) to support connected vehicle applications (vehicle-to-vehicle or vehicle-to-infrastructure)?

**Figure 3. Communication Technologies Deployed vs. Plan to Deploy**

## AV Deployment Status

Among all the surveyed agencies, over one-third (39 percent) report automated vehicle testing or deployment occurring in their region or state. However, only 14 percent report active involvement in the testing; 10 percent support the AV testing, and 4 percent lead the AV testing. The remaining 25 percent of agencies are not involved in the AV testing.



Source: USDOT

Q: Are there any automated vehicle tests or deployments that are being conducted or have been conducted in your region/state? (Please select one)

Q: What is your agency's primary role in the automated vehicle testing or deployment?

**Figure 4. AV Testing in Region or State**

Freeway agencies are the most aware of AV testing or deployment. A total of 58 percent of freeway agencies report AV testing or deployment in their region or state, compared to 39 percent of arterial agencies and 28 percent of transit agencies.

## Types of AV Testing

*Automated Fixed Route Shuttle* testing/deployment (37 percent) is among the most reported for agencies aware of AV testing/deployment in their region or state. Of the small number of transit agencies aware of AV testing/deployment, a majority report *Automated Fixed Route Shuttle* (50 percent), which is also the most commonly reported type of testing/deployment among arterial agencies (37 percent). Transit agencies also report testing/deployment of *Automated Flexible Mobility-on-Demand Shuttle Service* (27 percent).

A slightly greater share of freeway agencies aware of AV testing/deployment in their region or state, report *Truck Platooning* (34 percent), compared to 29 percent reporting *Automated Fixed Route Shuttle* testing/deployment (29 percent). *Truck Platooning* testing/deployment is also reported to some degree by arterial agencies (18 percent). *Automated Light-duty Passenger Vehicle* testing/deployment is reported evenly across all agencies types: freeway (16 percent), arterial (17 percent), and transit agencies (17 percent).

**Table 4. Summary of Common AV Testing/Deployments by Agency Type**

AV Testing	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i> (Base: Agencies reporting AV testing in region/state)	185	38	117	30
Automated Fixed Route Shuttle	37%	29%	37%	50%
Truck Platooning	20%	34%	18%	10%
Automated Light Duty Passenger Vehicle	17%	16%	17%	17%
Automated Regional or Long Haul Trucking	14%	16%	15%	7%
Automated Flexible Mobility-on-Demand Shuttle Service	11%	11%	8%	27%

Source: USDOT

Q. Which, if any, of the following automated [Transit/Commercial/Light Duty] tests or deployments are or were being conducted?

## AV Readiness

Overall, relatively few surveyed agencies have undertaken AV readiness activities. Readiness among agencies with a role in AV was studied to get some sense of what activities were undertaken or completed by those directly involved with AV tests/deployments. Among agencies with a role, *Partnering with Other Entities to Test AV* (54 percent) stands out as the most common readiness factor. Other top readiness activities include: *Conducting an AV Planning Study* (35 percent), *Including AV in Agency Planning Documents* (35 percent), and *Applying for a Federal Grant to Fund AV Testing* (35 percent).

**Table 5. Summary of Key AV Readiness Factors (Underway or Completed) by Agency Role**

AV Readiness Factors (Underway or Complete)	Total	Agency Has Role	Agency Has No Role/Not Testing
<i>Number of Respondents</i>	474	71	403
Partnered with other entities to test automated vehicles	13%	54%	6%
Included automated vehicle technologies and/or applications in agency planning documents	11%	35%	7%
Updated your Regional ITS Architecture to include automated vehicle applications and interfaces	11%	27%	9%
Applied for a Federal grant to fund the testing of AV technology	9%	35%	4%
Enhanced infrastructure maintenance	9%	17%	8%
Conducted an automated vehicle planning study	8%	35%	3%

Source: USDOT

Q. The US Department of Transportation is trying to understand agencies' readiness to deploy AV technology. For each of the following activities, please indicate your agency's current status

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## Conclusions and Next Steps

The surveyed freeway, arterial, and transit agencies are still in the early stages of CV and AV deployment. However, there are differences in levels of agency involvement in deployment of these technologies. One-quarter of surveyed agencies currently deploy CV, and another third indicate plans to deploy in the future. Although nearly 40 percent of surveyed agencies report AV activity in their region/state, only a small fraction of agencies are involved in AV testing/deployment.

Agencies active in CV and AV reported on current and planned deployments. Only a few CV applications were mentioned by a majority of active agencies. They include Agency Data Applications and three intelligent traffic signal based applications. Other applications selected were specific to each agency type. Agencies reporting AV activity provided information on the tests occurring in their region or state. Automated Fixed-route Shuttles, Truck Platooning, and Automated Light duty Vehicles were the most common tests.

Readiness activities involving upgrading physical and communications infrastructure are key first steps for agencies considering CV. Partnering with other entities stands out as the most common readiness factor for agencies involved in AV testing. Readiness factors common to CV and AV include: applying for grant funding and including CV/AV in planning documents. Outside of those with a current involvement in CV and AV, few agencies are undertaking any of the surveyed readiness activities. This presents ITS JPO with an opportunity to support agencies as they take the first steps toward CV or AV deployment.

Agencies face many challenges and unknowns as they approach CV and AV deployment. Uncertainty around future spectrum allocation may be causing reluctance in committing to DSRC. While two-thirds of agencies deploying CV indicate they are using DSRC, those who are planning to deploy CV are more divided with respect to communication technologies: 45 percent plan to use DSRC while 56 percent plan to use cellular.

### Next Steps

The CV/AV Survey data provides a current snapshot of CV and AV deployment progress among large and medium sized cities, and the ITS JPO will use the findings to better understand the ways in which it can support CV/AV deployment and technology transfer activities. In addition, the findings will inform any changes that may be needed to the survey instruments prior to the administration of the next CV/AV Survey in 2021.

The ITS JPO is currently redesigning the DTS and will expand the survey population beyond large and medium size cities to also include agencies in small urban and rural areas. This change to the survey population will provide the ITS JPO with a more representative understanding of the level of ITS deployment throughout the US. In addition, this update to the survey methodology aligns with General Accountability Office's recommendation that the ITS JPO should track ITS among small urban and rural areas on a more regular basis.

# Chapter 1. Study Purpose

The mission of the US Department of Transportation (DOT) Intelligent Transportation System's Joint Program Office (ITS JPO) is to lead collaborative and innovative research, development, and implementation of ITS to improve the safety and mobility of people and goods. The ITS JPO supports deployment and technology transfer activities for a broad range of ITS, including Connected Vehicle (CV) and Automated Vehicle (AV) technologies. The ITS JPO has supported the advancement of connected vehicle technologies through its CV Pilot Demonstration Program, as CV applications offer the potential to increase safety, improve personal mobility, enhance economic productivity, reduce environmental impacts and transform public agency operations. Likewise, the ITS JPO's automation research program is a significant component of the USDOT's vision of supporting the safe, reliable, efficient, and cost effective integration of automation into the transportation system.

This report summarizes findings from the 2019 CV/AV Survey, administered by the Volpe National Transportation Systems Center in support of the ITS JPO. The survey was conducted to provide baseline data on the current state of connected vehicle and automated vehicle deployment, with the intention that future surveys will continue to monitor progress in the adoption of these technologies. The survey was also designed to address the following key questions:

- What are agencies' levels of readiness with respect to CV and AV?
- What are the key challenges and barriers to CV and AV deployment?
- What assistance/resources are needed to overcome challenges and barriers?

The findings will provide the ITS JPO with a baseline understanding of CV and AV deployment and will be used to respond strategically to ITS deployment gaps and execute technical transfer activities that help states and local agencies plan and execute ITS deployments.

## Background

The ITS JPO has been conducting ITS Deployment Tracking Surveys (DTS) since 1997. The ITS JPO originally administered the DTS to track and manage progress toward the Secretary of Transportation's 1995 goal to deploy an integrated metropolitan ITS infrastructure in 75 of the nation's largest metropolitan areas by 2006.<sup>2</sup> Based on this mandate, the survey population was initially comprised of the 75 largest metropolitan areas, as the first generation of ITS technologies focused almost exclusively on congestion reduction and so large metro areas were most likely to adopt ITS. The ITS JPO later expanded the survey population to include medium-sized cities to obtain a more complete assessment of the state of ITS deployment nationally. The ITS JPO used the Roadway Congestion Index, which is a measure of traffic congestion, along with measures of tourism activity to identify medium sized cities.<sup>3</sup>

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<sup>2</sup> Speech delivered at the Transportation Research Board in Washington, DC on January 10, 1996:

<sup>3</sup> Steve Gordon and Jeff Trombly. Creating a Deployment Baseline for Statewide and Rural Intelligent Systems: A White Paper. May 2002.



Prior to conducting the next DTS in 2020, the ITS JPO sought to understand the current state of connected vehicle (CV) and automated vehicle (AV) deployment. This 2019 CV/AV Survey provides an in-depth assessment on the status of CV and AV planning and deployment. The survey includes connected vehicle questions similar to those asked in the 2016 DTS, but the CV content has been updated and expanded to reflect advancement in CV. Questions related to automated vehicles were added for the first time in the 2019 survey.

# Chapter 2. Methodology

This chapter describes the sample development, questionnaire, and data collection procedures used for the 2019 Connected and Automated Vehicle Survey.

## Sample Development

The 2019 Connected and Automated Vehicle Survey (CV/AV Survey) was administered online to freeway, arterial, and transit agencies in the 78 large metropolitan areas and 30 medium sized cities. This survey population is the same one used in previous Deployment Tracking Surveys (DTS). The research team utilized the agency contact lists from the most recent DTS conducted in 2016. Prior to data collection, each agency was contacted by email and phone to notify them of the upcoming survey and to verify that the listed contact was the appropriated respondent for the Connected and Automated Vehicle Survey. Replacement contacts were obtained when necessary.

## Questionnaire

The research team designed the CV/AV Survey questionnaire, with significant input from ITS JPO staff and CV and AV subject matter experts (SMEs). The research team initiated questionnaire design with the 2016 CV questions, but input from SMEs indicted that those questions needed to be updated. The updated survey includes a question on connected vehicle deployment, so it is possible to compare findings to the 2016 survey, but all other CV content has been updated and expanded to reflect advancement in this area. Updated key survey topics for CV included:

- Current deployment status/timeline for future deployment
- Partnerships
- CV applications being deployed/planned (including a list of V2I, V2V, Mobility-focused, Environment-focused and Other CV applications)
- Transportation objectives in deploying CV
- Challenges/barriers to CV deploying or planning
- CV Readiness
- Types of communication technologies being used/planned to support CV
- Types of technologies used/planned for backhaul communications to support CV
- Use and familiarity with CV Architecture, Tools and Standards
- Resource Needs to support AV

Questions related to AV were added for the first time in the 2019 CV/AV Survey. Although many of the same topic areas as CV were covered, the questions were tailored to AV. Questions included:

- Current AV deployment or testing region/State and plans to participate in future testing
- Agency's role in the testing
- Partnerships

- Types of Automated Testing (asked separately for Automated Transit, automated commercial, and automated light duty passenger)
- Location of testing
- Challenges/barriers to AV deployment or planning
- Changes in laws, regulations or policies to accommodate AV
- AV Readiness
- Resource Needs to support AV

The full survey can be found in Appendix A.

The survey was programmed online using Qualtrics, a commercial survey software program. The research team conducted pre-testing with internal staff and a small groups of transportation agencies to ensure that the survey logic functioned as designed.

## Data Collection

The Volpe team fielded the online survey between October 7, 2019 and December 31, 2019.

Initially, invitations were sent to a subset of the sample (25 arterial, 50 freeway, and 50 arterial agencies), so that if there were any problems with the deployment they could be addressed prior to sending the survey to the remaining sample. Since the initial rollout went smoothly, the research team continued by sending out the remainder of the sample in two waves:

- Wave 1 (N=398): October 7 – December 31
- Wave 2 (N=395): November 4 – December 31

Table 6 shows the survey was sent to an outgoing sample of 123 freeway, 460 arterial, and 210 transit agencies. Contacts received several reminders by email and phone to encourage participation. The final response rate was 60 percent, including of 66 freeway, 301 arterial, and 108 transit agencies.

**Table 6: Sample Size and Response Rate by Agency Type**

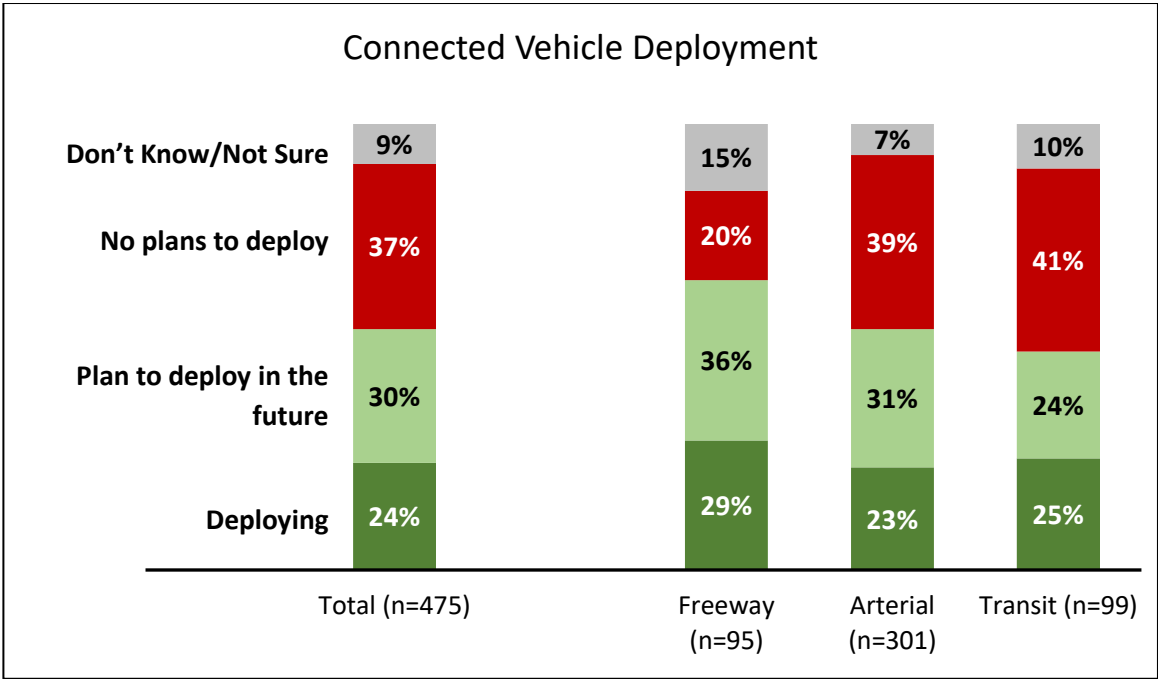
Agency Type	Outgoing sample	Respondents	Response Rate
Freeway	123	66	53%
Arterial	460	301	65%
Transit	210	108	51%
<b>Total</b>	<b>793</b>	<b>475</b>	<b>60%</b>

Source: USDOT

# Chapter 3. Connected Vehicles Findings

## Connected Vehicle Deployment Status

Connected vehicle deployment status for 2019 is shown in Figure 5. Roughly one-quarter of agencies responding to the survey reported that they are currently deploying CV applications. Twenty-nine percent of freeway agencies are deploying CV, compared to 23 percent of arterial agencies and 25 percent of transit agencies. When looking at the percentage who are **Active Agencies**, either currently deploying or planning to deploy CV, freeway agencies lead at 65 percent, followed by arterial agencies (54 percent), and transit agencies (49 percent). Roughly 40 percent of arterial and transit agencies report they have no plans to deploy CV. Additional research would be helpful to understand the reasons these agencies are not considering CV at this time.



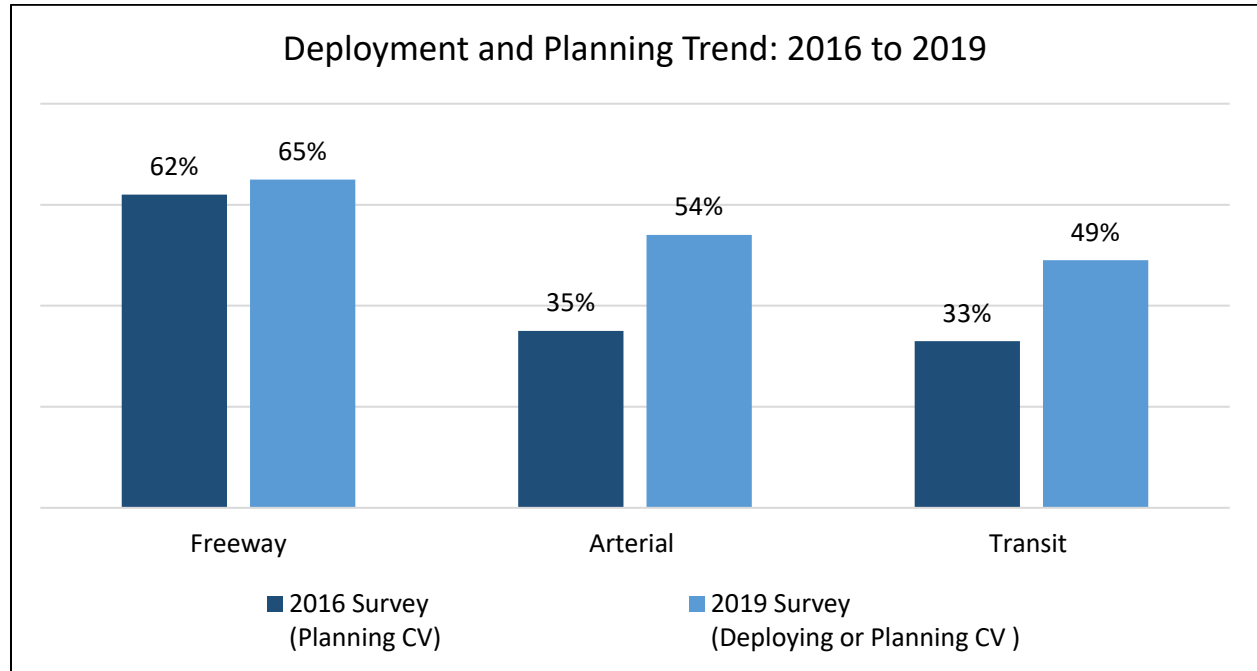
Source: USDOT

Q: Is your agency currently deploying connected vehicle (CV) technology? Base: All Agencies

Figure 5. 2019 Connected Vehicle Deployment by Agency Type

## Deployment Status Trend

Arterial and transit agencies have made significant progress in the three years since CV activity was first measured, while freeway activity remains steady.<sup>4</sup> Figure 6 shows that in 2016, 35 percent of arterial agencies reported CV planning, and by 2019, this figure increased to 54 percent. Among transit agencies, CV planning increased from 33 percent in 2016 to 49 percent in 2019. This progress may have been influenced by advancements in the development and marketing of CV technologies, as well as by USDOT and ITS JPO interventions supporting the deployment of CV technologies (e.g. Connected Vehicle Deployment Program, Advanced Transportation and Congestion Management Technologies Deployment Program, Signal Phase and Timing (SPaT) challenges).



*Source: USDOT*

Q 2019: Is your agency currently deploying CV technology? Base: Freeway (n=66), Arterial (n=301), Transit (n=108)

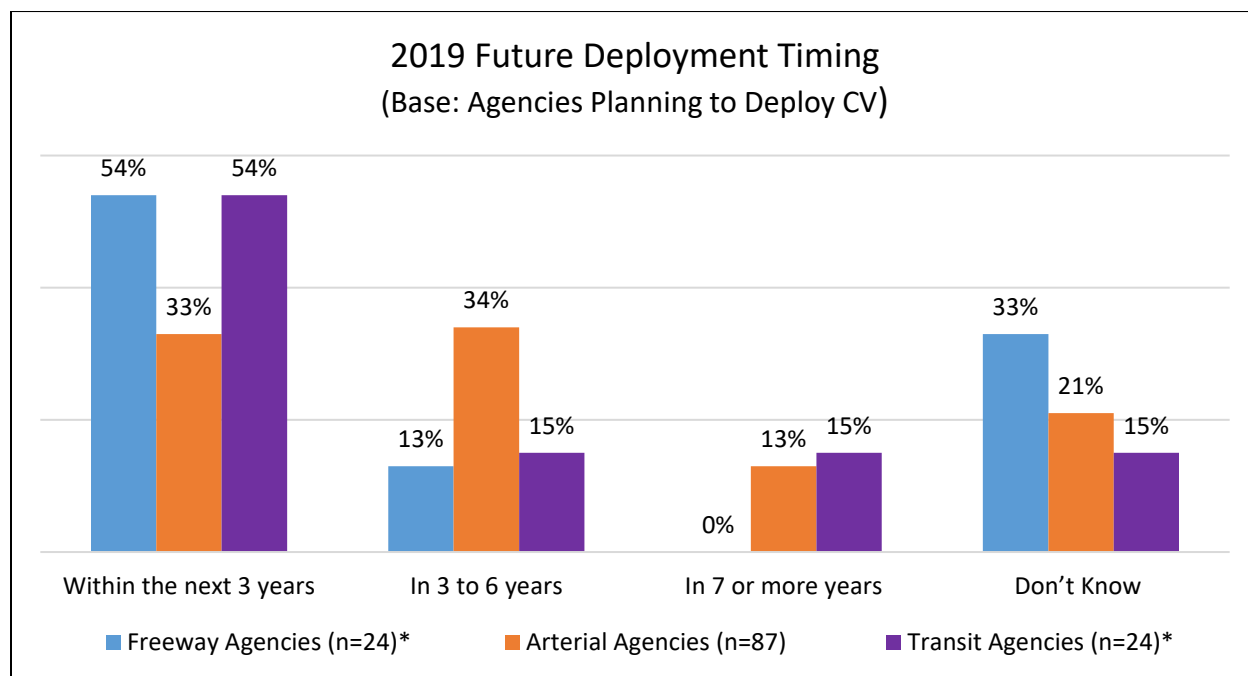
Q 2016: Is your agency currently planning CV technology? Base: Freeway (n=99), Arterial (n=274), Transit (n=99)

**Figure 6. Connected Vehicle Deployment/Planning Trend**

<sup>4</sup> Comparisons of 2016 and 2019 CV deployment and planning estimates should be considered directional only, since the 2016 asked solely about CV planning while the 2019 question distinguished between CV deployment and planning, offering both as a choice. It is assumed that if any CV deployment had occurred by 2016, agencies responded in the survey that they were planning to deploy CV.

## Timing of Future CV Deployments

The timing of planned CV deployments differs by agency type. Figure 7 shows that roughly half of freeway and transit agencies planning CV (54 percent) expect to deploy the technologies within the next three years, compared to only one-third (33 percent) of arterial agencies. Of the remaining 46 percent of freeway agencies who are not planning to deploy CV in next three years, 13 percent expect to do so in 3 to 6 years and the remaining 33 percent report that they don't know. Transit agencies not planning to deploy in the near term are split evenly among the other options, 15 percent expect to deploy *in 3 to 6 years*, 15 percent in 7 or more years, and the remaining 15 percent reported that they don't know.<sup>5</sup> Arterial agencies tend to have a longer time horizon for deploying CV, with 34 percent planning to deploy in 3 to 6 years, 13 percent in 7 or more years, and 21 percent reporting they don't know. Survey findings on the barriers and challenges to deploying CV (see Challenges to CV Deployment) provide some insights on why agencies are not currently deploying.



Q: When do you expect to deploy connected vehicle technology? Base: Agencies planning to deploy CV.

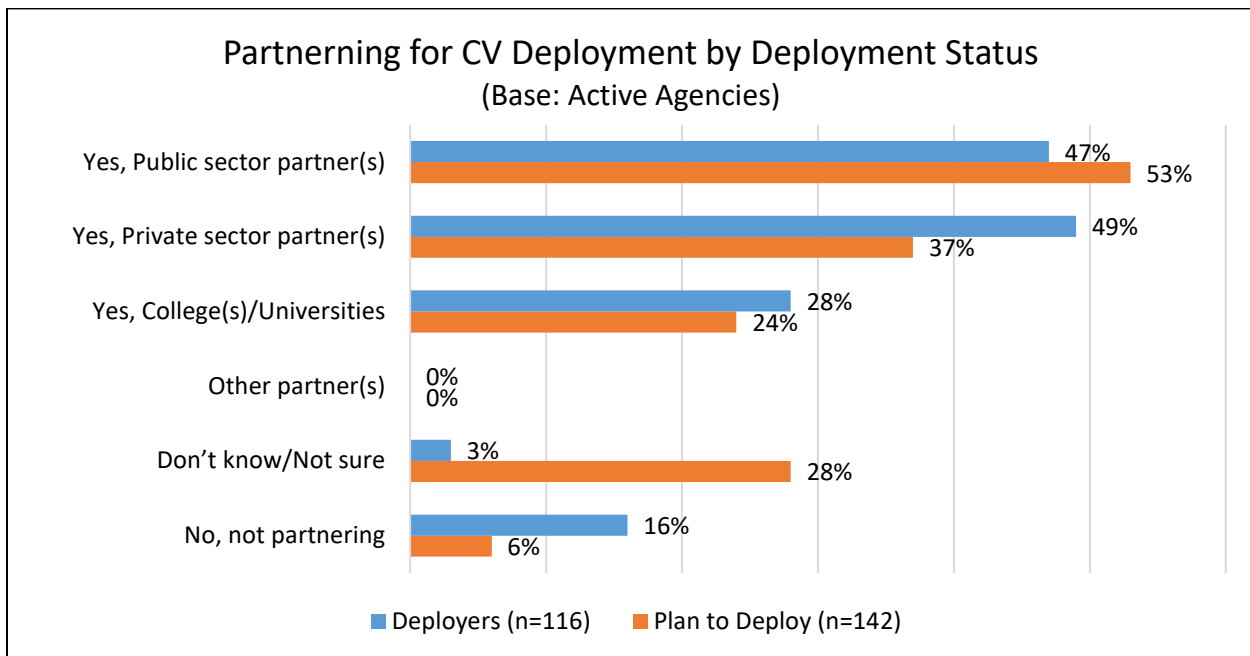
\*Small sample size <30 agencies.

**Figure 7. Timing of Future CV Deployments by Agency Type**

<sup>5</sup> Numbers do not sum to 46 percent due to rounding.

## Partnerships

Active agencies report that both public and private sector partners play roles in CV deployment (see Figure 8). Roughly half of agencies currently deploying CV report partnering with public sector entities (47 percent), and a similar percentage (49 percent) report partnerships with the private sector. Twenty-eight percent indicate university partnerships, 16 percent say they are not partnering, and 3 percent report that they don't know. More than half of those planning to deploy (53 percent) see themselves partnering with *public entities*, slightly more than is reported by current deployers, but fewer (37 percent) anticipate partnerships with the private sector. This could indicate that agencies realize the need for private sector support once they are closer to deploying. Twenty-four percent of planners mention partnering with universities, and only 6 percent said they wouldn't partner (compared to 16 percent of deployers). More than one-quarter (28 percent) of planners report don't know/not sure about partnering.



Source: USDOT

Q: Is your agency partnering/Does your agency plan to partner with other entities to deploy connected vehicle technology?  
(Select all that apply)

**Figure 8. Partnerships for Connected Vehicle Deployments**

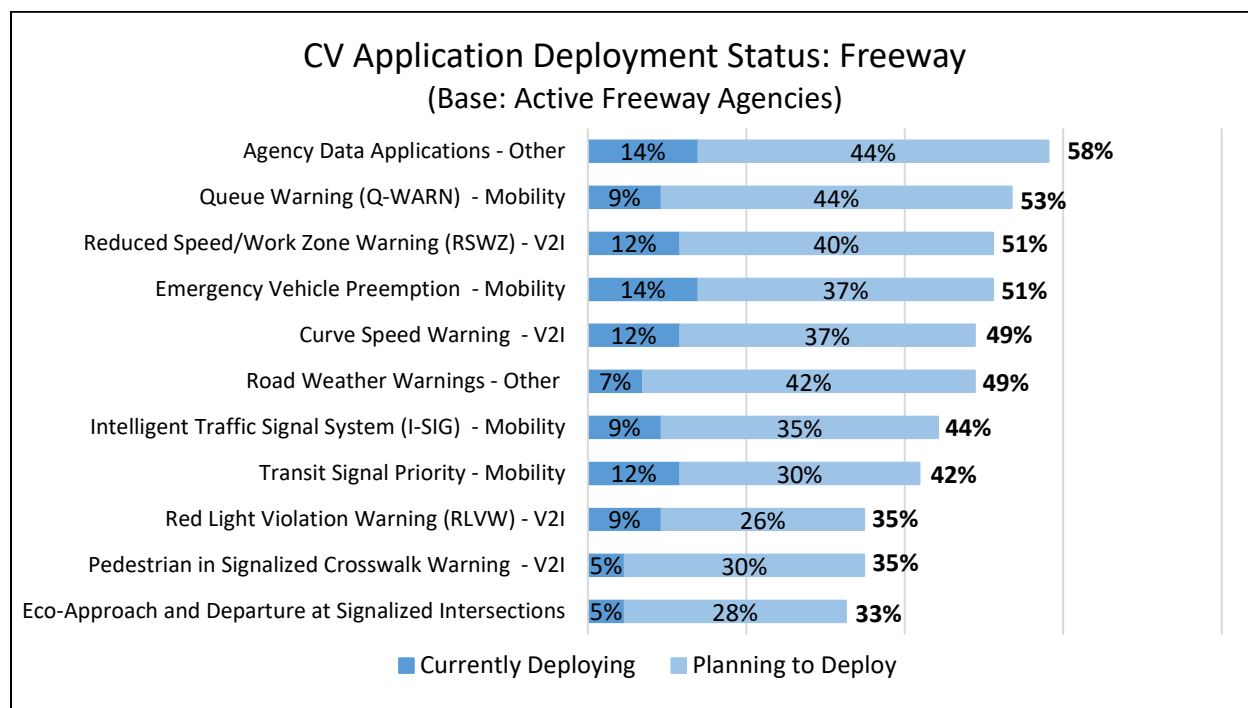
## CV Application Deployment Status

This section reviews findings on the CV applications being deployed or planned by freeway, arterial, and transit agencies. CV applications selected by more than 30 percent of agencies are reported. The deployment status for the full list of applications can be found in Appendix B, Table 19 to Table 28.

## Freeway Agency CV Deployment

Figure 9 shows that there are 11 CV technologies deployed or planned by over 30 percent of active freeway agencies. The percentage of agencies deploying each technology is relatively small, compared to the proportion who are planning to deploy. For example, 14 percent of freeway agencies are currently deploying *Agency Data Applications*, whereas 44 percent are planning to deploy this application. As Figure 9 demonstrates, no more than 14 percent of freeway agencies report currently deploying CV applications. For reporting purposes, this section combines “currently deploying” and “planning to deploy” to provide an overall picture of freeway agencies’ interest in CV applications.

Fifty-eight percent select *Agency Data Applications*, which are used to collect, transmit, analyze, or report local traffic, travel, and road-weather data. Safety and mobility applications such as *Queue Warning* (53 percent), *Reduced Speed/Work Zone Warning* (51 percent), *Curve Speed Warning* (49 Percent) and *Road Weather Warnings* (49 percent) also top the list. The remaining technologies, including *Emergency Vehicle Preemption* (51 percent), *Intelligent Signal Systems* (44 percent), *Transit Signal Priority* (42 percent), *Red Light Violation Warning* (35 percent), *Pedestrian in Signalized Crosswalk Warning* (35 percent), and *Eco-approach and Departure at Signalized Intersections* (33 percent) utilize traffic signals to improve safety and mobility.



Source: USDOT

Q: For each of the following [CATEGORY] applications, please indicate your agency’s deployment status.

Base: Active Freeway Agencies (n=43)

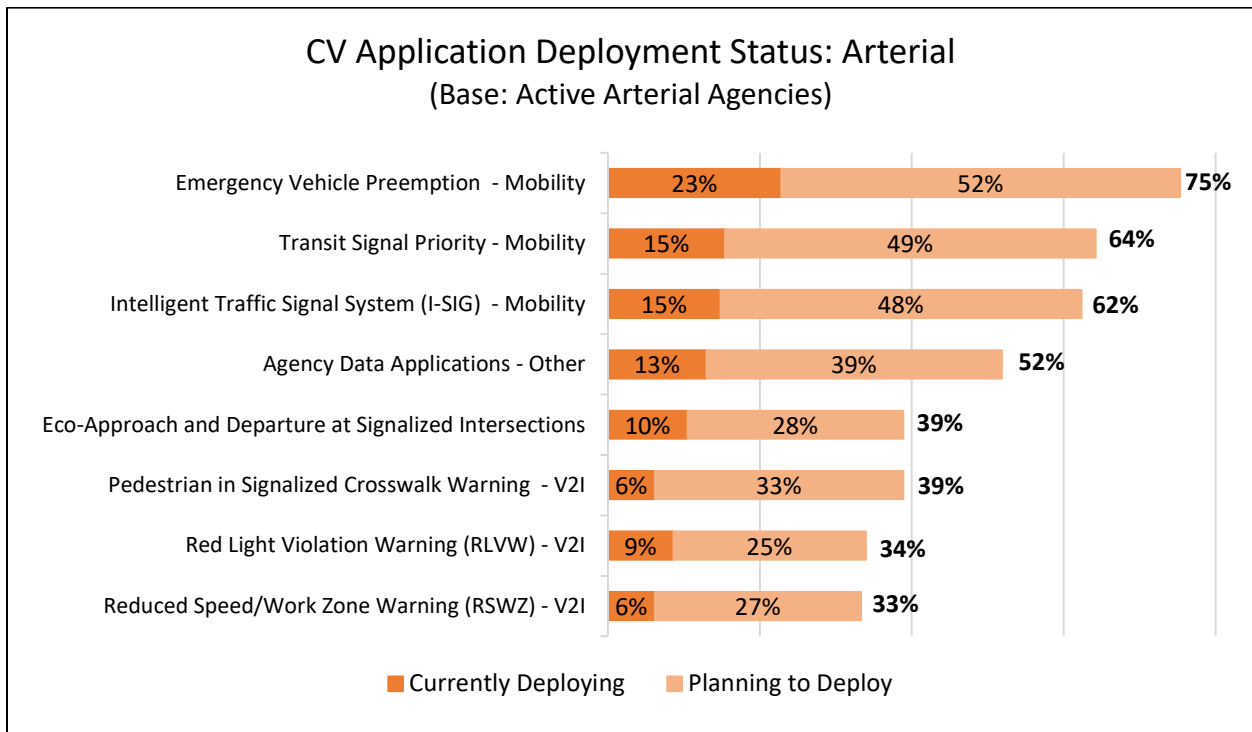
**Figure 9. Freeway CV Deployment (Percent Planned or Deployed)**



## Arterial Agency CV Deployment

There are 8 CV applications in the top tier, deployed or planned by more than 30 percent of active agencies, for arterial agencies (see Figure 10). Similar to freeway agencies, the bulk of active arterial agencies are in the planning stages, with fewer agencies having deployed the technology. Nonetheless, it is noteworthy that 23 percent of arterial agencies are currently deploying *Emergency Vehicle Preemption*; 15 percent or fewer agencies report currently deploying other CV applications. For reporting purposes, this section combines “currently deploying” and “planning to deploy” to provide an overall picture of arterial agencies’ interest in CV applications.

The top three applications, *Emergency Vehicle Preemption* (75 percent), *Transit Signal Priority* (64 percent), and *Intelligent Traffic Signal Systems* (62 percent) are mobility applications related to intelligent traffic signal operations. They are followed by *Agency Data Applications* at 52 percent. Three other applications on the list also involve traffic signals, *Eco-approach and Departure at Signalized Intersections* (39 percent), *Pedestrian in Signalized Crosswalk Warning* (39 percent), and *Red Light Violation Warning* (34 percent). The safety application *Reduced Speed/Work Zone Warning* (33 percent) completes the list.



Source: USDOT

Q: For each of the following [CATEGORY] applications, please indicate your agency’s deployment status.

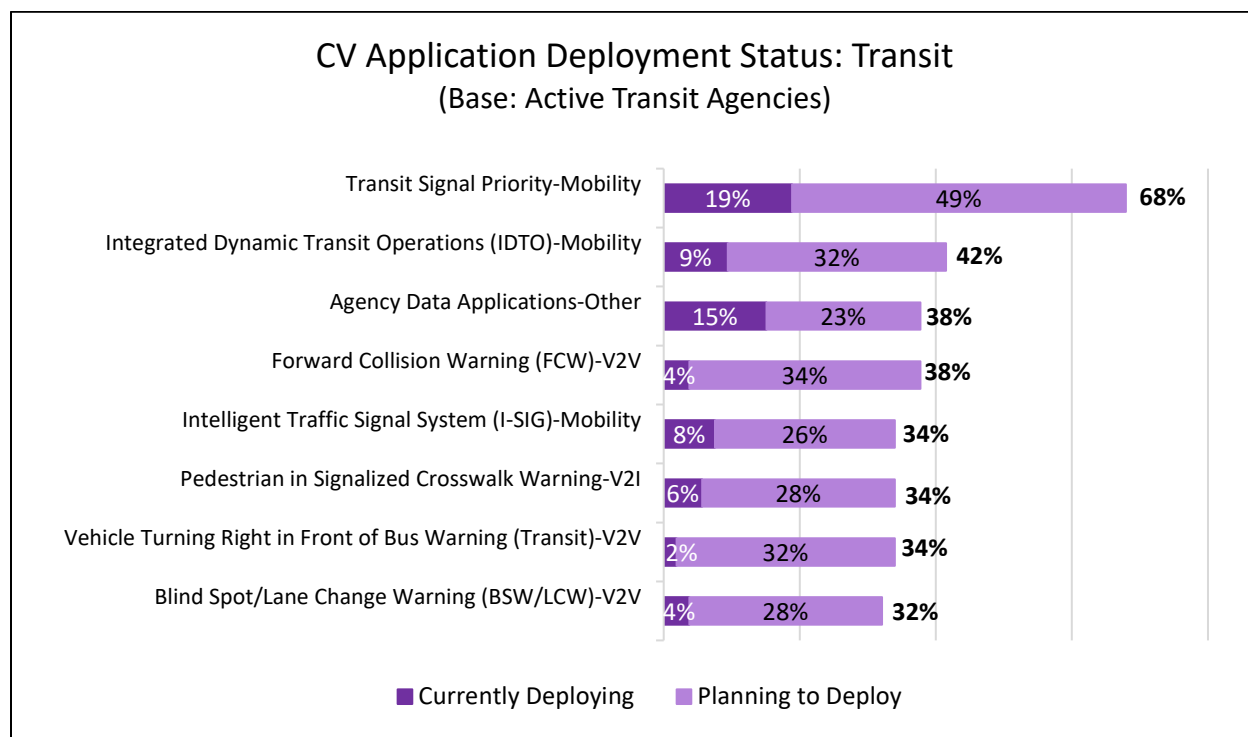
Base: Active Arterial Agencies (n=162)

**Figure 10. Arterial CV Deployment (Percent Planned or Deployed)**

## Transit Agency CV Deployment

As with arterial agencies, there are 8 CV technologies selected (deployed/planned) by over 30 percent of transit agencies (see Figure 11). By far, the greatest activity is with *Transit Signal Priority*, a traffic signal based mobility application selected by 68 percent of active transit agencies, with 19 percent of transit agencies currently deploying and 49 percent planning to deploy this application.

Fewer transit agencies report either currently deploying or planning to deploy *Integrated Dynamic Transit Operations (IDTO)* (42 percent). IDTO includes three applications that improve transit mobility, operations, and services: Transfer Connection Protection (T-CONNECT) dynamically holds vehicles at bus stops to meet with connecting passengers; Dynamic Dispatch (T-DISP) adjusts transit routing to pick up passengers or avoid congestion; and Dynamic Rideshare (D-RIDE) facilitates first-mile and last-mile shared riders. Thirty-eight percent of agencies are deploying or planning to deploy *Agency Data Applications*, a technology that is at or near the top of the list for all three agency types. Vehicle-to-vehicle applications including *Forward Collision Warning* (38 percent), *Vehicle Turning Right in Front of Bus Warning* (34 percent) and *Blind Spot/Lane Change Warning* (32 percent) tend to be more applicable to transit agencies. Two other signal-based systems make the top tier, including *Intelligent Traffic Signal Systems* and *Pedestrian in Signalized Crosswalk Warnings*, both at 34 percent.



Source: USDOT

Q: For each of the following [CATEGORY] applications, please indicate your agency's deployment status.  
 Base: Active Transit Agencies (n=53)

**Figure 11. Transit CV Deployment (Percent Planned or Deployed)**

## Common CV Applications

Despite increased activity since 2016, deployment of CV Applications is still not widespread. Table 7 shows that among all active agencies (n=258), there are only four CV applications currently deployed or planned by a majority: *Emergency Vehicle Preemption* (61 percent), *Transit Signal Priority* (61 percent), *Intelligent Traffic Signal Systems* (53 percent) and *Agency Data Applications* (50 percent). Three out of the four applications fall in the top tier for each agency type, the exception being *Emergency Vehicle Preemption*, which is less relevant to transit agencies (26 percent).

**Table 7: Summary Table of Common CV Applications by Agency Type**

CV Application	Total	Freeway	Arterial	Transit
<i>Number of Respondents (Base: Active Agencies)</i>	258	43	162	53
Emergency Vehicle Preemption	61%	51%	75%	26%
Transit Signal Priority	61%	42%	64%	68%
Intelligent Traffic Signal System (I-SIG)	53%	44%	62%	34%
Agency Data Applications	50%	58%	52%	38%

Source: USDOT

Q: For each of the following [CATEGORY] applications, please indicate your agency's deployment status. Base: Active Agencies (n=258)

## Transportation Objectives for CV Deployments

Table 8 shows the full list of surveyed transportation objectives for the total sample and each agency type. The top five transportation objectives for each agency type are shaded.<sup>6</sup> Looking at the top objectives provides a sense of what agencies hope to achieve with connected vehicles.

**Table 8. Transportation Objectives by Agency Type**

Transportation Objectives	Total	Freeway	Arterial	Transit
<i>Number of Respondents (Base: Active Agencies)</i>	258	43	162	53
Decrease vehicle crashes	88%	95%	91%	72%
Reduce travel time	81%	86%	81%	74%
Improve travel time reliability	81%	84%	78%	85%
Decrease pedestrian crashes	80%	77%	85%	68%
Reduce congestion	76%	81%	83%	51%
Improve customer experience	75%	81%	68%	92%
Improve agency operations	74%	81%	69%	85%
Decrease bicycle crashes	73%	70%	79%	58%
Reduce emissions	70%	70%	71%	66%
Improve on-time performance of transit vehicles	62%	44%	58%	89%
Increase throughput	60%	70%	60%	51%
Improve accessibility	59%	53%	57%	70%
Reduce fuel use	59%	51%	60%	60%
Reduce costs	55%	49%	49%	77%
Increase ridership	44%	23%	36%	85%

Source: USDOT

Q. Which of the following transportation objective is your agency trying to achieve with the deployment of connected vehicle technology? (Select all that apply)

Freeway priorities include safety, mobility, and operations improvements. *Vehicle Crash Reduction* (95 percent), is selected by nearly all freeway agencies, followed by the mobility goals *Reducing Travel Time* (86 percent), *Improving Travel Time Reliability* (84 percent) and *Reducing Congestion* (81 percent).

<sup>6</sup> Highlighting here represents the top five objectives; due to ties, more objectives may be highlighted in this and other tables.

Freeway agencies also prioritize service elements such as *Improving Customer Experience* (81 percent) and *Improving Agency Operations* (81 percent).

Crash reduction is a top objective for arterial agencies, who seek to reduce *Vehicle Crashes* (91 percent), *Pedestrian Crashes* (85 percent) and *Bicycle Crashes* (79 percent). Arterial agencies also prioritize mobility goals such as *Reducing Congestion* (83 percent) and *Reducing Travel Time* (81 percent).

Service goals such as *Improving Customer Experience* (92 percent) and *Improving Agency Operations* (85 percent) are important to most of the surveyed transit agencies. They also prioritize system performance goals such as improving *Travel Time Reliability* (85 percent) and *On-time Performance* (89 percent). Achieving these goals could help them *Increase Ridership* (85 percent), another objective. Two other goals skew higher for transit agencies in comparison to freeway and arterial, *Reducing Cost* (77 percent) and *Improving Accessibility* (70 percent).

## Challenges to CV Deployment

The top challenges to CV deployment tend to be consistent across agency types. Table 9 lists the challenges selected by at least 40 percent of the total sample. The top five challenges in total and for each agency type are highlighted. Results for the full list of CV challenges can be found in Appendix B.

Across agencies, *Limited Funding for CV* (68 percent) is the top concern, followed by *Cost of CV Technology* (67 percent), *Cost to Operate and Maintain CV Technology* (66 percent), and *Cost of Updates to Communications and Physical Infrastructure* (64 percent). Other top concerns include *Lack of Staff with the Right Qualifications/Expertise* (54 percent) and *Uncertainty around CV Communication Technologies* (53 percent).

There are also a few other challenges that are noteworthy due to higher importance for specific agency types. While not in the top five challenges, *Lack of Regulatory Support* skews higher for freeway agencies (62%). *Worker Acceptance Issues* skew higher for transit agencies (34 percent), compared to arterial (24 percent) and freeway agencies (18 percent) (see Appendix B, Table 30).

**Table 9. Challenges Planning or Deploying CV by Agency Type**

Barriers/Challenges to Deploying/Planning CV	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	475	66	301	108
Limited funding	68%	76%	69%	58%
Cost of CV technology	67%	71%	66%	66%
Cost to operate and maintain CV technology	66%	80%	66%	56%
Cost of required updates to communications and /or physical infrastructure	64%	70%	66%	55%
Lack of staff with the right qualifications/expertise	54%	67%	54%	47%
Uncertainty about the information/communication technologies needed (e.g., DSRC vs. cellular)	53%	70%	56%	33%
Integrating new technology with current systems	51%	56%	52%	46%
Too much technical risk; want to wait until technology and standards mature	49%	65%	48%	44%
Lack of support for long term operations/maintenance	45%	56%	47%	36%
Lack of a regulatory framework	44%	62%	47%	27%
Cybersecurity issues	43%	50%	44%	35%
Data governance concerns	41%	47%	45%	27%
Lack of information about connected vehicle technology	40%	41%	42%	34%

Source: USDOT

Q. Does your agency face any of the following challenges in planning or deploying connected vehicle technology?

## CV Readiness

This section looks at activities undertaken in preparation for CV deployment. Table 10 show the results for all of the surveyed readiness activities, in total and by agency type. The top three readiness factors are highlighted. In total, only two of the surveyed readiness factors were selected by more than 30 percent of respondents: *Built/Upgraded Communications Network* (48 percent) and *Upgraded Physical Infrastructure* (32 percent). Freeway agencies skew higher than other agency types on most readiness factors.

**Table 10. CV Readiness Activities: Percent Underway or Complete**

Readiness to Deploy CV Technology	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i> <sup>7</sup>	473	66	300	107
Built or upgraded your communications network	<b>48%</b>	<b>61%</b>	<b>52%</b>	<b>29%</b>
Upgraded physical infrastructure for connected vehicles	<b>32%</b>	<b>38%</b>	<b>38%</b>	<b>13%</b>
Included CV technologies and/or applications in agency planning documents	<b>17%</b>	24%	17%	<b>15%</b>
Updated Regional ITS Architecture to include CV applications and interfaces	<b>17%</b>	26%	<b>18%</b>	9%
Applied for a Federal grant to fund CV deployment	16%	24%	15%	<b>13%</b>
Conducted a connected vehicle planning study	12%	27%	11%	7%
Instituted MOUs with potential partners regarding roles and responsibilities for CV projects	12%	8%	13%	10%
Secured CV test bed/testing facilities	12%	18%	13%	6%
Procured contractor support for CV technologies	12%	23%	10%	12%
Developed ConOps or initial systems engineering documents for CV projects	11%	21%	9%	11%
Applied for an FCC License to use 5.9 GHz frequency spectrum (Dedicated Short-Range Communication)	11%	<b>29%</b>	9%	3%
Updated lane markings and infrastructure to support accurate MAP message generation	8%	11%	8%	4%
Created a data repository for storing CV data	8%	8%	7%	10%
Hired new staff with knowledge about connected vehicles	7%	14%	5%	6%
Created a data management plan for collecting, storing, analyzing, reporting and protecting privacy of CV data	6%	8%	6%	6%
Implemented a security credential management system (SCMS)	4%	6%	4%	3%
Engaged with USDOT's Equipment Loan and Help Desk program	1%	2%	1%	0%

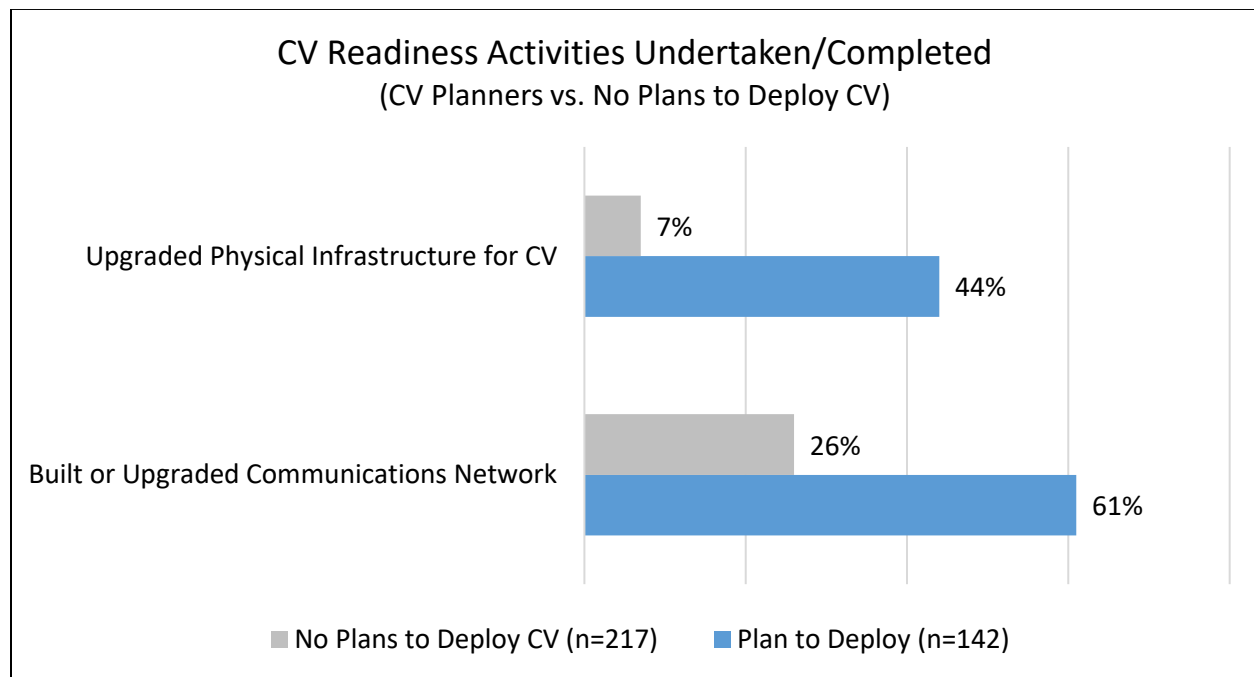
Source: USDOT

Q. The US Department of Transportation is trying to understand agencies' readiness to deploy CV technology. For each of the following readiness activities, please indicate your agency's current status

<sup>7</sup> Data is missing for two agencies

To better understand early activities undertaken to prepare for CV, readiness activities were analyzed by deployment phase. Comparing the activities undertaken or completed by agencies not planning to deploy CV to those of agencies planning to deploy CV found the biggest differences between the groups is upgrading physical and communications infrastructure, suggesting these are among the first steps agencies must undertake to prepare for connected vehicles.

Figure 12 shows that while 61 percent of transportation agencies planning to deploy CV indicated they *Built/Upgraded Communications Network*, only 26 percent of those not planning for CV did so, a 35 percentage point difference. Similarly, 44 percent of those planning to deploy CV indicated they *Upgraded Physical Infrastructure for CV*, compared to only 7 percent of those not planning for CV, a 37 percentage point difference.



Source: USDOT

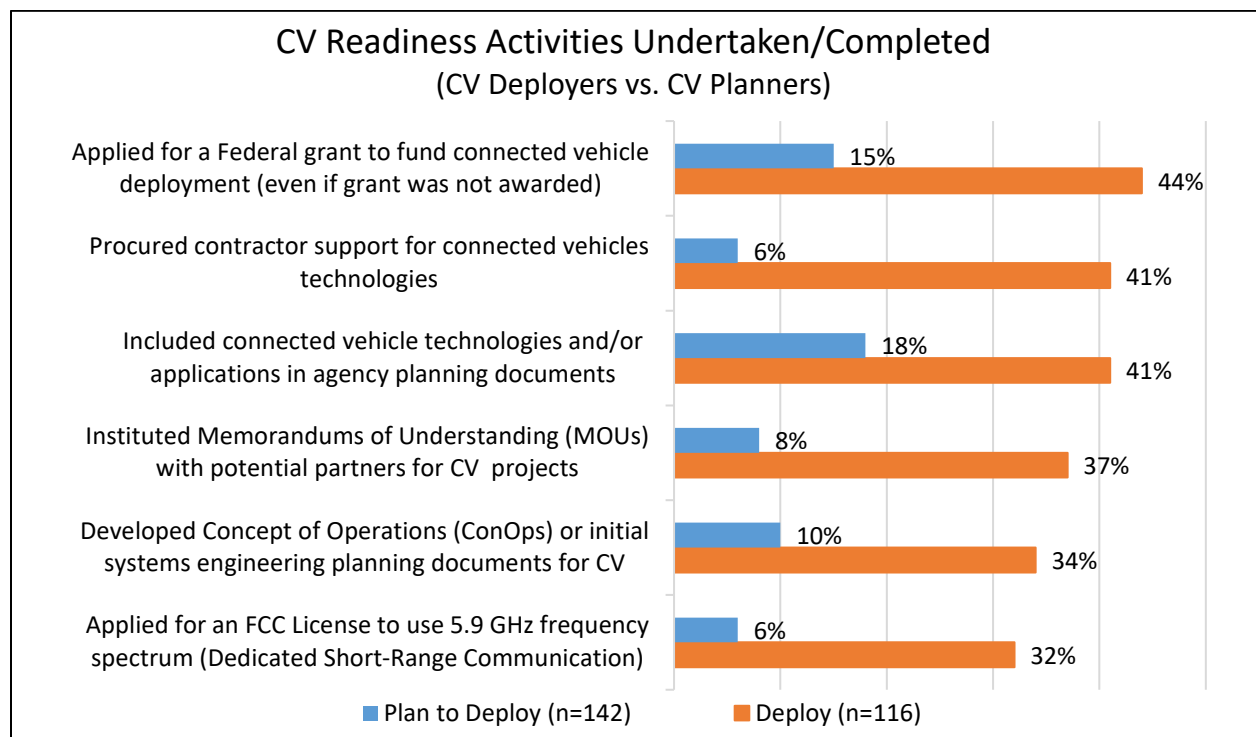
Q: For each of the following readiness activities, please indicate your agency's current status

**Figure 12. Early CV Readiness Activities**



The research team conducted a similar analysis comparing the readiness factors undertaken or completed by agencies currently deploying CV to those of agencies planning to deploy CV. The factors linked to moving from “planning” to “deploying” CV include: *Applying for a Federal Grant to Fund CV Deployment* (29 point difference), *Procuring Contractor Support for CV* (35 point difference), *Including CV in Agency Planning Documents* (23 point difference), *Instituting Memorandums of Understanding (MOUs) with Potential CV Partners* (29 point difference), *Developing Concepts of Operation (ConOps)* (24 point difference), and *Applying for a DSRC licenses* (26 point difference).

Even among agencies that are currently deploying CV, however, relatively few agencies indicated they were undertaking or had completed the surveyed readiness activities. For example, it was surprising to learn that only 41 percent of agencies that are currently deploying CV have *Procured Contractor Support for CV*, and that only 34 percent had developed a *Concept of Operations for CV*. Additional research may be needed to better understand the key activities that represent CV readiness.



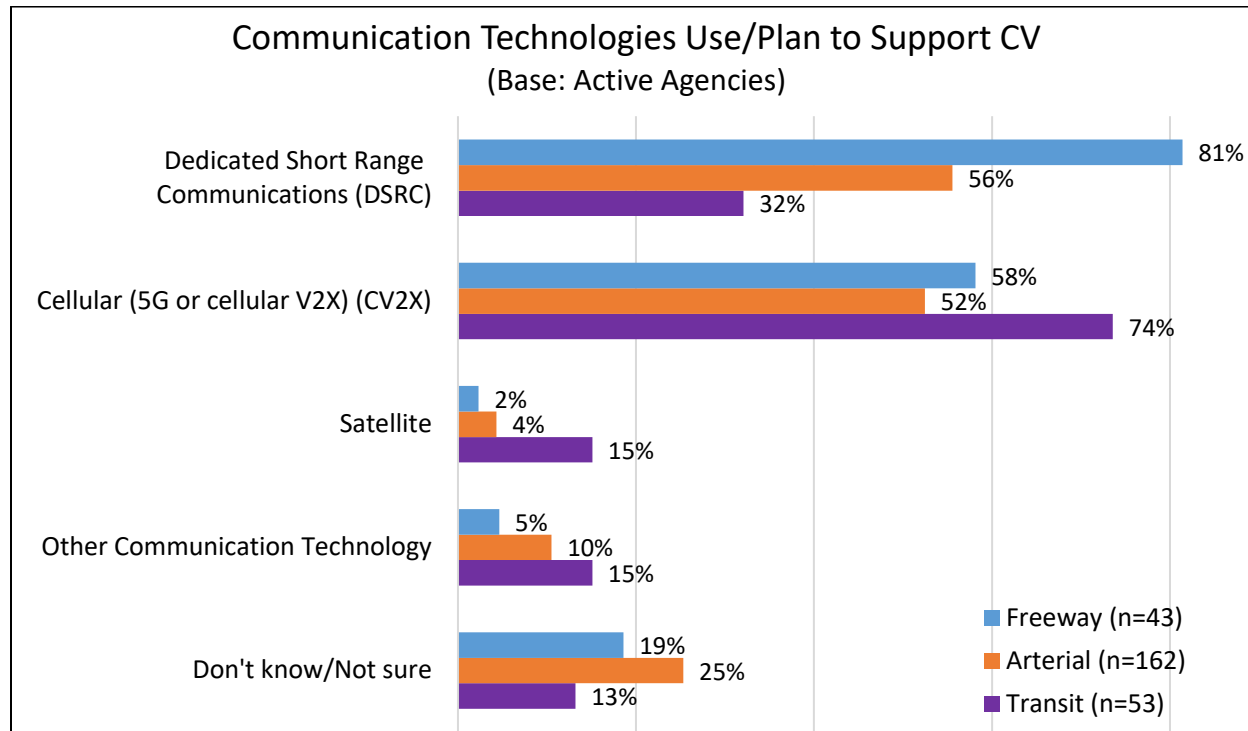
Source: USDOT

Q: For each of the following activities, please indicate your agency’s current status

**Figure 13. Later Stage CV Readiness Activities**

## Technologies to Support Connected Vehicles

This section highlights the communication technologies that agencies use/plan to use to support CV applications and backhaul communications. Among the active agencies, most freeway agencies use or plan to use DSRC to support their CV deployment (81 percent) whereas transit agencies favor the use of Cellular or 5G communication technologies (74 percent). It is possible that the current use of cellular technologies on transit vehicles make the implementation of 5G easier and more favorable for transit agencies. Active arterial agencies are relatively equally divided between the use of DSRC (56 percent) and use of Cellular/5G (52 percent).

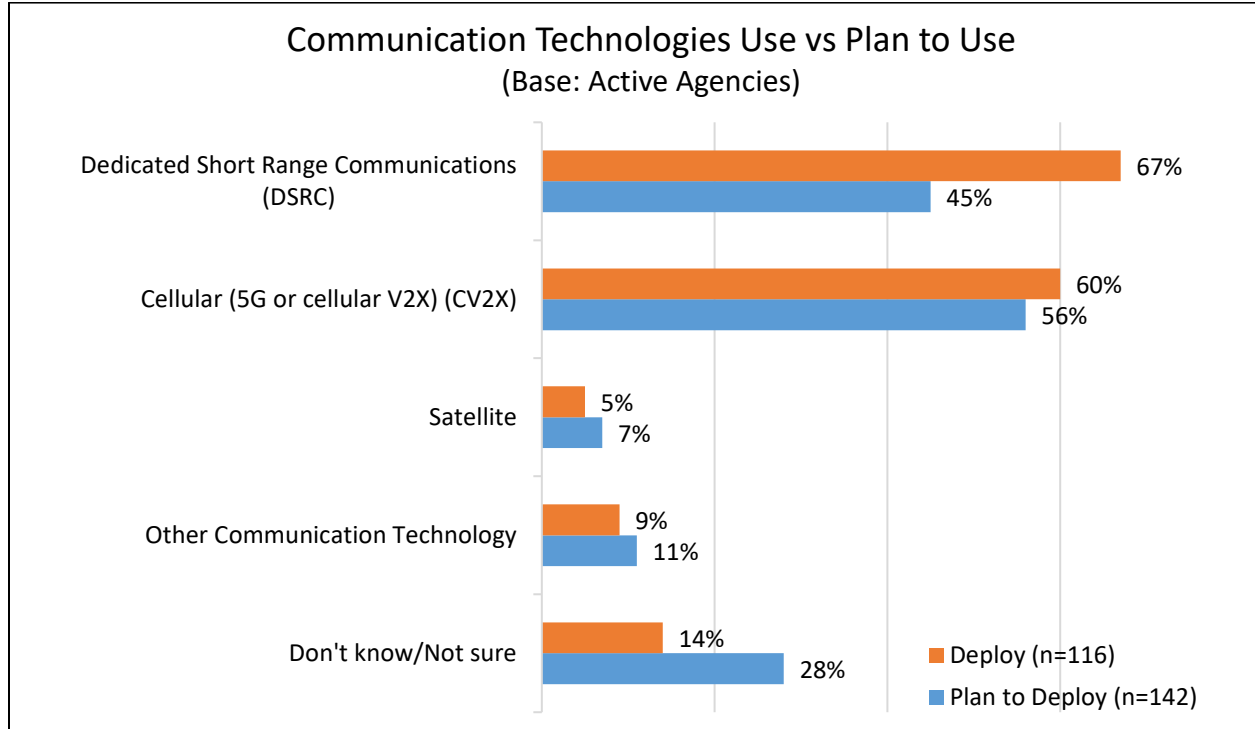


Source: USDOT

Q: What types of communication technologies does your agency currently use (or plan to use in the future) to support connected vehicle applications (vehicle-to-vehicle or vehicle-to-infrastructure)?

Figure 14. Communication Technologies to Support CV by Agency Type

The use of communications to support CV was also analyzed by deployment phase (see Figure 15). While over two-thirds of agencies currently deploying CV said they currently use or plan to use DSRC (67 percent), less than half of the agencies planning to deploy CV in the future indicated that they intended to use DSRC (45 percent). This differs from use of Cellular/5G which is similar for current deployers (60 percent) and planners (56 percent). Satellite is selected by only a small percentage of agencies: 5 percent of current deployers and 7 percent of planners; roughly 10 percent of each group selected Other Technologies. Twenty-eight percent of those planning for CV indicate that they don't know what communication technologies they will deploy, twice that of current deployers (14 percent). These data suggest that there is some uncertainty on whether agencies will use DSRC, or whether cellular technologies will dominate.

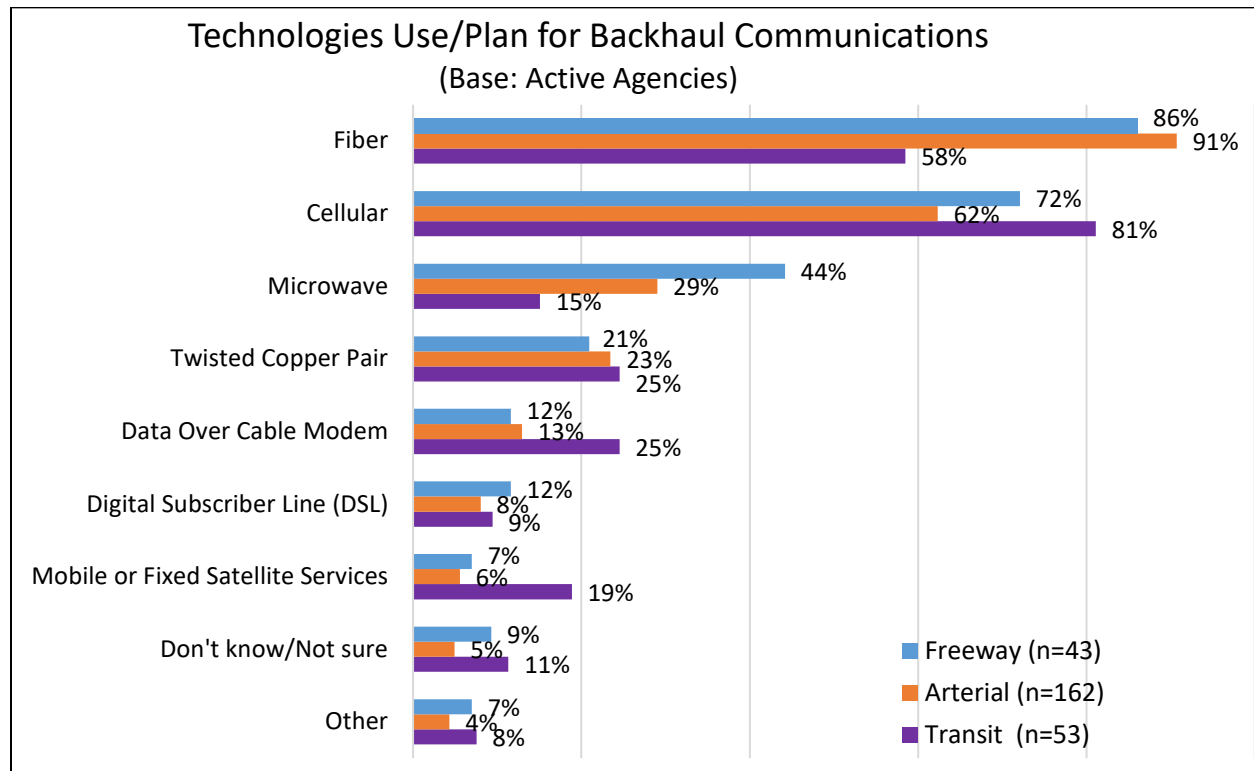


Source: USDOT

Q: What types of communication technologies does your agency currently use (or plan to use in the future) to support connected vehicle applications (vehicle-to-vehicle or vehicle-to-infrastructure)?

**Figure 15. Communication Technologies Deployed vs. Plan to Deploy**

Figure 16 shows that close to all active freeway (86 percent) and arterial (91 percent) agencies currently use or plan to use Fiber for backhaul communications, compared to 58 percent of active transit agencies. More freeway agencies indicate Microwave (44 percent) as a technology they may use, compared to 29 percent of arterial agencies, and 15 percent of transit agencies. Cellular looks to play a bigger role among transit agencies (81 percent), although use is also high among freeway (72 percent) and arterial (62 percent) agencies. Cellular looks to play a bigger role among transit agencies (81 percent), although use is also high among freeway (72 percent) and arterial (62 percent) agencies. Transit agencies are also more likely to cite use or planned use of Data Over Cable Modern (25 percent), compared to freeway (12 percent) and arterial (13 percent) agencies, and Mobile or Fixed Satellite Services (19 percent), compared to freeway (7 percent) and arterial (6 percent) agencies. Transit agencies are also more likely to cite use or planned use of Data Over Cable Modern (25 percent), compared to freeway (12 percent) and arterial (13 percent) agencies, and Mobile or Fixed Satellite Services (19 percent), compared to freeway (7 percent) and arterial (6 percent) agencies.



Source: USDOT

Q: What types of communication technologies does your agency currently use (or plan to use in the future) to provide backhaul communications in support of connected vehicle infrastructure (e.g., Roadside unit to Transportation Management Center)? (Select all that apply)

**Figure 16. Backhaul Communication Technologies by Agency Type**

## Connected Vehicle Tools

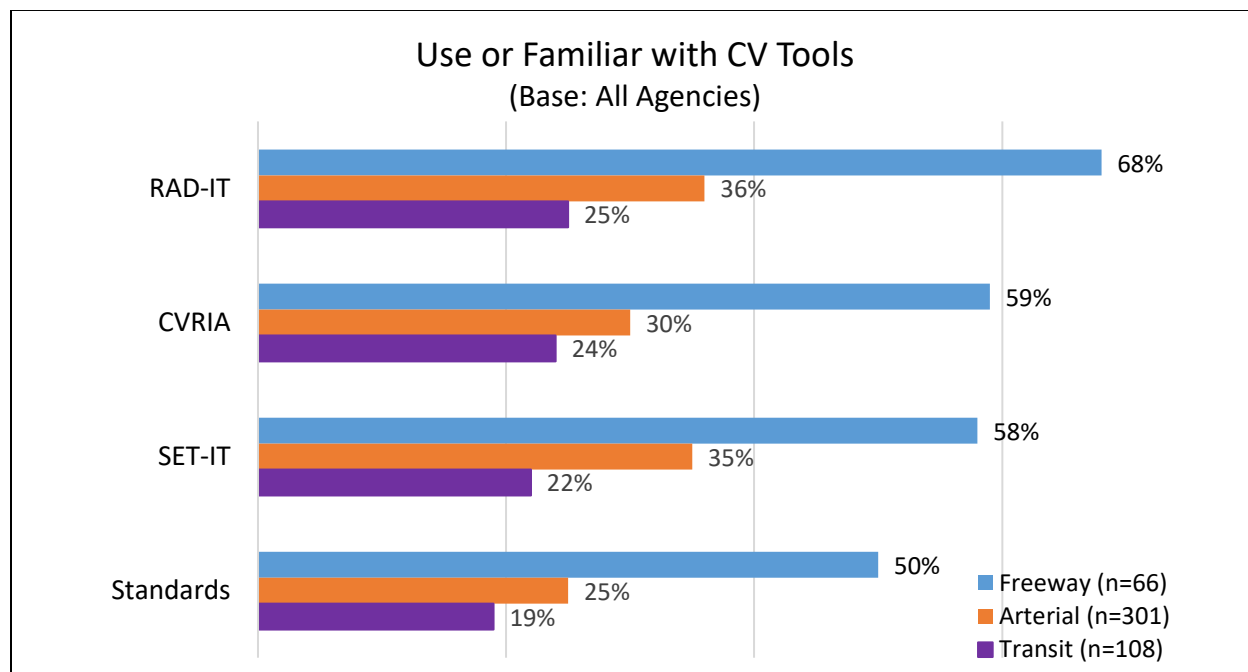
This section highlights agency engagement with CV architecture, tools, and standards. Specifically, the survey asked about familiarity and use with the following resources (a full breakout can be found in Appendix B, Table 39):

- Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT), which encompasses former National ITS Architecture and Connected Vehicle Reference Implementation Architecture (CVRIA),
- Systems Engineering Tool for Intelligent Transportation (SET-IT)
- Regional Architecture Development for Intelligent Transportation (RAD-IT), and
- US and International Standards associated with CV and AV deployment (e.g. SAE J2735, SAE J2945 Family, ISO 19091).

In line with their higher level of CV engagement, freeway agencies consistently show the highest levels of engagement (use or familiar) with CV architecture, tools, and standards. Figure 17 shows they lead the way in use/familiarity of RAD-IT (68 percent), CVRIA (59 percent), and SET-IT (58 percent).<sup>8</sup> Use/familiarity with Standards (50 percent) is also highest among freeway agencies. Use/familiarity among arterial agencies is moderate, with RAD-IT at 36 percent, SET-IT at 35 percent, CVRIA at 36 percent, and Standards coming in lower at 25 percent. Transit lags behind freeway and arterial agencies with only 20 to 25 percent of agencies indicating use of or familiarity with any of these CV tools.

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<sup>8</sup> The percentages shown combine two responses: the percent who “use” the tool and the percent who are “familiar with, but do not use” the tool. See Appendix B, Table 39 for full breakout of responses.



Source: USDOT

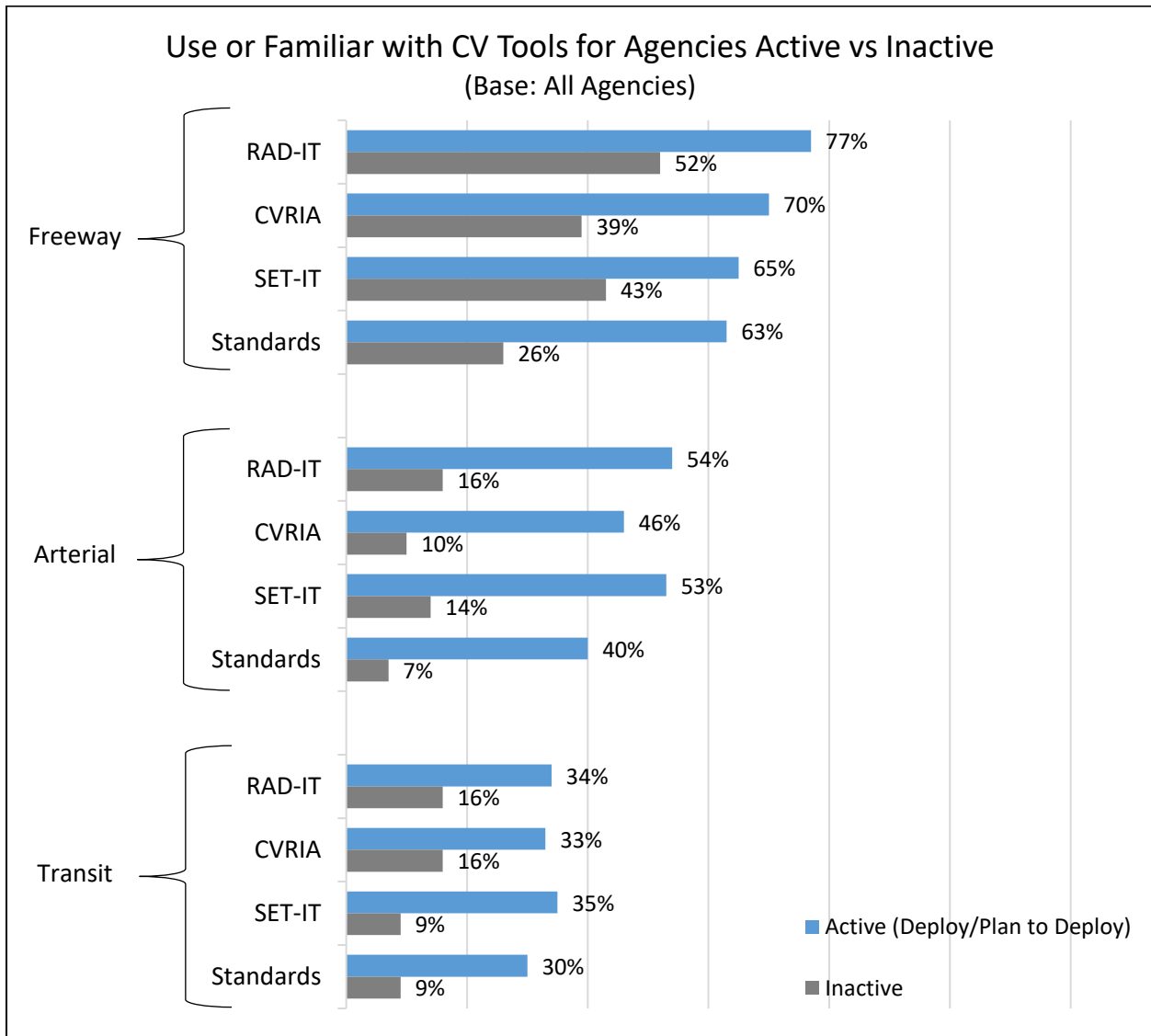
Q: Which of the response categories best describes your agency's usage and familiarity with each of the following? (Responses: Use; Don't use, but familiar; Not familiar)

**Figure 17. Combined Use/Familiar with CV Tools by Agency Type**

Among the surveyed agencies that are active in CV deployment (deploying or planning), active freeway agencies report the highest use of or familiarity with all the CV tools: RAD-IT (77 percent), CVRIA (70 percent), SET-IT (65 percent), and Standards (63 percent). The other inactive freeway agencies still have a relatively high use/familiarity with RAD-IT (52 percent). The other tools, SET-IT (43 percent), CVRIA (39 percent), and Standards (26 percent), have expectedly lower but still substantial use/familiarity.

Similar to freeway agencies, active arterial agencies have the highest use of or familiarity with RAD-IT (54 percent), but SET-IT is close behind (53 percent). CVRIA (46 percent) and Standards (40 percent) have lower use/familiarity. Unlike freeway agencies use/familiarity with CV tools declines substantially among inactive arterial agencies: RAD-IT (16 percent), SET-IT (14 percent), CVRIA (10 percent), and Standards (7 percent).

Transit use of or familiarity with CV tools is minimal. Even among the active transit agencies use/familiarity is relatively low: SET-IT (35 percent), RAD-IT (34 percent), CVRIA (33 percent) and Standards (30 percent). The use or familiarity with the CV tools among the inactive transit agencies is similar to the inactive arterial agencies: RAD-IT (16 percent), CVRIA (16 percent), SET-IT (9 percent), and Standards (9 percent).



Source: USDOT

Q: Which of the response categories best describes your agency's usage and familiarity with each of the following? (Responses: Use; Don't use, but familiar; Not familiar)

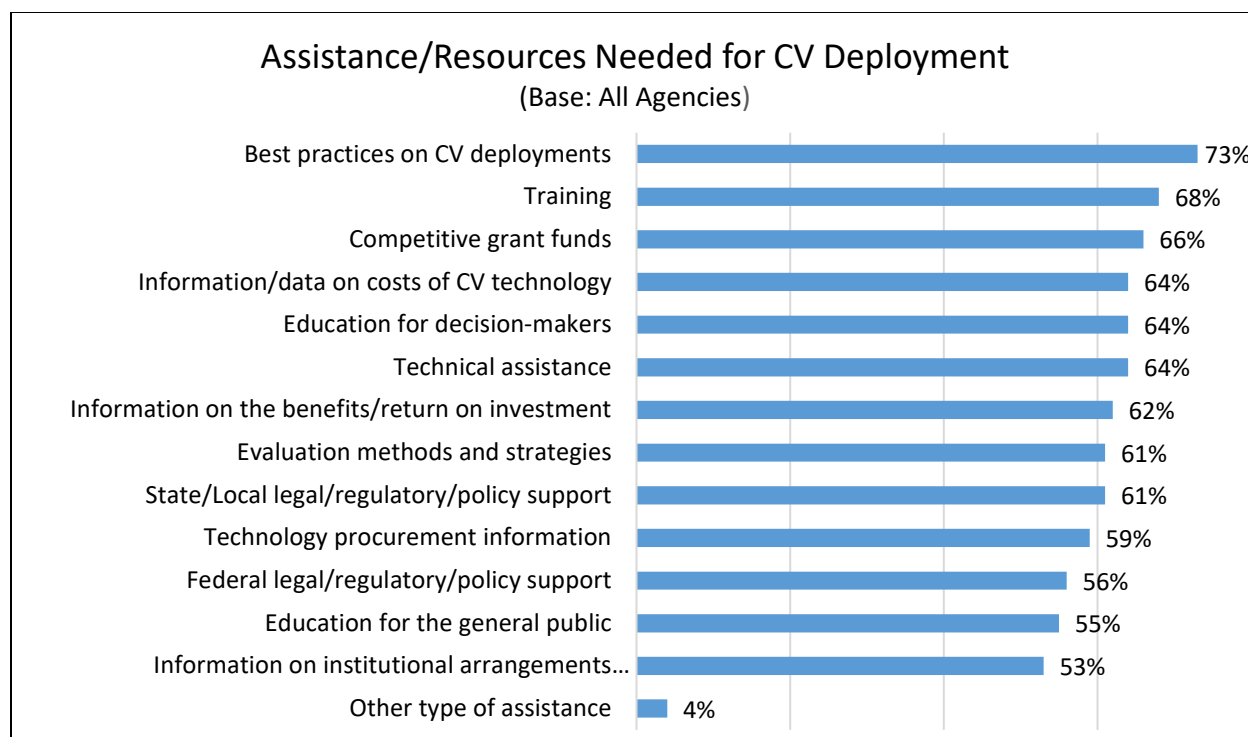
**Figure 18. Combined Use/Familiar with CV Tools (Active vs Inactive) by Agency Type**

## Assistance and Resources Needed for CV Deployment

This section highlights the different types of assistance and resources needed from agencies to support CV deployments. Figure 19 displays the responses by the total sample. There were no significant differences by agency type; those findings can be found in Appendix B, Table 41.

Figure 19 shows that agencies seek a wide range of resources to support CV deployments, as all of the items surveyed were selected by over 50 percent of agencies. Types of assistance topping the list include information-based resources such as *Best Practices on CV Deployment* (73 percent), *Data on Cost of CV Technologies* (64 percent), and *Information on Benefits/Return on Investment* (62 percent). Resources related to *Training* (68 percent) *Education* (64 percent), and *Technical Assistance* (64 percent) were also high on the list. *Information on Competitive Grants* (64 percent) was also sought.

A follow up question asked agencies to specify the type of training they would need. The open-end responses are found in Appendix C, **Error! Reference source not found.** to Table 76.



Source: USDOT

Q: *What types of assistance or resources does your agency need to support automated vehicle testing or deployment? (Select all that apply)*

**Figure 19. Types of Assistance and Resources for CV Deployment**



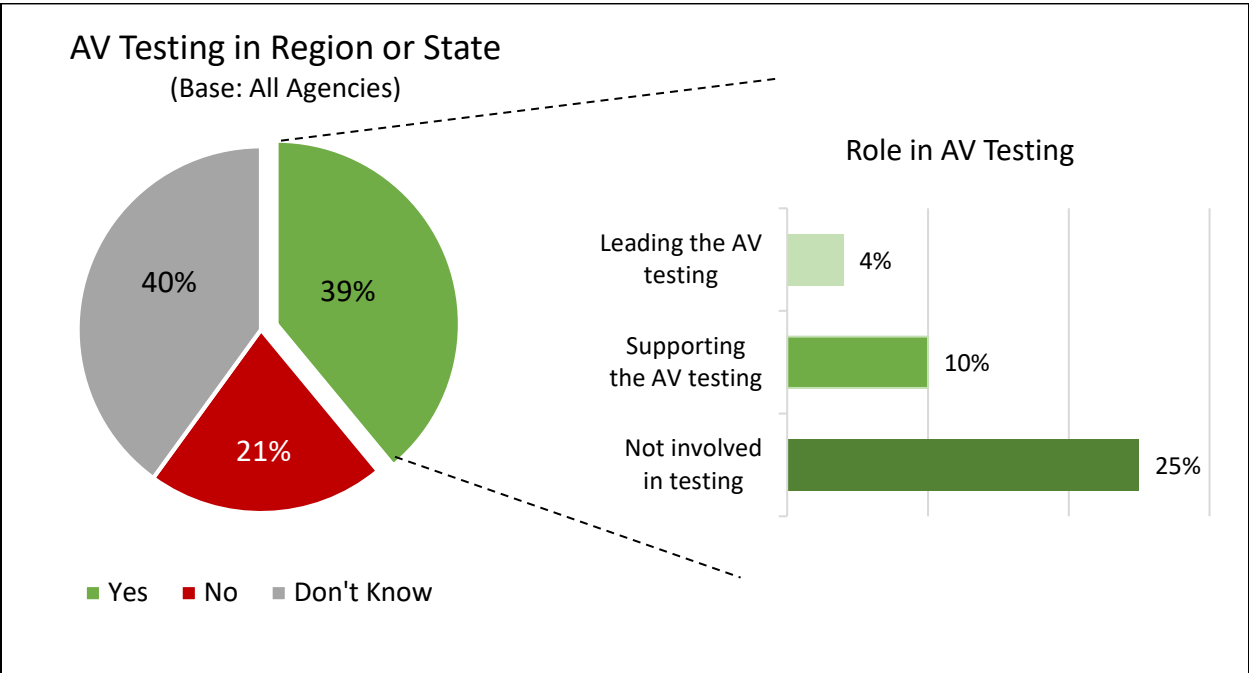
# Chapter 4. Automated Vehicle Findings

This chapter explains findings derived from the automated vehicle (AV) section of the CV/AV Survey.

## Presence of Automated Vehicle Testing

This section covers AV testing or deployment reported by agencies at the regional or state level, the role freeway, arterial, and transit agencies play, and the other entities supporting or leading the AV testing or deployment.

Among all the surveyed agencies, over one-third (39 percent) report automated vehicle testing or deployment occurring in their region or state. Of those 39 percent, only 14 percent reported they were actively involved in the testing; 10 percent support the AV testing, and 4 percent lead the AV testing. The remaining 25 percent of agencies are not involved in the AV testing.



Source: USDOT

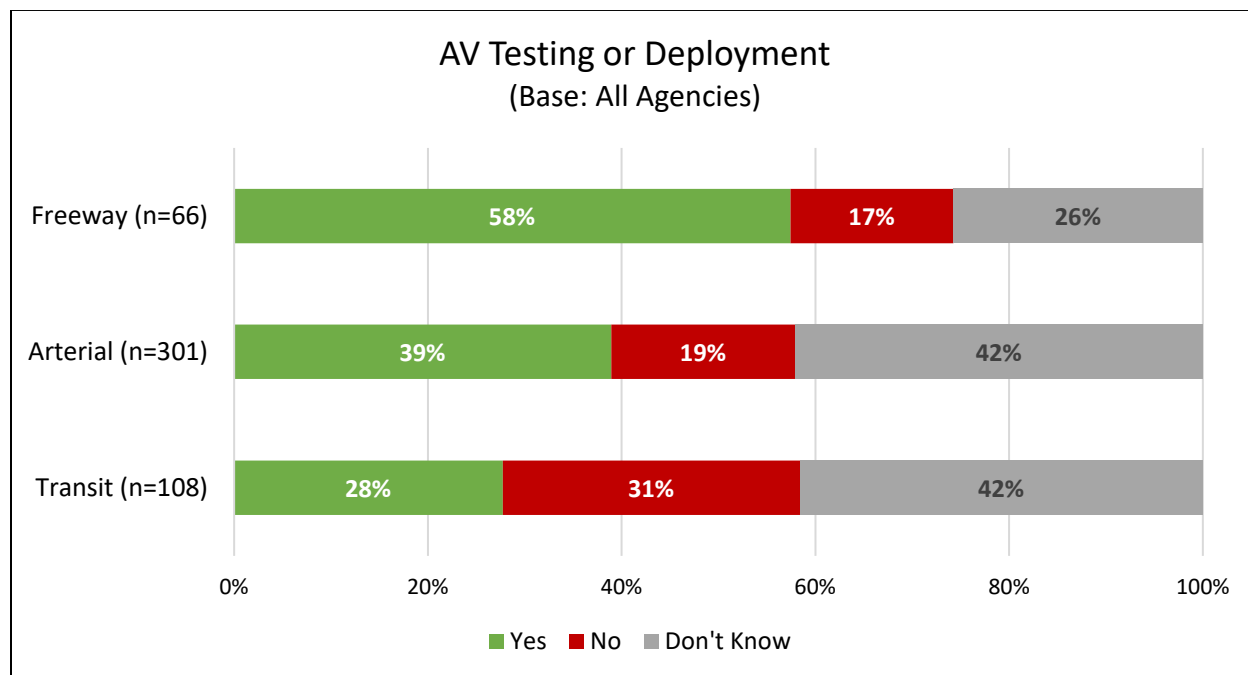
Q. Are there any automated vehicle tests or deployments that are being conducted or have been conducted in your region/state? (Please select one)

Q. What is your agency's primary role in the automated vehicle testing or deployment?

Figure 20. AV Testing in Region or State

## Reported AV Activity by Agency Type

Freeway agencies are the most aware of AV testing or deployments. A total of 58 percent of freeway agencies reported having AV testing or deployment in their region or state, 17 percent reported no AV activity, and 26 percent said that they did not know. Only 39 percent of arterial agencies indicate AV activity, while 19 percent reported that there was no activity, and 42 percent said they did not know. Transit agencies report the least activity: only 28 percent cite testing or deployment and 31 percent report that there is no testing. As with arterial agencies, 42 percent of transit agencies did not know if there was any AV activity in their state.



Source: USDOT

Q. Are there any automated vehicle tests or deployments that are being conducted or have been conducted in your region/state? (Please select one)

**Figure 21: Awareness of AV Testing/Deployment by Agency Type**

## Role in AV Testing by Agency Type

The degree to which agencies are involved in AV testing or deployment is presented in Table 11. Only a small fraction of agencies surveyed play any role in AV testing (four percent *leading role*, 10 percent *supporting role*). One-quarter reported they are *not involved* in the testing (25 percent), and a majority indicated there is *no testing* (or *don't know*) in their region/state (61 percent). Freeway agencies tend to be more involved than the other agency types. Nine percent of freeway agencies indicate playing a *leading role* in testing and 20 percent report a *supporting role*. In contrast, only three percent of arterial agencies report playing a *leading role* and eight percent report a *supporting role*. If transit agencies have any involvement in AV, it tends to be a supporting role; only one percent report *leading AV* tests/deployments, and 10 percent report a *supporting role*.

**Table 11: Role of Agency in AV Testing by Agency Type**

Agency Role	Total	Freeway	Arterial	Transit
Leading role	4%	9%	3%	1%
Supporting role	10%	20%	8%	10%
Not involved (but aware of testing in Region/State)	25%	29%	28%	17%
No Testing in Region/State or Don't Know	61%	42%	61%	73%

Source: USDOT

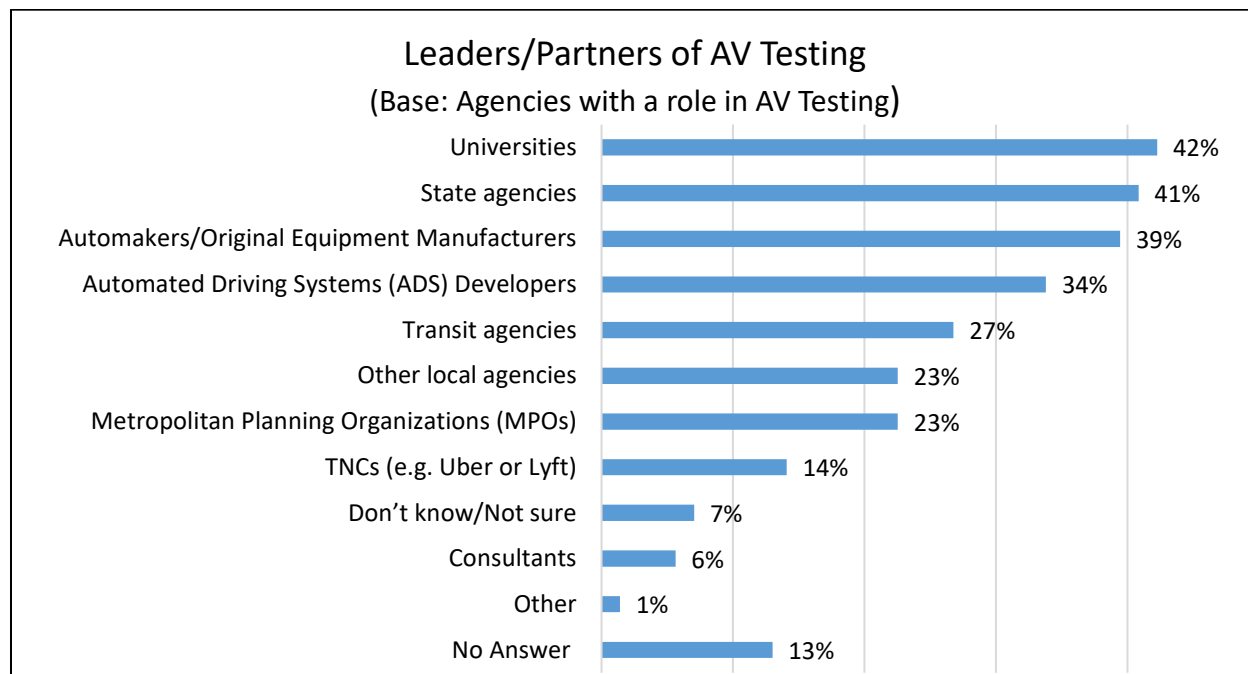
Q: What is your agency's primary role in the automated vehicle testing or deployment?

Agencies that were either leading or supporting AV testing/deployment were asked to describe their role in more detail. A few examples are provided below (see Appendix B, Table 77 for all responses).

- *[Leading]* "We have done several AV bus shuttle demos using ezmile 10 products. We have done several demos and research projects testing different supporting technologies like lidar testing and GPS lane keeping. Will be conducting an automated crash cushion test and deploying on work zones next summer."
- *[Leading]* "[Our] city had two pilot programs for autonomous shuttle service as part of its ride share program. One pilot used autonomous shuttle (EasyMile) driving on dedicated route without mixing into regular traffic area. The second pilot program were *[sic]* more robust with Drive.AI which included autonomous shuttle service on city streets with mix traffic condition navigating through signals and other traffic controls."
- *[Supporting AV]* "We allow full closure to freeways to test AV at our Proving Ground routes. In return, we participate on those testing to learn where are the technology now and what is their challenges/opportunities. Also, we learn what AV really needs from our infrastructure."
- *[Supporting AV]* "We are one of the founding member of Arizona's Institute of Automated Mobility (IAM) ..."

## Other Entities Involved in AV Testing

In addition to local agencies, a range of different organizations are involved in AV testing or deployment. The most common organizations reported by agencies with a role in AV testing (leading or supporting AV testing) include *Universities* (42 percent), *State Agencies* (41 percent), *Automakers or Original Equipment Manufacturers (OEM)* (39 percent), and *Automated Driving Systems (ADS) Developers* (34 percent). Less frequently involved are *Other Transit Agencies* (27 percent), *Other Local Agencies* (23 percent), *Metropolitan Planning Organizations (MPO)* (23 percent), and *Transportation Network Companies (TNC)* (14 percent). Very few agencies reported *Consultants* (6 percent) or *Other* entities (1 percent), and some agencies *did not know* (7 percent) or *did not answer this question* (13 percent).



Source: USDOT

Q: What entity(ies) are/were leading the automated vehicle testing or deployment in your region/state? (Select all that apply) Base: Agencies with role in AV testing n=71

Figure 22. Entities Leading or Partnering in AV Testing

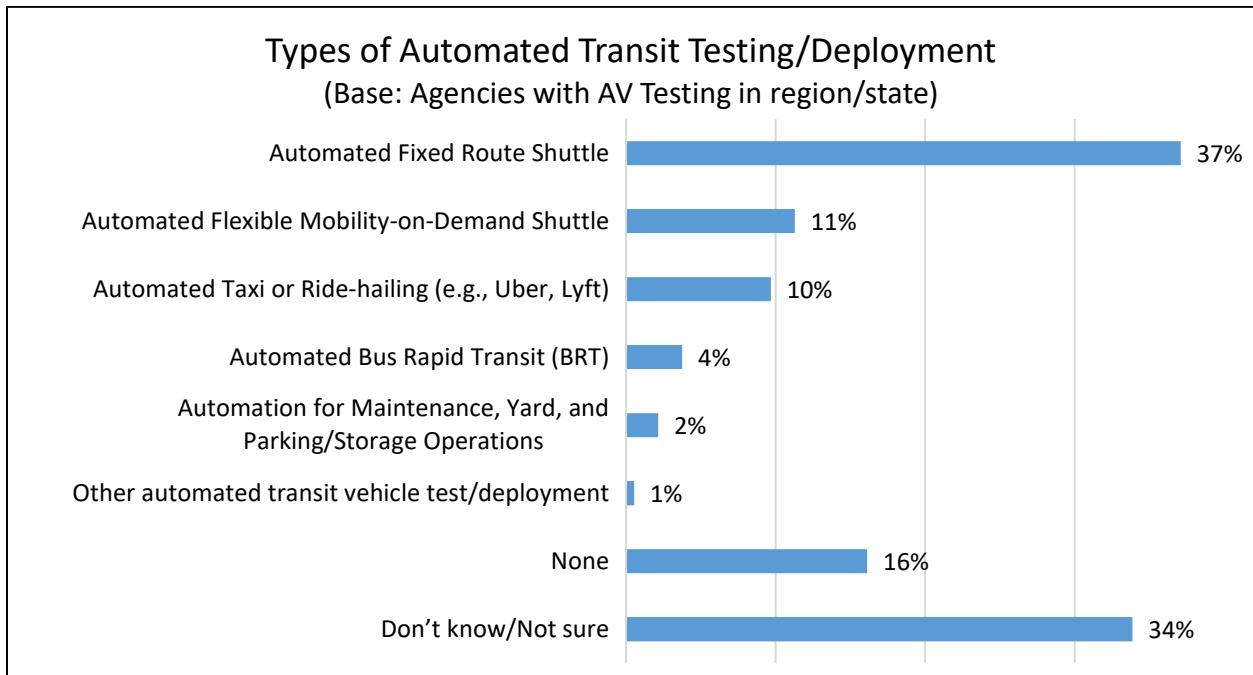
## Automated Vehicle Testing and Deployments

This section highlights the types of AV testing or deployments that are being or have been conducted. There are three categories of AV testing/deployments: Automated Transit Vehicles, Automated Commercial Vehicles, and Automated Light Duty Passenger Vehicles (other than for automated transit).

### Automated Transit Vehicles

Among the agencies that reported AV testing or deployments in their region or state, the most common type of automated transit test is *Automated Fixed Route Shuttle* (37 percent). However, a similar percentage of agencies (34 percent) reported they *don't know* of any automated transit tests, and 16 percent of agencies reported there are *none* (see Figure 23).

The other types of automated transit testing/deployments reported include *Automated Flexible Mobility-on-Demand Shuttle* (11 percent), *Automated Taxi or Ride-hailing* (10 percent), *Automated Bus Rapid Transit (BRT)* (4 percent), *Automation for Maintenance/Yard and Parking/Storage Operations* (2 percent), and any *Other Automated Transit Vehicle Test* (1 percent).



Source: USDOT

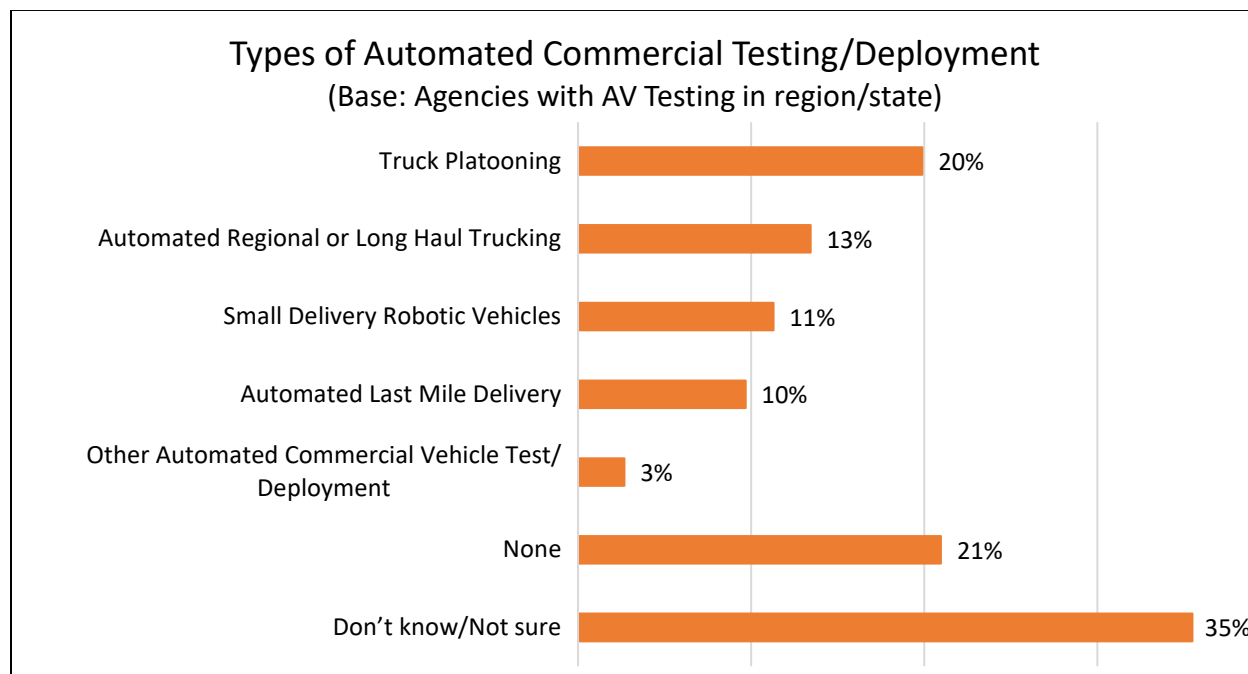
Q. Which, if any, of the following automated transit vehicle (e.g., bus, shuttle, etc.) tests or deployments are or were being conducted? Base: Agencies with AV testing in region/state n=185

**Figure 23. Automated Transit Vehicle Testing/Deployments**

## Automated Commercial Vehicles

Figure 24 shows that *Truck Platooning* (20 percent) was the most common automated commercial vehicle test/deployment reported by agencies with AV testing or deployment in their region/state. However, a larger share of these agencies reported they *don't know or are not sure* (35 percent) if there are automated commercial tests, and 20 percent of agencies reported there are *no commercial vehicle tests*.

Other types of automated commercial tests/deployments reported include *Automated Regional or Long Haul Trucking* (13 percent), *Small Delivery Robotic Vehicles* (11 percent), *Automated Last Mile Delivery* (10 percent), and *Other Automated Commercial Vehicle test/deployments* (3 percent).



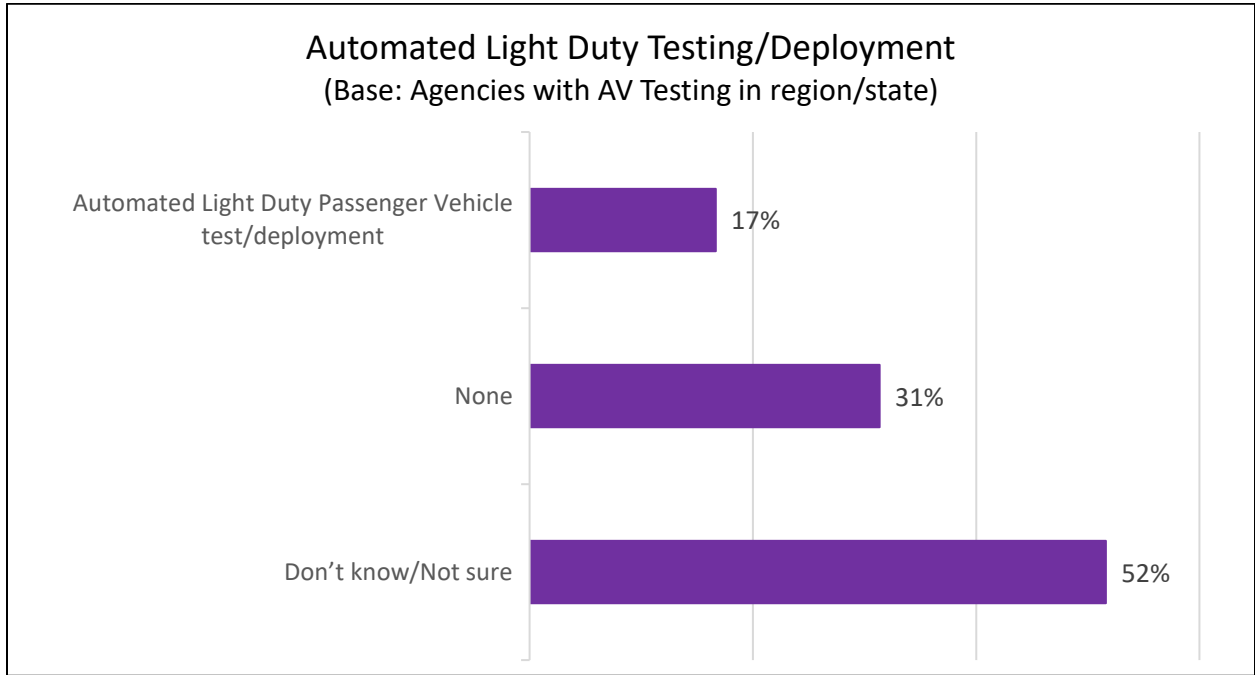
Source: USDOT

Q. Which, if any, of the following automated commercial vehicle (e.g., delivery truck, large truck) tests or deployments are or were being conducted? Base: Agencies with AV testing in region/state n=185

**Figure 24. Automated Commercial Vehicle Testing/Deployments**

## Automated Light Duty Passenger Vehicles

Figure 25 shows that 17 percent of agencies reporting AV testing/deployments in their region or state confirm that Automated Light Duty tests/deployments are being conducted. However, a majority of these agencies said they don't know or are not sure (52 percent) if such testing is occurring, and about one-third of these agencies report there is no automated light duty testing (31 percent).



Source: USDOT

Q. Are or were any automated light duty passenger vehicle tests or deployments being conducted (other than automated transit)? Base: Agencies with AV testing in region/state n=185

**Figure 25. Automated Light Duty Testing/Deployments**

## Common Automated Vehicle Testing

Table 12 combines all the surveyed AV tests/deployments into one table, showing the results in total and by agency type, and highlighting the top two tests/deployments for each agency type. Across all agency types, Automated Fixed Route Shuttles (37 percent) are one of the most reported types of testing/deployment for agencies with AV testing in their region or state. Of the small number of transit agencies aware of testing in their region/state, a majority report testing Automated Fixed Route Shuttles (50 percent), which is the most commonly reported test among arterial agencies as well (37 percent). Transit agencies also report testing Automated Flexible Mobility-on-Demand Shuttle Service (27 percent).

Among freeway agencies aware of testing in their region/State, a slightly greater share report Truck Platooning (34 percent) as their most common AV testing/deployment compared to Automated Fixed Route Shuttle tests (29 percent). There is also some degree of Truck Platooning among arterial agencies (18 percent). Automated light duty passenger vehicle testing/deployment is reported evenly across all agencies types; freeway (16 percent), arterial (17 percent), and transit agencies (17 percent).

**Table 12. Summary of AV Testing/Deployments by Agency Type**

AV Testing	Total	Freeway	Arterial	Transit
<i>Number of Respondents (Base: Agencies reporting AV testing in region/state)</i>	185	38	117	30
Automated Fixed Route Shuttle	37%	29%	37%	50%
Truck Platooning	20%	34%	18%	10%
Automated Light Duty Passenger Vehicle test/deployment	17%	16%	17%	17%
Automated Regional or Long Haul Trucking	14%	16%	15%	7%
Automated Flexible Mobility-on-Demand Shuttle Service	11%	11%	8%	27%
Small Delivery Robotic Vehicles	11%	8%	10%	20%
Automated Last Mile Delivery	10%	3%	10%	17%
Automated Taxi or Ride-hailing (e.g., Uber, Lyft)	10%	5%	10%	13%
Automated Bus Rapid Transit (BRT)	4%	0%	6%	0%
Automation for Maintenance, Yard, & Parking/Storage Operations	2%	0%	3%	3%

Source: USDOT

Q. Which, if any, of the following automated [Transit/Commercial/Light Duty] tests or deployments are or were being conducted?

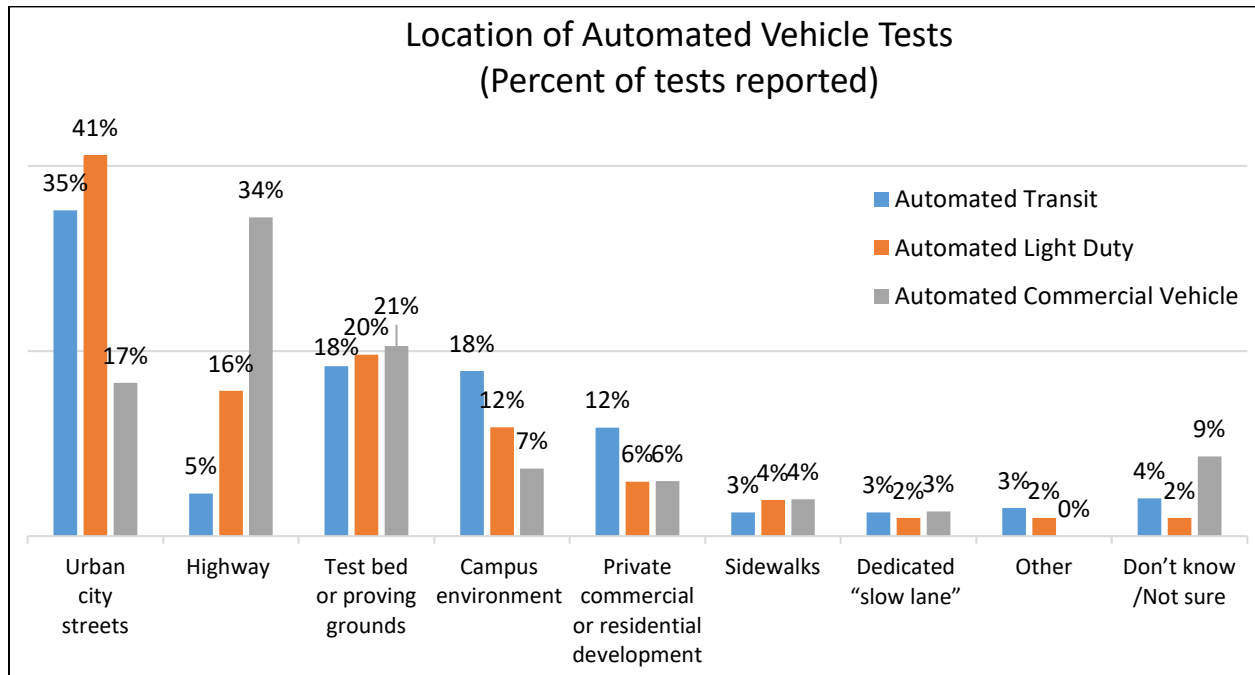


## Location of Automated Vehicle Testing

Figure 26 shows, at the category level, where automated vehicle test are conducted. Automated Transit tests occur most often on *urban city streets* (35 percent), but *test beds or proving grounds* (18 percent), *campus environments* (18 percent), and *private commercial or residential development* (12 percent) are also options for testing.

Automated Light Duty Passenger Vehicle tests also occur most often on *urban city streets* (41 percent). *Test beds or proving grounds* (20 percent) and *highways* (16 percent) are less commonly used, and a small amount of testing is found on *campus environments* (12 percent).

Automated Commercial Vehicle testing most often takes place on *highways* (34 percent), and to a lesser extent at *test beds or proving grounds* (21 percent) and on *urban city streets* (17 percent).



Source: USDOT

Q. Where is/was the [ENTER TEST] testing or deployment occurring? (Select all that apply).

Base: Reported AV tests, transit n=196, light duty n=51, commercial vehicle n=151

Figure 26. Location of AV Testing

## Challenges to AV Testing/Deployment

Table 13 shows the list of challenges to AV deployment selected by at least 40 percent of surveyed agencies. These challenges are reported in total and by agency type. The top three items are highlighted for each agency type. A full list of challenges can be found in Appendix B, Table 54.

Across agency types, the top three reported challenges to AV deployment are related to funding and cost: *Limited Funding* (56 percent), *Cost of Automated Technology* (55 percent), and *Cost of Required Updates to Communications and/or Physical Infrastructure* (53 percent). A few other challenges rise to the top by agency type. For freeway agencies, legal and policy issues are a top challenge, with 53 percent selecting both *Legal/Policy/Regulatory Issues at the State or Local Level* and *Lack of a Regulatory Framework*. *Staff with the Right Qualifications/Expertise* (53 percent) is also selected a top concern for this group. Transit agencies also see *Legal/Policy/Regulatory Issues* as a top challenge (52 percent), while arterial agencies report *Cost to Operate and Maintain AV Technology* (54 percent) as a top issue.

**Table 13. Challenges to AV Testing/Deployment by Agency Type**

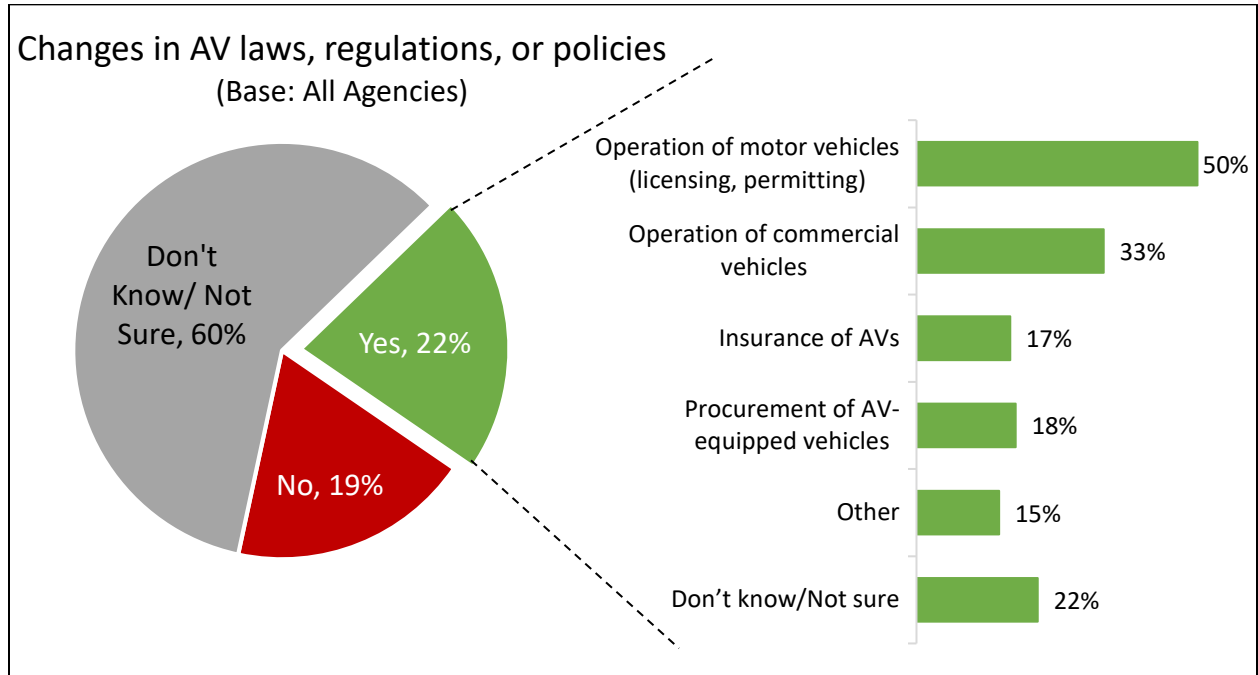
Challenges to planning or conducting AV testing/deployment	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	475	66	301	108
Limited funding	56%	56%	56%	56%
Cost of automated technology	55%	53%	53%	63%
Cost of required updates to communications and/or physical infrastructure	53%	56%	52%	51%
Cost to operate and maintain AV technology	52%	50%	54%	47%
Legal/policy/regulatory issues at the State or local level	48%	53%	46%	52%
Lack of staff with the right qualifications/expertise	48%	53%	47%	45%
Too much technical risk; want to wait until technology and standards mature	47%	42%	46%	50%
Lack of a regulatory framework	47%	53%	46%	44%
Integrating new technology with current systems	44%	42%	45%	42%
Uncertainty about the information/communications technologies needed	44%	41%	46%	39%
Lack of support for long term operations and maintenance	44%	44%	45%	39%
Legal/policy/regulatory issues at the Federal level	40%	44%	39%	44%

Source: USDOT

Q. Does your agency face any of the following challenges in planning or conducting automated vehicle testing or deployment?

## Changes in Laws/Regulations for AV

The majority of surveyed agencies don't know or are not sure (60 percent) if there has been a change to their laws, regulations, or policies regarding AV testing/deployment. Only about one-fifth of agencies report that there has been a change to their laws (22 percent). Of the agencies that reported a change, the most common law, regulation, or policy change for AV is related to the Operation of Motor Vehicles (50 percent). Other reported changes include Operation of Commercial Vehicles (33 percent), Insurance of AVs (17 percent), and Procurement of AV-equipped vehicles (18 percent).



Source: USDOT

Q: Has your state or locality changed (or in the process of changing) their laws, regulations or policies to accommodate automated vehicles? (Select one) Base: all agencies n=475

Q: What laws, regulations, or policies have been or are being changed? (Select all that apply) Base: agencies reporting changes to laws n=102

**Figure 27. Changes in Laws/Regulations for AV**

## AV Readiness

Overall, relatively few surveyed agencies have undertaken AV readiness activities. Readiness among agencies with a role in AV was studied, to get some sense of what activities were undertaken or completed by those directly involved with AV tests/deployments. Among agencies with a role, *Partnering with Other Entities to Test AV* (54 percent) stands out as the most common readiness factor. Other top readiness activities include: *Conducting an AV Planning Study* (35 percent), *Including AV in Agency Planning Documents* (35 percent), and *Applying for a Federal Grant to Fund AV Testing* (35 percent).

**Table 14. Summary of AV Readiness Factors (Underway or Completed) by Agency Role**

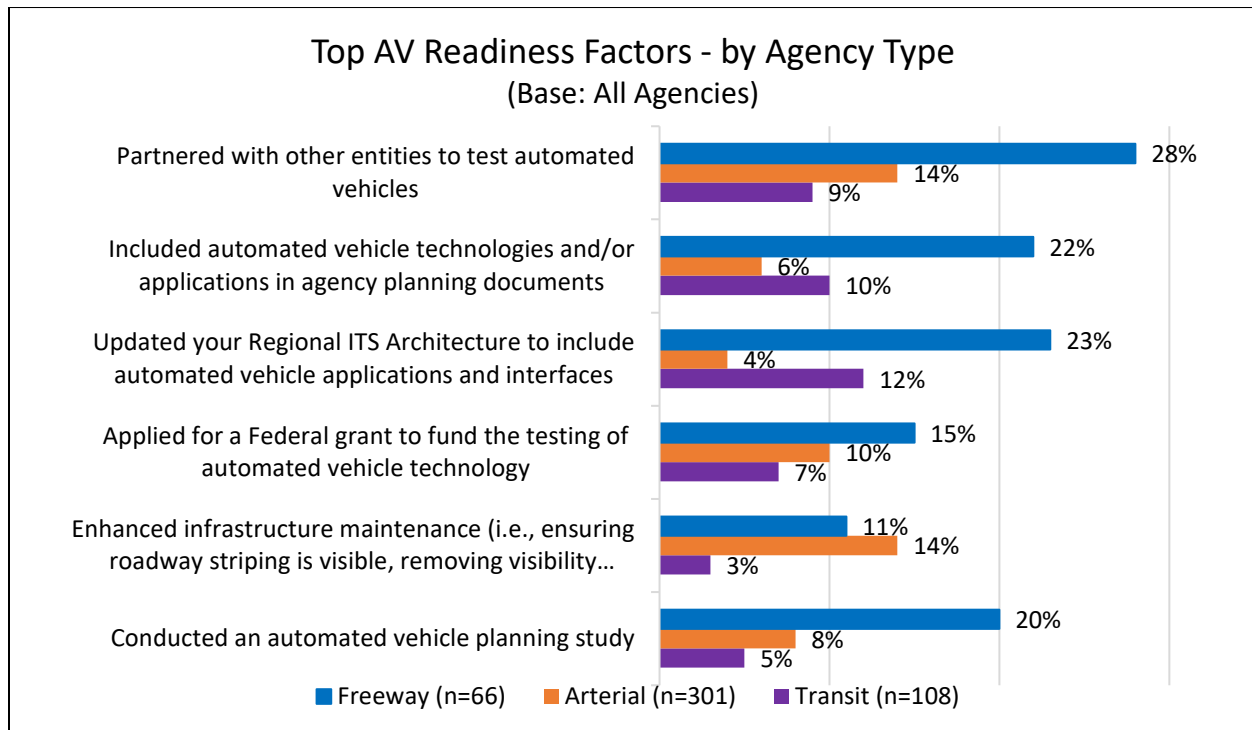
AV Readiness Factors (Percent Underway or Complete)	Total	Agency Has Role	Agency Has No Role/Not Testing
<i>Number of Respondents</i> <sup>9</sup>	474	71	403
Partnered with other entities to test automated vehicles	13%	54%	6%
Included automated vehicle technologies and/or applications in agency planning documents	11%	35%	7%
Updated your Regional ITS Architecture to include automated vehicle applications and interfaces	11%	27%	9%
Applied for a Federal grant to fund the testing of AV technology	9%	35%	4%
Enhanced infrastructure maintenance	9%	17%	8%
Conducted an automated vehicle planning study	8%	35%	3%
Developed local regulations or other policies regarding AV testing and operations	6%	23%	3%
Upgraded physical infrastructure for automated vehicles	6%	15%	4%
Procured contractor support for automated vehicles technologies	5%	27%	1%
Hired staff with knowledge about automated vehicles	4%	14%	3%
Developed ConOps or initial systems engineering planning documents for AV projects	3%	11%	2%
Created a data management plan for collecting, storing, analyzing, reporting and protecting privacy of AV data	3%	15%	1%
Created a data repository for storing AV data	3%	14%	1%

Source: USDOT

Q. The US Department of Transportation is trying to understand agencies' readiness to deploy AV technology. For each of the following activities, please indicate your agency's current status.

<sup>9</sup> Data is missing for one agency.

Figure 28 shows the top six readiness factors undertaken or completed by agency type. In general, freeway agencies are taking the lead in AV readiness. A greater share of freeway agencies report readiness activities including: *Partnering with Other Entities to Test AV* (28 percent), *Updating Regional ITS Architecture* (23 percent), *Including AV Technologies and/or Applications in Planning Documents* (22 percent), and *Conducting an AV Planning Study* (20 percent). Arterial agencies lead on only one of the top readiness factor *Enhanced Infrastructure Maintenance* (14 percent). Transit lags behind, with only 3 to 10 percent reporting undertaking any of the top readiness factors. The full list of readiness activities by agency type is in Appendix B, Table 60.



Source: USDOT

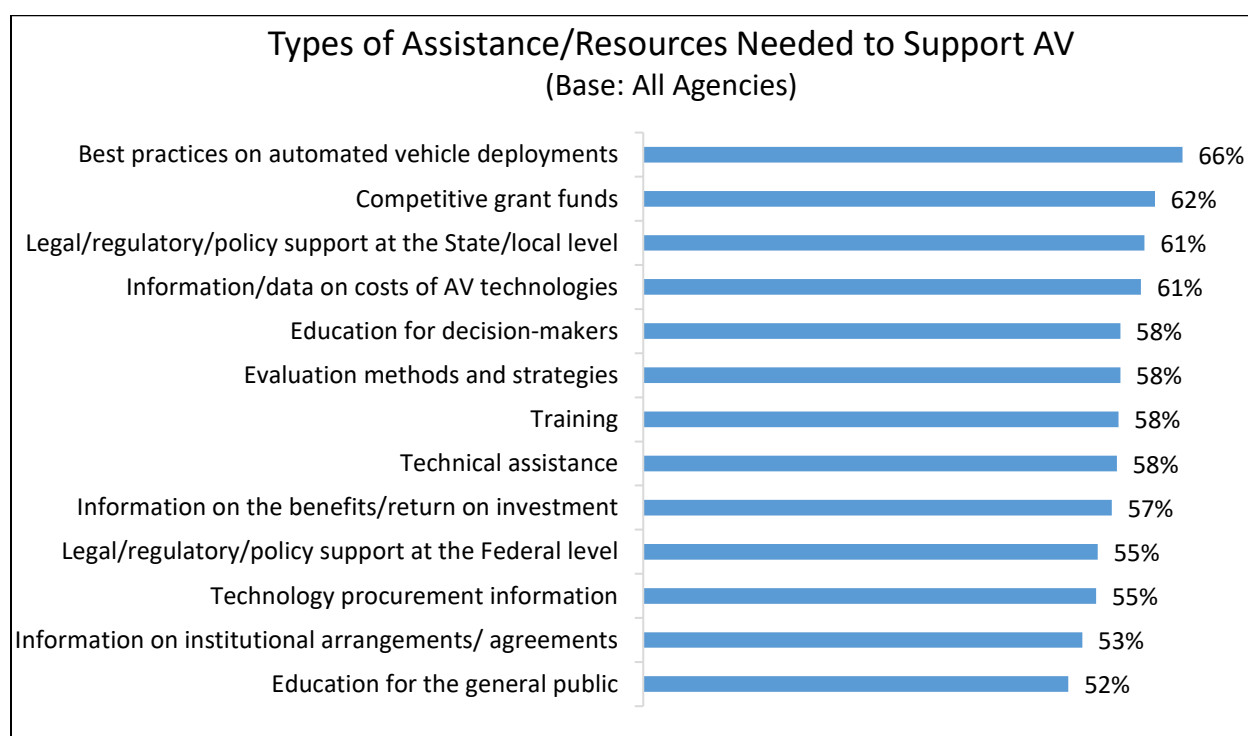
Q. The US Department of Transportation is trying to understand agencies' readiness to deploy AV technology. For each of the following activities, please indicate your agency's current status

**Figure 28: Top Readiness Factors by Agency Type**

## Assistance and Resources Need for AV Deployment

Each of the surveyed options for support of AV deployment was selected as by over 50 percent of all agencies (see Figure 29), showing that agencies are looking for a wide range of resources to support AV deployment. *Best Practices on AV Deployments* (66 percent) is the most desired resource. The other top assistance and resources chosen are *Competitive grant funds* (62 percent), *Legal/Regulatory/Policy Support of the State or Local Level* (61 percent), and *Information/Data on Costs of AV Technologies* (61 percent).

Overall, freeway agencies indicated a greater need for most types of support. A full list of assistance and resources by agency type is in Appendix B, Table 64. In addition, a follow up question asked agencies to specify the type of training they would need. The open-end responses are found in Appendix C, Table 81 to Table 85.



Source: USDOT

Q. What types of assistance or resources does your agency need to support automated vehicle testing or deployment?  
(Select all that apply)

**Figure 29. Assistance and Resources Needed for AV Deployment**

# Chapter 5. Conclusions and Next Steps

The 2019 Connected Vehicle and Automated Vehicle Survey (CV/AV Survey) was conducted to provide information on the current state of connected vehicle and automated vehicle deployment. The CV/AV Survey provides baseline data for use in monitoring the progress of connected and automated vehicle deployment using future DTS surveys. The CV/AV Survey findings will also inform the redesign of the base Deployment Tracking Survey as well as subsequent research efforts related to connected and automated vehicles.

## Conclusions

The surveyed freeway, arterial, and transit agencies are still in the early stages of connected and automated vehicle deployment. In 2019, a quarter of surveyed agencies reported deploying connected vehicles, although another 30 percent indicated plans to deploy. Freeway agencies lead the way, with two-thirds active in CV (deploying or planning to deploy), compared to roughly half of arterial and transit agencies. Despite a slower start however, arterial and transit agencies show significant uptake in CV deployment activity since 2016; while freeway activity remains constant.

There are only a few CV applications that a majority of active agencies plan to deploy. These include agency data applications and a set of traffic-signal-based applications designed to improve mobility. Each agency type has a set of CV applications that meet its unique needs. Freeway agencies select applications focused on improving highway safety and mobility, arterial agencies seek traffic signal-based solutions to mobility and safety issues, and transit agencies gravitate to vehicle-to-vehicle safety applications, and transit specific solutions to improve customer service and operations.

Roughly 40 percent of surveyed agencies report AV testing or deployment in their region or state, but only 14 percent are involved in the testing, with most playing a supporting rather than a leading role. Similar to CV, freeway agencies appear to be more aware and involved in AV testing/deployment. Across all agencies aware of AV testing, automated fixed route shuttle tests are the most reported, followed by truck platooning and automated light-duty vehicles. Test locations vary by vehicle type, with automated transit vehicle tests and automated light-duty vehicle tests occurring most frequently on urban city streets and automated commercial vehicle tests taking place on highways. Additionally, for all three vehicle types there is some use of test beds or proving grounds.

Readiness activities such as upgrading physical and communications infrastructure are key first steps for agencies considering CV. Partnering with other entities stands out as the most common readiness factor for agencies involved in AV testing. Readiness factors common to CV and AV include: applying for grant funding and including CV/AV in planning documents. Outside of those currently involved in CV and AV, few agencies are undertaking any of the surveyed readiness activities. This presents ITS JPO with an opportunity to support agencies as they take the first steps toward CV or AV deployment.

Agencies face many challenges and unknowns as they approach CV and AV deployment. Uncertainty around future spectrum allocation may be causing reluctance in committing to DSRC for CV communications. While two-thirds of agencies deploying CV indicate they are using DSRC, those who are planning to deploy CV are more divided with respect to communication technologies: 45 percent plan to use DSRC while 56 percent plan to use cellular. Lack of a regulatory framework and legal/policy issues are cited as barrier to testing or deploying automated vehicles. Other challenges that are common to CV and AV include funding, technology costs, as well as technical and staffing issues. Agencies seek a wide range of resources to support CV and AV, including best practices, competitive grant funds, education and training, and information on costs and benefits, among others.

## Next Steps

The CV/AV Survey data provides a current snapshot of CV and AV deployment progress among large and medium sized cities, and the ITS JPO will use the findings to better understand the ways in which it can support CV/AV deployment and technology transfer activities. In addition, the findings will inform any changes that may be needed to the survey instruments prior to the administration of the next CV/AV survey in 2021.

The ITS JPO is currently redesigning the DTS and will expand the survey population beyond large and medium size cities to also include agencies in small urban and rural areas. This change to the survey population will provide the ITS JPO with a more representative understanding of the level of ITS deployment throughout the US. In addition, this update to the survey methodology aligns with General Accountability Office's recommendation that the ITS JPO should track ITS among small urban and rural areas on a more regular basis.



# Appendix A. 2019 CV and AV Survey Instrument

Welcome to the 2019 Connected Vehicle and Automated Vehicle Survey.

This survey is being administered to assist the Intelligent Transportation Systems (ITS) Joint Program Office (JPO) with baselining and tracking Connected Vehicle (CV) and Automated Vehicle (AV) deployment and plans for deployment.

This survey is split into two sections; the first section asks questions about actual and planned CV deployment, and the second section asks about actual and planned AV deployment. The survey will take approximately 15 to 25 minutes, depending on your agency's involvement with CV and AV.

Thank you in advance for your time and effort. The ITS JPO greatly appreciates your participation.

## CONNECTED VEHICLES

Connected vehicles (CV) are vehicles that communicate wirelessly with each other, infrastructure, and wireless devices to share vital transportation information. Vehicles use wireless, sensor, or other communication systems to attain 360-degree awareness of nearby vehicles and infrastructure. This communication enables safety, mobility, environmental, and road weather benefits.

For more information about CV applications see [http://www.its.dot.gov/pilots/cv\\_pilot\\_apps.htm](http://www.its.dot.gov/pilots/cv_pilot_apps.htm)

### 1. Is your agency currently deploying Connected Vehicle technology? (Select one)

- (1) Yes
- (2) No, but plan to deploy in the future
- (3) No plans to deploy [SKIP TO Q6]
- (4) Don't know/Not sure [SKIP TO Q6]

### 2. [IF Q1= OPTION 2] When do you expect to deploy connected vehicle technology? (Select one)

- Within the next 3 years
- In 3 to 6 years
- In 7 or more years
- Don't know/Not sure

3. [IF Q1= OPTION 1] Is your agency partnering with other entities to deploy connected vehicle technology? (Select all that apply)

[IF Q1=OPTION 2] Does your agency plan to partner with other entities to deploy connected vehicle technology? (Select all that apply)

- Yes, public sector partner(s)
- Yes, private sector partner(s)
- Yes, college/university partner(s)
- Other partner(s) (please specify)
- No, not partnering [Exclusive]
- Don't know/Not sure [Exclusive]

[SHOW BASED ON RESPONSE TO Q1]

[In the next section, you are asked about whether your agency is [currently deploying or planning to deploy/planning to deploy] connected vehicle (CV) applications. You will see a selection of applications currently being tested in the field. For a complete listing of connected vehicle (CV) applications (including a brief description of each) visit the website:

[https://www.its.dot.gov/pilots/cv\\_pilot\\_apps.htm](https://www.its.dot.gov/pilots/cv_pilot_apps.htm)

4. CONNECTED VEHICLE APPLICATIONS

[IF Q1= OPTION 1 OR 2] For each of the following **Vehicle to Infrastructure (V2I) Safety Applications**, please indicate your agency's deployment status. (Select one response in each row)

Hover over the items with underlined text for more information

Vehicle to Infrastructure (V2I) Safety Applications	Currently Deploying [SHOW ONLY IF Q1= OPTION1]	Planning to Deploy [ASK IF Q1= OPTION 1 OR 2]	NOT planning to deploy	Don't Know	Not Applicable
<u>Red Light Violation Warning (RLVW)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Curve Speed Warning (CSW)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Stop Sign Gap Assist (SSGA)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Reduced Speed/Work Zone Warning (RSWZ)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Pedestrian in Signalized Crosswalk Warning (Transit)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other V2I Safety Application (please specify):	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- [IF Q1= OPTION 1 OR 2] For each of the following **Vehicle to Vehicle (V2V) Safety Applications**, please indicate your agency's deployment status. (Select one response in each row)

Hover over the items with underlined text for more information

<b>Vehicle to Vehicle (V2V) Safety Applications</b>	Currently Deploying [SHOW ONLY IF Q1= OPTION1]	Planning to Deploy [ASK IF Q1= OPTION 1 OR 2]	NOT planning to deploy	Don't Know	Not applicable
<u>Emergency Electronic Brake Lights (EEBL)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Forward Collision Warning (FCW)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Intersection Movement Assist (IMA)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Left Turn Assist (LTA)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Blind Spot/Lane Change Warning (BSW/LCW)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Do Not Pass Warning (DNPW)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Vehicle Turning Right in Front of Bus Warning (Transit)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other V2V Safety Application (please specify):	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- **[IF Q1= OPTION 1 OR OPTION 2]** For each of the following **Mobility-related CV Applications**, please indicate your agency's deployment status. *(Select one response in each row)*

Hover over the items with underlined text for more information

<b>Mobility-related CV Applications</b>	Currently Deploying [SHOW ONLY IF Q1= OPTION1]	Planning to Deploy [ASK IF Q1= OPTION 1 OR 2]	NOT planning to deploy	Don't Know	Not Applicable
<u>Intelligent Traffic Signal System (I-SIG)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Transit Signal Priority</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Freight Signal Priority</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Emergency Vehicle Preemption (PREEMPT)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Dynamic Speed Harmonization (SPD-HARM)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Queue Warning (Q-WARN)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Cooperative Adaptive Cruise Control (CACC)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Response, Emergency Staging, Communications, Uniform Management, and Evacuation (R.E.S.C.U.M.E.)</u> (e.g., Incident Scene Staging Guidance for Emergency Responders (RESP-STG), Incident Scene Work Zone Alerts (INC-ZONE), Emergency Communications and Evacuation (EVAC))	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Integrated Dynamic Transit Operations (IDTO)</u> (e.g. Connection Protection (T-CONNECT), Dynamic Transit Operations (T-DISP), and Dynamic Ridesharing (D-RIDE))	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<b>Mobility-related CV Applications</b>	Currently Deploying [SHOW ONLY IF Q1= OPTION1]	Planning to Deploy [ASK IF Q1= OPTION 1 OR 2]	NOT planning to deploy	Don't Know	Not Applicable
<u>Freight-Specific Dynamic Travel Planning and Performance</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other Mobility Application (please specify):	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[IF Q1= OPTION 1 OR 2] For each of the following **Environment-focused CV Applications**, please indicate your agency's deployment status. (Select one response in each row)

Hover over the items with underlined text for more information

<b>Environment-focused CV Applications</b>	Currently Deploying [SHOW ONLY IF Q1= OPTION1]	Planning to Deploy [ASK IF Q1= OPTION 1 OR 2]	NOT planning to deploy	Don't Know	Not applicable
<u>Eco-Approach and Departure at Signalized Intersections</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Dynamic Eco Routing</u> (light vehicle, transit, freight)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other Environment-focused Application (please specify):	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[IF Q1= OPTION 1 OR 2] For each of the following **Other CV Applications**, please indicate your agency's deployment status. (Select one response in each row)

Hover over the items with underlined text for more information

<b>Other CV Applications</b>	Currently Deploying [SHOW ONLY IF Q1= OPTION1]	Planning to Deploy [ASK IF Q1= OPTION 1 OR 2]	NOT planning to deploy	Don't Know	Not applicable
<u>Agency Data Applications (e.g. probe data collection, CV-enabled data collection etc.)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Road Weather Warnings (e.g., Motorist Advisories and Warnings (MAW) and Motorist Advisories and Warnings (MAW) Enhanced Maintenance Decision Support System (MDSS))</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Smart Roadside (e.g. Wireless Inspection and Smart Truck Parking)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other CV Applications (please specify):	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**5. [IF Q1=OPTION 1] Which of the following transportation objectives is your agency trying to achieve with the deployment of connected vehicle technology?(Select all that apply)**

**[IF Q1=OPTION 2] Which of the following transportation issues objectives will your agency be trying to achieve with the deployment of connected vehicle technology? (Select all that apply)**

	<b>Transportation Issues or Problems</b>	<b>Select all that apply</b>
<b>Safety</b>	Decrease vehicle crashes	<input type="checkbox"/>
	Decrease pedestrian crashes	<input type="checkbox"/>
	Decrease bicycle crashes	<input type="checkbox"/>
<b>Mobility</b>	Reduce travel time	<input type="checkbox"/>
	Reduce congestion	<input type="checkbox"/>
	Improve on-time performance of transit vehicles	<input type="checkbox"/>
	Improve travel time reliability	<input type="checkbox"/>
<b>Environment</b>	Increase throughput	<input type="checkbox"/>
	Reduce emissions	<input type="checkbox"/>
<b>Service</b>	Reduce fuel use	<input type="checkbox"/>
	Improve customer experience	<input type="checkbox"/>
	Improve accessibility	<input type="checkbox"/>
	Improve agency operations	<input type="checkbox"/>

	Transportation Issues or Problems	Select all that apply
<b>Productivity</b>	Reduce costs	<input type="checkbox"/>
	Increase ridership	<input type="checkbox"/>
	<b>Other (please specify):</b>	<input type="checkbox"/>
	<b>Don't know/Not sure [EXCLUSIVE]</b>	<input type="radio"/>
	<b>None [EXCLUSIVE]</b>	<input type="radio"/>

6. [IF Q1=OPTION 1 or 2] Does your agency face any of the following major challenges in planning or deploying connected vehicle technology? *(Select all that apply)*

[IF Q1=OPTION 3 or 4] Does your agency see any of the following as major barriers to planning or deploying connected vehicle technology? *(Select all that apply)*

	Challenges in Planning or Deploying CV	Select all that apply
<b>Cost</b>	Cost of connected vehicle technology	<input type="checkbox"/>
	Cost of required updates to communications and/or physical infrastructure (e.g. communications networks, traffic signal controllers, etc.)	<input type="checkbox"/>
	Cost to operate and maintain connected vehicle technology	<input type="checkbox"/>
<b>Technology</b>	Lack of information about connected vehicle technology	<input type="checkbox"/>
	Uncertainty about the information/communications technologies needed (e.g. DSRC vs. cellular)	<input type="checkbox"/>
	Too much technical risk; want to wait until technology and standards mature	<input type="checkbox"/>
	Uncertainty about the benefits of connected vehicles	<input type="checkbox"/>
	Data privacy issues (e.g. protection of Personally Identifiable Information)	<input type="checkbox"/>
	Cybersecurity issues	<input type="checkbox"/>
<b>Institutional</b>	Partnership issues	<input type="checkbox"/>
	Procurement issues	<input type="checkbox"/>
	Limited funding (e.g., due to competition for funds with other transportation projects)	<input type="checkbox"/>
	Lack of support from leadership and decision-makers	<input type="checkbox"/>
<b>Policy</b>	Lack of a regulatory framework	<input type="checkbox"/>
	Legal/policy/regulatory issues at the Federal level)	<input type="checkbox"/>
	Legal/policy/regulatory issues at the state or local level	<input type="checkbox"/>
<b>Operations</b>	Lack of public acceptance of connected vehicles	<input type="checkbox"/>

	<b>Challenges in Planning or Deploying CV</b>	<b>Select all that apply</b>
	Worker acceptance issues (e.g., apprehension, confusion, or annoyance with technology; union issues, etc.)	<input type="checkbox"/>
	Lack of staff with the right qualifications/expertise	<input type="checkbox"/>
	Lack of support for long term operations and maintenance	<input type="checkbox"/>
	Integrating new technology with current systems	<input type="checkbox"/>
<b>Data</b>	Data access issues	<input type="checkbox"/>
	Data storage issues	<input type="checkbox"/>
	Data governance concerns	<input type="checkbox"/>
	Other (please specify):	<input type="checkbox"/>
	<b>Don't know/Not sure [EXCLUSIVE]</b>	<input type="radio"/>
	<b>None/No current challenges [EXCLUSIVE]</b>	<input type="radio"/>

**7. [ASK ALL] The US Department of Transportation is trying to understand agencies' readiness to deploy connected vehicle technology. For each of the following activities, please indicate your agency's current status. (Select one response per row)**

*Information on institutional arrangements and agreements*

	<b>Underway or complete</b>	<b>Not underway, but plan to</b>	<b>No plans to</b>	<b>Don't Know</b>
<b>Planning</b>				
Conducted a connected vehicle planning study	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Included connected vehicle technologies and/or applications in agency planning documents (e.g., long range transportation plan, Strategic Highway Safety Plan, Transportation Improvement Program, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Instituted <u>Memorandums of Understanding (MOUs)</u> with potential partners regarding roles and resource commitments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Developed <u>Concept of Operations</u> or initial Systems Engineering documents	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Demonstrations and Deployment</b>				
Updated your <u>Regional ITS Architecture</u> to include connected vehicle applications and interfaces	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Applied for a Federal grant to fund connected vehicle deployment (even if grant was not awarded)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Infrastructure</b>				
Secured <u>CV test bed/testing facilities</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Engaged with USDOT's <u>Equipment Loan and Help Desk program</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



	Underway or complete	Not underway, but plan to	No plans to	Don't Know
Built or upgraded your communications network (e.g. fiber optic network, wireless communications network)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Upgraded physical infrastructure (e.g., traffic signal controllers) for connected vehicles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Updated lane markings and infrastructure to support accurate MAP message generation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Implemented a <u>security credential management system (SCMS)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Applied for an FCC License to use <u>5.9 GHz frequency spectrum (Dedicated Short-Range Communication)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Staffing/Organizational</b>				
Procured contractor support for connected vehicles technologies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hired new staff with knowledge about connected vehicles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Data Management</b>				
Created a data management plan for collecting, storing, analyzing, reporting and protecting privacy of CV data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Created a data repository for storing CV data (e.g., cloud service, new data servers, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8. [ASK IF Q1=1 OR 2] What types of communication technologies does your agency currently use (or plan to use in the future) to support connected vehicle applications (vehicle-to-vehicle or vehicle-to-infrastructure)? (Select all that apply)

*Hover over the items with underlined text for more information*

	Use or plan to use for CV applications
<u>Dedicated Short Range Communications (DSRC)</u>	<input type="checkbox"/>
<u>Cellular (5G or cellular V2X) (CV2X))</u>	<input type="checkbox"/>
Satellite	<input type="checkbox"/>
Other (please specify):	<input type="checkbox"/>
<b>Don't know/Not sure [EXCLUSIVE]</b>	<input type="radio"/>

8a.. [ASK IF Q1=1 OR 2] What types of communication technologies does your agency currently use (or plan to use in the future) to provide backhaul communications in support

**of connected vehicle infrastructure (e.g., Roadside unit to Transportation Management Center)? (Select all that apply)**

	Use or plan to use for CV applications
<i>Fiber</i>	<input type="checkbox"/>
<i>Twisted Copper Pair</i>	<input type="checkbox"/>
<i>Cellular</i>	<input type="checkbox"/>
Mobile or Fixed Satellite Services	<input type="checkbox"/>
Data Over Cable Modem	<input type="checkbox"/>
Digital Subscriber Line (DSL)	<input type="checkbox"/>
Microwave	<input type="checkbox"/>
Other (please specify):	<input type="checkbox"/>
<b>Don't know/Not sure [EXCLUSIVE]</b>	<input type="radio"/>

**9. [ASK ALL] Which of the response categories best describes your agency’s usage and familiarity with each of the following? (Select one response per row)**

*Hover over the items with underlined text for more information*

<b>Architecture, Tools, and Standards</b>	Use	Don't use, but familiar	Not familiar
Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT), encompasses former National ITS Architecture and Connected Vehicle Reference Implementation Architecture (CVRIA)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Systems Engineering Tool for Intelligent Transportation (SET-IT)</u>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>Regional Architecture Development for Intelligent Transportation (RAD-IT)</u> , formerly TurboArchitecture	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<u>US and International Standards</u> associated with CV and AV deployment (e.g. – SAE J2735, SAE J2945 Family, ISO 19091)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**10. [ASK ALL] What types of assistance or resources does your agency need to support a connected vehicle deployment? (Select all that apply)**

	<b>Types of Assistance/Resources</b>	<b>Select all that apply</b>
<b>Funding/ Procurement</b>	Competitive grant funds	<input type="checkbox"/>
	Technology procurement information	<input type="checkbox"/>
<b>Evaluation Resources</b>	Best practices on connected vehicle deployments	<input type="checkbox"/>
	Evaluation methods and strategies	<input type="checkbox"/>
		<input type="checkbox"/>
	Information on the benefits/return on investment	<input type="checkbox"/>
	Information/data on costs of connected vehicle technologies	<input type="checkbox"/>
<b>Training/Technical Assistance</b>	Training	<input type="checkbox"/>
	Education for decision-makers	<input type="checkbox"/>
	Education for the general public	<input type="checkbox"/>
	Technical assistance	<input type="checkbox"/>
	Information on institutional arrangements and agreements	<input type="checkbox"/>
<b>Legal/Regulatory/Policy</b>	Legal/regulatory/policy support at the Federal level	<input type="checkbox"/>
	Legal/regulatory/policy support at the State/local level	<input type="checkbox"/>
	Other (please specify):	<input type="checkbox"/>
	<b>Don't know/Not sure [EXCLUSIVE]</b>	<input type="radio"/>
	<b>None [EXCLUSIVE]</b>	<input type="radio"/>

**10a. [IF YES TO ANY TRAINING/TECHNICAL ASSISTANCE] Please provide more detail on the type of training or technical assistance that would be most useful to you (be as specific as possible) \_\_\_\_\_**

## AUTOMATED VEHICLES/Automated Driving Systems

Automated Driving Systems (ADS) are a set of vehicle features that, when engaged, do not require a human to drive the vehicle. ADS refers to the Society of Automotive Engineers (SAE) International Automation Levels 3, 4, or 5, which are described as Automated Vehicles (AV) in this survey. Most of the ADS/AV testing done to date would be categorized as Level 3 or Level 4. For more information on SAE Levels of Automation, see: <https://www.sae.org/news/press-room/2018/12/sae-international-releases-updated-visual-chart-for-its-%E2%80%9Clevels-of-driving-automation%E2%80%9D-standard-for-self-driving-vehicles>.

**11. Are there any automated vehicle tests or deployments that are being conducted or have been conducted in your region/state? (Please select one)**

- (1) Yes (completed or in progress)
- (2) No [SKIP TO 15]
- (3) Don't know/Not sure [SKIP TO 15]

**12. [ASK IF Q11=OPTION 1] What is your agency's primary role in the automated vehicle testing or deployment? (Please select one)**

- (1) Agency is/was leading the automated vehicle testing
- (2) Agency is/was supporting the planning or execution of the automated vehicle testing
- (3) Agency is not involved in the automated vehicle testing
- (4) Other (please specify)

13a. [IF Q12=OPTION 1 OR 2] Please describe your agency's activities with respect to automated vehicle testing: \_\_\_\_\_

**13. [Q12 = OPTION 2]: What entity(ies) are/were leading the automated vehicle testing or deployment in your region/state? (Select all that apply)**

**[Q12 = OPTION 1] What other entity(ies) are/were you partnering with for the automated vehicle testing or deployment in your region/state? (Select all that apply)**

- Automakers or Original Equipment Manufacturers (OEMs)
- Automated Driving Systems (ADS) Developers
- Transportation Network Companies (TNCs) (e.g. Uber or Lyft)
- State agencies
- Metropolitan Planning Organizations (MPOs)
- Universities
- Transit agencies
- Other local agencies
- Consultants (please specify): \_\_\_\_\_
- Other (please specify): \_\_\_\_\_
- Don't know/Not sure [EXCLUSIVE]

In the next section, you will be asked about the types of automated vehicle tests or deployments that are being or have been conducted in your region/state.

14. [ASK if Q11=OPTION 1] Automated Vehicle Tests or Deployments

- Which, if any, of the following *automated transit vehicle* (e.g., bus, shuttle, etc.) tests or deployments are or were being conducted?

*Hover over the items with underlined text for more information*

<b>Automated Transit Vehicle Tests/Deployments</b>	
<u>Automated Fixed Route Shuttle</u>	<input type="checkbox"/>
<u>Automated Bus Rapid Transit (BRT)</u>	<input type="checkbox"/>
<u>Automated Flexible Mobility-on-Demand Shuttle Service</u>	<input type="checkbox"/>
<u>Automation for Maintenance, Yard, and Parking/Storage Operations</u>	<input type="checkbox"/>
<u>Automated taxi or ride-hailing testing (e.g., Uber, Lyft)</u>	<input type="checkbox"/>
Other <i>automated transit vehicle test/deployment</i> (please specify):	<input type="checkbox"/>
<b>Don't know/Not sure [EXCLUSIVE]</b>	<input type="radio"/>
<b>None [EXCLUSIVE]</b>	<input type="radio"/>

- Which, if any, of the following *automated commercial vehicle* (e.g., delivery truck, large truck) tests or deployments are or were being conducted?

*Hover over the items with underlined text for more information*

<b>Automated Commercial Vehicle Tests/Deployments</b>	
<u>Small Delivery Robotic Vehicles</u>	<input type="checkbox"/>
<u>Automated Last Mile Delivery</u>	<input type="checkbox"/>
<u>Automated Regional or Long Haul Trucking</u>	<input type="checkbox"/>
<u>Truck Platooning</u>	<input type="checkbox"/>
Other <i>automated commercial vehicle test/deployment</i> (please specify):	<input type="checkbox"/>
<b>Don't know/Not sure [EXCLUSIVE]</b>	<input type="radio"/>
<b>None [EXCLUSIVE]</b>	<input type="radio"/>

- Are or were any automated light duty passenger vehicle tests or deployments being conducted (other than automated transit)? *(Select all that apply)*

<b>Automated Light Duty Passenger Vehicle Tests/Deployments</b>	
<i>Automated light duty passenger vehicle test/deployment</i> _(please specify):_____	<input type="checkbox"/>
<b>Don't know/Not sure [EXCLUSIVE]</b>	<input type="radio"/>
<b>None [EXCLUSIVE]</b>	<input type="radio"/>

**[FOR EACH RESPONSE CHECKED IN Q14]:**

**14d. Where is/was the [ENTER TEST FROM Q14] testing or deployment occurring? *(Select all that apply)***

- Test bed or proving grounds
- Sidewalks
- Dedicated "slow lane"
- Urban city streets
- Highway
- Campus environment
- Private commercial or residential development
- Other (please specify):
- Don't know/Not sure [EXCLUSIVE]**

**15. [IF Q11 = OPTIONS 2 OR 3] Are there plans for your agency to participate in automated vehicle testing or deployment in the future? *(Select one)***

- Yes [CONTINUE]
- No [SKIP TO Q19]
- Don't know/Not sure [SKIP TO Q19]

**16. [IF Q15 = OPTION 1] When does your agency expect to participate in automated vehicle testing or deployment? *(Select one)***

- Within the next 3 years
- In 3 to 6 years
- In 7 or more years
- Don't know/Not sure

17. [IF Q11=1 OR Q15=1] Does your agency face any of the following challenges in planning or conducting automated vehicle testing or deployment? (Select all that apply)

[IF Q11 = 2 OR 3 & Q15 NE 1] Does your agency see any of the following as major barriers to planning or conducting automated vehicle testing or deployment? (Select all that apply)

	Challenges / Barriers	Select all
<b>Cost</b>	Cost of automated vehicle technology	<input type="checkbox"/>
	Cost of required updates to communications and/or physical infrastructure (e.g. communications networks, pavement markings, road/curb conditions, signage, etc.)	<input type="checkbox"/>
	Cost to operating and maintaining AV technology	<input type="checkbox"/>
<b>Technology</b>	Lack of information about automated vehicle technology	<input type="checkbox"/>
	Uncertainty about the information/communications technologies needed	<input type="checkbox"/>
	Too much technical risk; want to wait until technology and standards mature	<input type="checkbox"/>
	Uncertainty about benefits of automated vehicles	<input type="checkbox"/>
	Data privacy issues (e.g. protection of Personally Identifiable Information)	<input type="checkbox"/>
	Cybersecurity issues	<input type="checkbox"/>
<b>Institutional</b>	Partnerships issues	<input type="checkbox"/>
	Procurement issues	<input type="checkbox"/>
	Limited funding (e.g., due to competition for funds with other transportation projects)	<input type="checkbox"/>
	Lack of support from leadership and decision-makers	<input type="checkbox"/>
<b>Policy</b>	Lack of a regulatory framework	<input type="checkbox"/>
	Legal/policy/regulatory issues at the Federal level	<input type="checkbox"/>
	Legal/policy/regulatory issues at the State or local level	<input type="checkbox"/>
<b>Operations</b>	Lack of public acceptance of automated vehicles	<input type="checkbox"/>
	Worker acceptance issues (e.g., apprehension, confusion, or annoyance with technology; union issues, etc.)	<input type="checkbox"/>
	Lack of staff with the right qualifications/expertise	<input type="checkbox"/>
	Lack of support for long term operations and maintenance	<input type="checkbox"/>
	Integrating new technology with current systems	<input type="checkbox"/>
<b>Data</b>	Data access issues	<input type="checkbox"/>
	Data storage issues	<input type="checkbox"/>
	Data governance concerns	<input type="checkbox"/>
	Other (please specify): _____	<input type="checkbox"/>
	<b>Don't Know/Not Sure [EXCLUSIVE]</b>	<input type="radio"/>
	<b>None [EXCLUSIVE]</b>	<input type="radio"/>

18. [ASK ALL] Has your state or locality changed (or in the process of changing) their laws, regulations or policies to accommodate automated vehicles? (Select one)

- Yes  
 No [SKIP TO Q20]  
 Don't Know/Not Sure [SKIP TO Q20]

a. [IF Q18= OPTION 1] What laws, regulations, or policies have been or are being changed? (Select all that apply)

- State laws for operation of motor vehicles (e.g., licensing, permitting)  
 State laws for operation of commercial vehicles



- State laws pertaining to the insurance of automated vehicles
- State laws pertaining to the procurement of AV-equipped vehicles
- Other (please specify): \_\_\_\_\_

**Don't know/Not sure [EXCLUSIVE]**

**19. [ASK ALL] The US Department of Transportation is trying to understand agencies' readiness to deploy AV technology. For each of the following activities, please indicate your agency's current status. (Select one response per row)**

Hover over the items with underlined text for more information

	Underway or complete	Not underway, but plan to	No plans to	Don't Know
<b>Planning</b>				
Conducted an automated vehicle planning study	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Developed local regulations or other policies regarding automated vehicle testing and operations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Included automated vehicle technologies and/or applications in agency planning documents (e.g., long range transportation plan, Strategic Highway Safety Plan, Transportation Improvement Program, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Partnered with other entities to test automated vehicles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Developed <u>Concept of Operation</u> or initial Systems Engineering documents	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Demonstrations and Deployment</b>				
Updated your <u>Regional ITS Architecture</u> to include automated vehicle applications and interfaces	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Applied for a Federal grant to fund the testing of automated vehicle technology (even if grant was not awarded)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Infrastructure</b>				
Enhanced infrastructure maintenance (i.e., ensuring roadway striping is visible, removing visibility barriers from signs, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Upgraded physical infrastructure for automated vehicles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Organizational</b>				

	Underway or complete	Not underway, but plan to	No plans to	Don't Know
Procured contractor support for automated vehicles technologies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hired staff with knowledge about automated vehicles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Data Management</b>				
Created a data management plan for collecting, storing, analyzing, reporting and protecting privacy of AV data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Created a data repository for storing AV data (e.g., cloud service, new data servers, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**20. [ASK ALL] What types of assistance or resources does your agency need to support automated vehicle testing or deployment? (Select all that apply)**

	Types of Assistance/Resources	Select all that apply
<b>Funding/ Procurement</b>	Competitive grant funds	<input type="checkbox"/>
	Technology procurement information	<input type="checkbox"/>
<b>Evaluation Resources</b>	Best practices on automated vehicle deployments	<input type="checkbox"/>
	Evaluation methods and strategies	<input type="checkbox"/>
		<input type="checkbox"/>
	Information on the benefits/return on investment	<input type="checkbox"/>
	Information/data on costs of automated vehicle technologies	<input type="checkbox"/>
<b>Training/Technical Assistance</b>	Training	<input type="checkbox"/>
	Education for decision-makers	<input type="checkbox"/>
	Education for the general public	<input type="checkbox"/>
	Technical assistance	<input type="checkbox"/>
	Information on institutional arrangements and agreements	<input type="checkbox"/>
<b>Legal/Regulatory/Policy</b>	Legal/regulatory/policy support at the Federal level	<input type="checkbox"/>
	Legal/regulatory/policy support at the State/local level	<input type="checkbox"/>
	Other (please specify): _____	<input type="checkbox"/>
	<b>Don't know/Not sure [EXCLUSIVE]</b>	<input type="radio"/>

	Types of Assistance/Resources	Select all that apply
	None [EXCLUSIVE]	<input type="radio"/>

**21a. [IF YES TO TRAINING/TECHNICAL ASSISTANCE] Please provide more detail on the type of training or technical assistance that would be most useful to you (be as specific as possible). \_\_\_\_\_ [OPEN-END]**

**21. [ASK ALL] Is there anything else you would like to share about your agency's current or future planned activities related to connected and automated vehicles? \_\_\_\_\_ [OPEN-END]**

# Appendix B. Additional Data Findings

This Appendix presents additional findings from each of the questions in the CV/AV survey. Unless otherwise noted, the findings are based on all respondents (i.e. column denoted “Total”) and by agency type (i.e., Freeway, Arterial, and Transit). The question wording appears below each table.

**Table 15: Currently Deploying CV Technology**

Response Categories	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	475	66	301	108
Yes	24%	29%	23%	25%
No, but plan to deploy in the future	30%	36%	31%	24%
No plans to deploy	37%	20%	39%	41%
Don't know/Not sure	9%	15%	7%	10%

Source: USDOT

Q1: Is your agency currently deploying Connected Vehicle technology? (Select one)

**Table 16: Plans to Deploy CV Technology**

Based on Respondents Planning to Deploy CV

Response Categories	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	142	24*	92	26*
Within the next 3 years	40%	54%	33%	54%
In 3 to 6 years	27%	13%	34%	15%
In 7 or more years	11%	0%	13%	15%
Don't know/Not sure	22%	33%	21%	15%

\*Small sample size (<30)

Source: USDOT

Q2: When do you expect to deploy connected vehicle technology? (Select one)

**Table 17: Partnering to Deploy CV Technology**

Based on Respondents Currently Deploying CV

Response Categories	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	116	19*	70	27*
Yes, Public sector partner(s)	47%	47%	47%	44%
Yes, Private sector partner(s)	49%	58%	54%	30%
Yes, College(s)/Universities	28%	47%	30%	11%
No, not partnering	16%	11%	13%	26%
Don't know/Not sure	3%	5%	1%	7%

\*Small sample size (&lt;30)

Source: USDOT

Q3A: Is your agency partnering with other entities to deploy connected vehicle technology? (Select all that apply)

**Table 18: Plans to Partner to Deploy CV Technology**

Based on Respondents Planning to Deploy CV

Response Categories	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	142	24*	92	26*
Yes, Public sector partner(s)	53%	58%	50%	58%
Yes, Private sector partner(s)	37%	58%	36%	19%
Yes, College(s)/Universities	24%	54%	18%	15%
No, not partnering	6%	0%	8%	8%
Don't know/Not sure	28%	25%	29%	27%

\*Small sample size (&lt;30)

Source: USDOT

Q3B: Does your agency plan to partner with other entities to deploy connected vehicle technology? (Select all that apply)

**Table 19: V2I Deployment Status**

Based on Respondents Deploying or Planning to Deploy CV

<b>CV Application and Response Categories</b>	<b>Total</b>	<b>Freeway</b>	<b>Arterial</b>	<b>Transit</b>
<i>Number of Respondents</i>	258	43	162	53
<b>a. Red Light Violation Warning (RLVW)</b>	No data	No data	No data	No data
Currently Deploying	7%	9%	9%	0%
Planning to Deploy	24%	26%	25%	17%
NOT Planning to Deploy	32%	26%	33%	36%
Don't Know	32%	33%	31%	34%
Not Applicable	5%	7%	2%	13%
No data	No data	No data	No data	No data
<b>b. Curve Speed Warning</b>	No data	No data	No data	No data
Currently Deploying	6%	12%	6%	2%
Planning to Deploy	22%	37%	21%	11%
NOT Planning to Deploy	31%	16%	33%	36%
Don't Know	34%	30%	35%	36%
Not Applicable	7%	5%	4%	15%
No data	No data	No data	No data	No data
<b>c. Stop Sign Gap Assist</b>	No data	No data	No data	No data
Currently Deploying	1%	0%	1%	0%
Planning to Deploy	10%	14%	10%	9%
NOT Planning to Deploy	38%	33%	41%	34%
Don't Know	44%	44%	44%	42%
Not Applicable	7%	9%	4%	15%
No data	No data	No data	No data	No data
<b>d. Reduced Speed/Work Zone Warning (RSWZ)</b>	No data	No data	No data	No data
Currently Deploying	6%	12%	6%	2%
Planning to Deploy	26%	40%	27%	13%
NOT Planning to Deploy	27%	14%	27%	36%
Don't Know	36%	35%	36%	34%
Not Applicable	5%	0%	3%	15%
No data	No data	No data	No data	No data
<b>e. Pedestrian in Signalized Crosswalk Warning</b>	No data	No data	No data	No data
Currently Deploying	6%	5%	6%	6%
Planning to Deploy	31%	30%	33%	28%
NOT Planning to Deploy	27%	30%	26%	26%
Don't Know	28%	26%	28%	30%
Not Applicable	8%	9%	7%	9%
No data	No data	No data	No data	No data

CV Application and Response Categories	Total	Freeway	Arterial	Transit
<b>f. Other V2I</b>	No data	No data	No data	No data
Currently Deploying	8%	12%	9%	2%
Planning to Deploy	8%	8%	6%	14%
NOT Planning to Deploy	16%	4%	18%	21%
Don't Know	46%	60%	47%	35%
Not Applicable	22%	16%	20%	28%

Source: USDOT

Q4A: For each of the following Vehicle to Infrastructure (V2I) Safety Applications, please indicate your agency's deployment status. (Select one response in each row)

**Table 20: Summary of V2I Applications**

Based on Respondents Deploying or Planning to Deploy CV

CV Applications	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	258	43	162	53
Pedestrian in Signalized Crosswalk Warning	37%	35%	39%	34%
Reduced Speed/Work Zone Warning (RSWZ)	33%	51%	33%	15%
Red Light Violation Warning (RLVW)	31%	35%	34%	17%
Curve Speed Warning	28%	49%	27%	13%
Other V2I	16%	20%	15%	16%
Stop Sign Gap Assist	11%	14%	11%	9%

Source: USDOT

Q4A: For each of the following Vehicle to Infrastructure (V2I) Safety Applications, please indicate your agency's deployment status. (Select one response in each row)

**Table 21: V2V Deployment Status**

Based on Respondents Deploying or Planning to Deploy CV

<b>CV Application and Response Categories</b>	<b>Total</b>	<b>Freeway</b>	<b>Arterial</b>	<b>Transit</b>
<i>Number of Respondents</i>	258	43	162	53
<b>a. Emergency Electronic Brake Lights (EEBL)</b>	No data	No data	No data	No data
Currently Deploying	1%	0%	1%	2%
Planning to Deploy	12%	14%	9%	21%
NOT Planning to Deploy	29%	23%	31%	30%
Don't Know	40%	56%	38%	32%
Not Applicable	17%	7%	21%	15%
<b>b. Forward Collision Warning (FCW)</b>	No data	No data	No data	No data
Currently Deploying	3%	5%	2%	4%
Planning to Deploy	17%	16%	11%	34%
NOT Planning to Deploy	28%	23%	30%	26%
Don't Know	36%	47%	37%	23%
Not Applicable	17%	9%	20%	13%
<b>c. Intersection Movement Assist (IMA)</b>	No data	No data	No data	No data
Currently Deploying	2%	0%	2%	0%
Planning to Deploy	16%	14%	14%	23%
NOT Planning to Deploy	28%	23%	29%	26%
Don't Know	41%	53%	40%	34%
Not Applicable	15%	9%	15%	17%
<b>d. Left Turn Assist (LTA)</b>	No data	No data	No data	No data
Currently Deploying	0%	0%	0%	2%
Planning to Deploy	14%	9%	11%	26%
NOT Planning to Deploy	28%	26%	30%	26%
Don't Know	42%	56%	42%	32%
Not Applicable	15%	9%	17%	13%
<b>e. Blind Spot/Lane Change Warning (BSW/LCW)</b>	No data	No data	No data	No data
Currently Deploying	1%	0%	1%	4%
Planning to Deploy	14%	12%	9%	28%
NOT Planning to Deploy	29%	23%	30%	30%
Don't Know	40%	56%	40%	28%
Not Applicable	16%	9%	20%	9%

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<b>CV Application and Response Categories</b>	<b>Total</b>	<b>Freeway</b>	<b>Arterial</b>	<b>Transit</b>
<b>f. Do Not Pass Warning (DNPW)</b>	No data	No data	No data	No data
Currently Deploying	0%	2%	0%	0%
Planning to Deploy	8%	2%	7%	15%
NOT Planning to Deploy	33%	26%	35%	32%
Don't Know	42%	60%	40%	36%
Not Applicable	17%	9%	19%	17%
<b>g. Vehicle Turning Right in Front of Bus Warning (Transit)</b>	No data	No data	No data	No data
Currently Deploying	1%	0%	1%	2%
Planning to Deploy	13%	2%	9%	32%
NOT Planning to Deploy	32%	33%	33%	28%
Don't Know	38%	51%	38%	26%
Not Applicable	16%	14%	19%	11%
No data	No data	No data	No data	No data
<b>h. Other V2V</b>	No data	No data	No data	No data
Currently Deploying	2%	8%	2%	0%
Planning to Deploy	6%	4%	6%	5%
NOT Planning to Deploy	22%	17%	23%	23%
Don't Know	44%	50%	44%	38%
Not Applicable	27%	21%	25%	35%

Source: USDOT

Q4B. For each of the following Vehicle to Vehicle (V2V) Safety Applications, please indicate your agency's deployment status. (Select one response in each row)

**Table 22: Summary of V2V Applications**

Based on Respondents Deploying or Planning to Deploy CV

<b>CV Applications</b>	<b>Total</b>	<b>Freeway</b>	<b>Arterial</b>	<b>Transit</b>
<i>Number of Respondents</i>	258	43	162	53
Forward Collision Warning (FCW)	20%	21%	14%	38%
Intersection Movement Assist (IMA)	17%	14%	16%	23%
Blind Spot/Lane Change Warning (BSW/LCW)	15%	12%	10%	32%
Emergency Electronic Brake Lights (EEBL)	14%	14%	10%	23%
Left Turn Assist (LTA)	14%	9%	11%	28%
Vehicle Turning Right in Front of Bus Warning (Transit)	14%	2%	10%	34%
Do Not Pass Warning (DNPW)	9%	5%	7%	15%
Other V2V	8%	13%	8%	5%

Source: USDOT

Q4B. For each of the following Vehicle to Vehicle (V2V) Safety Applications, please indicate your agency's deployment status. (Select one response in each row)

**Table 23: Environment-Focused Application Deployment Status**

Based on Respondents Deploying or Planning to Deploy CV

<b>CV Application and Response Categories</b>	<b>Total</b>	<b>Freeway</b>	<b>Arterial</b>	<b>Transit</b>
<i>Number of Respondents</i>	258	43	162	53
<b>a. Eco-Approach and Departure at Signalized Intersections</b>	No data	No data	No data	No data
Currently Deploying	8%	5%	10%	2%
Planning to Deploy	24%	28%	28%	8%
NOT Planning to Deploy	25%	21%	23%	34%
Don't Know	36%	37%	35%	42%
Not Applicable	7%	9%	4%	15%
No data	No data	No data	No data	No data
<b>b. Dynamic Eco-Routing (light vehicle, transit, freight)</b>	No data	No data	No data	No data
Currently Deploying	2%	0%	1%	8%
Planning to Deploy	10%	9%	11%	8%
NOT Planning to Deploy	33%	30%	33%	38%
Don't Know	43%	51%	45%	28%
Not Applicable	12%	9%	10%	19%
No data	No data	No data	No data	No data
<b>c. Other Environment-focused Application</b>	No data	No data	No data	No data
Currently Deploying	2%	4%	1%	3%
Planning to Deploy	2%	0%	3%	0%
NOT Planning to Deploy	23%	9%	22%	32%
Don't Know	48%	61%	49%	37%
Not Applicable	26%	26%	24%	29%

Source: USDOT

Q4C. For each of the following Environment-focused CV Applications, please indicate your agency's deployment status. (Select one response in each row)

**Table 24: Summary of Environment-Focused Applications**  
 Based on Respondents Deploying or Planning to Deploy CV

<b>CV Applications</b>	<b>Total</b>	<b>Freeway</b>	<b>Arterial</b>	<b>Transit</b>
<i>Number of Respondents</i>	258	43	162	53
Eco-Approach and Departure at Signalized Intersections	32%	33%	39%	9%
Dynamic Eco-Routing (light vehicle, transit, freight)	12%	9%	12%	15%
Other Environment-focused Application	4%	4%	4%	3%

Source: USDOT

Q4C. For each of the following Environment-focused CV Applications, please indicate your agency's deployment status. (Select one response in each row)

**Table 25: Mobility Application Deployment Status**  
Based on Respondents Deploying or Planning to Deploy CV

<b>CV Applications and Response Categories</b>	<b>Total</b>	<b>Freeway</b>	<b>Arterial</b>	<b>Transit</b>
<i>Number of Respondents</i>	258	43	162	53
<b>a. Intelligent Traffic Signal System (I-SIG)</b>	No data	No data	No data	No data
Currently Deploying	12%	9%	15%	8%
Planning to Deploy	41%	35%	48%	26%
NOT Planning to Deploy	12%	9%	10%	19%
Don't Know	28%	42%	25%	25%
Not Applicable	7%	5%	2%	23%
No data	No data	No data	No data	No data
<b>b. Transit Signal Priority</b>	No data	No data	No data	No data
Currently Deploying	16%	12%	15%	19%
Planning to Deploy	46%	30%	49%	49%
NOT Planning to Deploy	12%	14%	12%	9%
Don't Know	21%	33%	21%	13%
Not Applicable	6%	12%	3%	9%
No data	No data	No data	No data	No data
<b>c. Freight Signal Priority</b>	No data	No data	No data	No data
Currently Deploying	3%	5%	4%	0%
Planning to Deploy	10%	14%	10%	4%
NOT Planning to Deploy	37%	23%	44%	26%
Don't Know	35%	53%	35%	21%
Not Applicable	15%	5%	6%	49%
No data	No data	No data	No data	No data
<b>d. Emergency Vehicle Preemption</b>	No data	No data	No data	No data
Currently Deploying	18%	14%	23%	6%
Planning to Deploy	43%	37%	52%	21%
NOT Planning to Deploy	11%	12%	9%	17%
Don't Know	17%	30%	14%	13%
Not Applicable	11%	7%	2%	43%
No data	No data	No data	No data	No data
<b>e. Dynamic Speed Harmonization (SPD-HARM)</b>	No data	No data	No data	No data
Currently Deploying	2%	9%	1%	0%
Planning to Deploy	12%	19%	10%	11%
NOT Planning to Deploy	31%	23%	33%	30%
Don't Know	43%	47%	48%	28%
Not Applicable	12%	2%	8%	30%

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<b>CV Applications and Response Categories</b>	<b>Total</b>	<b>Freeway</b>	<b>Arterial</b>	<b>Transit</b>
No data	No data	No data	No data	No data
<b>f. Queue Warning (Q-WARN)</b>	No data	No data	No data	No data
Currently Deploying	5%	9%	5%	0%
Planning to Deploy	22%	44%	18%	17%
NOT Planning to Deploy	26%	14%	28%	26%
Don't Know	40%	30%	44%	34%
Not Applicable	8%	2%	4%	23%
No data	No data	No data	No data	No data
<b>g. Cooperative Adaptive Cruise Control (CACC)</b>	No data	No data	No data	No data
Currently Deploying	1%	2%	1%	0%
Planning to Deploy	5%	7%	5%	6%
NOT Planning to Deploy	31%	21%	31%	40%
Don't Know	47%	65%	49%	25%
Not Applicable	16%	5%	14%	30%
No data	No data	No data	No data	No data
<b>h. Evacuation (R.E.S.C.U.M.E.)</b>	No data	No data	No data	No data
Currently Deploying	1%	0%	2%	0%
Planning to Deploy	17%	23%	16%	15%
NOT Planning to Deploy	24%	16%	28%	19%
Don't Know	50%	56%	49%	45%
Not Applicable	8%	5%	4%	21%
No data	No data	No data	No data	No data
<b>i. Integrated Dynamic Transit Operations (IDTO)</b>	No data	No data	No data	No data
Currently Deploying	3%	0%	2%	9%
Planning to Deploy	12%	5%	8%	32%
NOT Planning to Deploy	27%	30%	30%	15%
Don't Know	45%	53%	46%	32%
Not Applicable	13%	12%	14%	11%
No data	No data	No data	No data	No data
<b>j. Freight Specific Dynamic Travel Planning and Performance</b>	No data	No data	No data	No data
Currently Deploying	2%	2%	2%	2%
Planning to Deploy	6%	14%	4%	4%
NOT Planning to Deploy	33%	23%	41%	19%
Don't Know	42%	58%	43%	28%
Not Applicable	17%	2%	10%	47%
No data	No data	No data	No data	No data

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CV Applications and Response Categories	Total	Freeway	Arterial	Transit
<b>k. Other Mobility Application</b>	No data	No data	No data	No data
Currently Deploying	3%	5%	3%	3%
Planning to Deploy	3%	5%	3%	3%
NOT Planning to Deploy	14%	5%	15%	18%
Don't Know	45%	67%	48%	26%
Not Applicable	34%	19%	31%	50%

Source: USDOT

Q4D. For each of the following Mobility-related CV Applications, please indicate your agency's deployment status. (Select one response in each row)

**Table 26: Summary of Mobility Applications**  
Based on Respondents Deploying or Planning to Deploy CV

CV Applications	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	258	43	162	53
Emergency Vehicle Preemption	61%	51%	75%	26%
Transit Signal Priority	61%	42%	64%	68%
Intelligent Traffic Signal System (I-SIG)	53%	44%	62%	34%
Queue Warning (Q-WARN)	27%	53%	23%	17%
Evacuation (R.E.S.C.U.M.E.)	18%	23%	18%	15%
Integrated Dynamic Transit Operations (IDTO)	16%	5%	10%	42%
Dynamic Speed Harmonization (SPD-HARM)	14%	28%	11%	11%
Freight Signal Priority	13%	19%	14%	4%
Freight Specific Dynamic Travel Planning and Performance	8%	16%	6%	6%
Other Mobility Application	7%	10%	7%	6%
Cooperative Adaptive Cruise Control (CACC)	6%	9%	6%	6%

Source: USDOT

Q4D. For each of the following Mobility-related CV Applications, please indicate your agency's deployment status. (Select one response in each row)

**Table 27: Other CV Applications Deployment Status**  
 Based on Respondents Deploying or Planning to Deploy CV

CV Applications and Response Categories	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	258	43	162	53
<b>a. Agency Data Applications</b>	No data	No data	No data	No data
Currently Deploying	14%	14%	13%	15%
Planning to Deploy	36%	44%	39%	23%
NOT Planning to Deploy	16%	14%	17%	13%
Don't Know	30%	26%	29%	36%
Not Applicable	4%	2%	2%	13%
No data	No data	No data	No data	No data
<b>b. Road Weather Warnings</b>	No data	No data	No data	No data
Currently Deploying	5%	7%	4%	4%
Planning to Deploy	24%	42%	24%	11%
NOT Planning to Deploy	23%	9%	25%	28%
Don't Know	41%	40%	42%	38%
Not Applicable	7%	2%	4%	19%
No data	No data	No data	No data	No data
<b>c. Smart Roadside</b>	No data	No data	No data	No data
Currently Deploying	2%	7%	1%	2%
Planning to Deploy	11%	23%	9%	6%
NOT Planning to Deploy	37%	21%	45%	26%
Don't Know	33%	47%	32%	25%
Not Applicable	17%	2%	13%	42%
No data	No data	No data	No data	No data
<b>d. Other CV Applications</b>	No data	No data	No data	No data
Currently Deploying	2%	5%	1%	3%
Planning to Deploy	3%	0%	4%	0%
NOT Planning to Deploy	17%	9%	14%	30%
Don't Know	51%	64%	55%	33%
Not Applicable	28%	23%	26%	35%

Source: USDOT

Q4E. For each of the following Other CV Applications, please indicate your agency's deployment status. (Select one response in each row)



**Table 28: Summary of Other CV Applications**

Based on Respondents Deploying or Planning to Deploy CV

CV Applications	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	258	43	162	53
Agency Data Applications	50%	58%	52%	38%
Road Weather Warnings	29%	49%	28%	15%
Smart Roadside	13%	30%	10%	8%
Other CV Applications	4%	5%	5%	3%

Source: USDOT

Q4E. For each of the following Other CV Applications, please indicate your agency's deployment status. (Select one response in each row)

**Table 29: Objectives for Deploying CV Technology**

Based on Respondents Deploying or Planning to Deploy CV

Objectives for Deploying CV	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	258	43	162	53
Decrease vehicle crashes	88%	95%	91%	72%
Reduce travel time	81%	86%	81%	74%
Improve travel time reliability	81%	84%	78%	85%
Decrease pedestrian crashes	80%	77%	85%	68%
Reduce congestion	76%	81%	83%	51%
Improve customer experience	75%	81%	68%	92%
Improve agency operations	74%	81%	69%	85%
Decrease bicycle crashes	73%	70%	79%	58%
Reduce emissions	70%	70%	71%	66%
Improve on-time performance of transit vehicles	62%	44%	58%	89%
Increase throughput	60%	70%	60%	51%
Reduce fuel use	59%	51%	60%	60%
Improve accessibility	59%	53%	57%	70%
Reduce costs	55%	49%	49%	77%
Increase ridership	44%	23%	36%	85%
Don't Know	3%	2%	5%	2%
NONE	2%	0%	2%	2%
Other	1%	0%	1%	0%

Source: USDOT

Q5. Which of the following transportation objectives is/will your agency be trying to achieve with the deployment of connected vehicle technology? (Select all that apply)

**Table 30: Barriers to Deploying or Planning CV Technology**

Barriers to CV	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	475	66	301	108
Limited funding	68%	76%	69%	58%
Cost of connected vehicle technology	67%	71%	66%	66%
Cost to operate and maintain connected vehicle technology	66%	80%	66%	56%
Cost of required updates to communications and/or physical infrastructure	64%	70%	66%	55%
Lack of staff with the right qualifications/expertise	54%	67%	54%	47%
Uncertainty about the information/communications technologies needed	53%	70%	56%	33%
Integrating new technology with current systems	51%	56%	52%	46%
Too much technical risk; want to wait until technology and standards mature	49%	65%	48%	44%
Lack of support for long term operations and maintenance	45%	56%	47%	36%
Lack of a regulatory framework	44%	62%	47%	27%
Cybersecurity issues	43%	50%	44%	35%
Data governance concerns	41%	47%	45%	27%
Lack of information about connected vehicle technology	40%	41%	42%	34%
Legal/policy/regulatory issues at the state or local level	38%	44%	41%	28%
Data storage issues	37%	45%	38%	30%
Legal/policy/regulatory issues at the Federal level	31%	45%	31%	24%
Procurement issues	31%	44%	30%	28%
Data privacy issues (e.g. protection of Personally Identifiable Information)	30%	35%	31%	25%
Data access issues	30%	30%	32%	23%
Uncertainty about the benefits of connected vehicles	25%	21%	29%	18%
Worker acceptance issues	25%	18%	24%	34%
Partnership issues	22%	30%	20%	21%
Lack of public acceptance of connected vehicles	21%	27%	22%	15%
Lack of support from leadership and decision-makers	19%	29%	19%	11%
Don't know/Not sure	8%	2%	9%	8%
Other	4%	0%	4%	7%
None/No current challenges	2%	0%	2%	2%

Source: USDOT

Q6. Does your agency see any of the following as major barriers to planning or deploying connected vehicle technology? (Select all that apply)

**Table 31: Barriers to Deploying CV Technology by Deployment Status**

Barriers to Deploying CV	Total	Deploy	Planning to Deploy	No or Don't Know
<i>Number of Respondents</i>	475	116	142	217
Limited funding	68%	66%	72%	66%
Cost of connected vehicle technology	67%	65%	72%	64%
Cost to operate and maintain connected vehicle technology	66%	66%	70%	63%
Cost of required updates to communications and/or physical infrastructure	64%	62%	68%	62%
Lack of staff with the right qualifications/expertise	54%	49%	57%	55%
Uncertainty about the information/communications technologies needed	53%	53%	63%	46%
Integrating new technology with current systems	51%	47%	61%	47%
Too much technical risk; want to wait until technology and standards mature	49%	40%	55%	51%
Lack of support from leadership and decision-makers	19%	14%	15%	24%
Lack of a regulatory framework	44%	37%	49%	45%
Cybersecurity issues	43%	47%	45%	39%
Data governance concerns	41%	44%	47%	35%
Lack of information about connected vehicle technology	40%	24%	45%	45%
Legal/policy/regulatory issues at the state or local level	38%	34%	41%	39%
Data storage issues	37%	32%	44%	35%
Legal/policy/regulatory issues at the Federal level	31%	30%	37%	28%
Procurement issues	31%	33%	38%	26%
Data privacy issues (e.g. protection of Personally Identifiable Information)	30%	31%	33%	28%
Data access issues	30%	25%	30%	32%
Uncertainty about the benefits of connected vehicles	25%	19%	26%	28%
Worker acceptance issues	25%	19%	27%	28%
Partnership issues	22%	17%	25%	22%
Lack of public acceptance of connected vehicles	21%	20%	23%	21%
Lack of support for long term operations and maintenance	45%	41%	50%	45%
Don't know/Not sure	8%	2%	6%	12%
Other	4%	3%	3%	6%
None/No current challenges	2%	4%	1%	1%

Source: USDOT

Q6. Does your agency see any of the following as major barriers to planning or deploying connected vehicle technology? (Select all that apply)

**Table 32: Readiness Factors for CV Deployment**

<b>Readiness Factors and Response Categories</b>	<b>Total</b>	<b>Freeway</b>	<b>Arterial</b>	<b>Transit</b>
<i>Number of Respondents</i>	473*	66	300*	107*
<b>a. Conducted a connected vehicle planning study</b>	No data	No data	No data	No data
Underway or complete	12%	27%	11%	7%
Not underway, but plan to	19%	15%	21%	15%
No plans to	53%	32%	56%	58%
Don't know	16%	26%	12%	19%
No data	No data	No data	No data	No data
<b>b. Included connected vehicle technologies and/or applications in agency planning documents (e.g., long range transportation plan, Strategic Highway Safety Plan, Transportation Improvement Program)</b>	No data	No data	No data	No data
Underway or complete	17%	24%	17%	15%
Not underway, but plan to	24%	35%	23%	22%
No plans to	40%	17%	45%	41%
Don't know	18%	24%	16%	22%
No data	No data	No data	No data	No data
<b>c. Instituted Memorandums of Understanding (MOUs) with potential partners regarding roles and resource commitments for connected vehicle projects</b>	No data	No data	No data	No data
Underway or complete	12%	8%	13%	10%
Not underway, but plan to	19%	32%	18%	17%
No plans to	47%	27%	50%	48%
Don't know	23%	33%	19%	25%
No data	No data	No data	No data	No data
<b>d. Developed Concept of Operations (ConOps) or initial systems engineering planning documents for connected vehicle projects</b>	No data	No data	No data	No data
Underway or complete	11%	21%	9%	11%
Not underway, but plan to	23%	30%	24%	14%
No plans to	49%	30%	51%	54%
Don't know	17%	18%	16%	21%
No data	No data	No data	No data	No data

Readiness Factors and Response Categories	Total	Freeway	Arterial	Transit
<b>e. Updated your Regional ITS Architecture to include connected vehicle applications and interfaces</b>	No data	No data	No data	No data
Underway or complete	17%	26%	18%	9%
Not underway, but plan to	24%	36%	23%	19%
No plans to	37%	23%	40%	39%
Don't know	22%	15%	19%	32%
No data	No data	No data	No data	No data
<b>f. Applied for a Federal grant to fund connected vehicle deployment (even if grant was not awarded)</b>	No data	No data	No data	No data
Underway or complete	16%	24%	15%	13%
Not underway, but plan to	18%	15%	21%	10%
No plans to	45%	27%	48%	49%
Don't know	21%	33%	17%	28%
No data	No data	No data	No data	No data
<b>g. Secured CV test bed/testing facilities</b>	No data	No data	No data	No data
Underway or complete	12%	18%	13%	6%
Not underway, but plan to	11%	18%	10%	9%
No plans to	60%	42%	63%	65%
Don't know	17%	21%	15%	19%
No data	No data	No data	No data	No data
<b>h. Engaged with USDOT's Equipment Loan and Help Desk program</b>	No data	No data	No data	No data
Underway or complete	1%	2%	1%	0%
Not underway, but plan to	9%	9%	9%	8%
No plans to	58%	38%	64%	56%
Don't know	32%	52%	27%	36%
No data	No data	No data	No data	No data
<b>i. Built or upgraded your communications network (e.g. fiber optic network, wireless communications network)</b>	No data	No data	No data	No data
Underway or complete	48%	61%	52%	29%
Not underway, but plan to	16%	14%	17%	17%
No plans to	27%	20%	24%	41%
Don't know	9%	6%	8%	14%
No data	No data	No data	No data	No data

Readiness Factors and Response Categories	Total	Freeway	Arterial	Transit
<b>j. Upgraded physical infrastructure (e.g., traffic signal controllers) for connected vehicles</b>	No data	No data	No data	No data
Underway or complete	32%	38%	38%	13%
Not underway, but plan to	24%	27%	23%	27%
No plans to	32%	21%	33%	38%
Don't know	11%	14%	6%	22%
<b>k. Updated lane markings and infrastructure to support accurate MAP message generation</b>	No data	No data	No data	No data
Underway or complete	8%	11%	8%	4%
Not underway, but plan to	23%	35%	25%	11%
No plans to	46%	27%	49%	49%
Don't know	23%	27%	18%	36%
No data	No data	No data	No data	No data
<b>l. Implemented a security credential management system (SCMS)</b>	No data	No data	No data	No data
Underway or complete	4%	6%	4%	3%
Not underway, but plan to	15%	23%	14%	13%
No plans to	48%	23%	53%	47%
Don't know	33%	48%	28%	37%
<b>m. Applied for an FCC License to use 5.9 GHz frequency spectrum (Dedicated Short-Range Communication)</b>	No data	No data	No data	No data
Underway or complete	11%	29%	9%	3%
Not underway, but plan to	12%	17%	11%	11%
No plans to	45%	23%	48%	52%
Don't know	32%	32%	32%	34%
No data	No data	No data	No data	No data
<b>n. Procured contractor support for connected vehicles technologies</b>	No data	No data	No data	No data
Underway or complete	12%	23%	10%	12%
Not underway, but plan to	14%	14%	15%	10%
No plans to	51%	26%	54%	56%
Don't know	23%	38%	20%	21%
No data	No data	No data	No data	No data
<b>o. Hired new staff with knowledge about connected vehicles</b>	No data	No data	No data	No data
Underway or complete	7%	14%	5%	6%
Not underway, but plan to	12%	20%	10%	12%
No plans to	60%	39%	64%	62%
Don't know	21%	27%	20%	19%
No data	No data	No data	No data	No data

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Readiness Factors and Response Categories	Total	Freeway	Arterial	Transit
<b>p. Created a data management plan for collecting, storing, analyzing, reporting and protecting privacy of CV data</b>	No data	No data	No data	No data
Underway or complete	6%	8%	6%	6%
Not underway, but plan to	23%	33%	23%	16%
No plans to	50%	23%	53%	56%
Don't know	21%	36%	18%	21%
<b>q. Created a data repository for storing CV data (e.g., cloud service, new data servers, etc.)</b>	No data	No data	No data	No data
Underway or complete	8%	8%	7%	10%
Not underway, but plan to	22%	30%	22%	16%
No plans to	49%	26%	52%	52%
Don't know	22%	36%	19%	22%

\*Missing 2 respondents: 1 arterial and 1 transit response

Source: USDOT

Q7. The U.S. Department of Transportation is trying to understand agencies' readiness to deploy connected vehicle technology. For each of the following activities, please indicate your agency's current status. (Select one response per row)

**Table 33: Summary of CV Readiness Factors (Underway or Completed)**

Readiness Factors	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	473*	66	300*	107*
Built or upgraded your communications network	48%	61%	52%	29%
Upgraded physical infrastructure (e.g., traffic signal controllers) for connected vehicles	32%	38%	38%	13%
Included connected vehicle technologies and/or applications in agency planning documents	17%	24%	17%	15%
Updated your Regional ITS Architecture to include connected vehicle applications and interfaces	17%	26%	18%	9%
Applied for a Federal grant to fund connected vehicle deployment (even if grant was not awarded)	16%	24%	15%	13%
Conducted a connected vehicle planning study	12%	27%	11%	7%
Procured contractor support for connected vehicles technologies	12%	23%	10%	12%
Secured CV test bed/testing facilities	12%	18%	13%	6%
Instituted Memorandums of Understanding (MOUs) with potential partners for CV projects	12%	8%	13%	10%
Applied for an FCC License to use 5.9 GHz frequency spectrum (Dedicated Short-Range Communication)	11%	29%	9%	3%
Developed Concept of Operations (ConOps) or initial systems engineering planning documents for CV projects	11%	21%	9%	11%
Updated lane markings and infrastructure to support accurate MAP message generation	8%	11%	8%	4%
Created a data repository for storing CV data (e.g., cloud service, new data servers, etc.)	8%	8%	7%	10%
Hired new staff with knowledge about connected vehicles	7%	14%	5%	6%
Created a data management plan for collecting, storing, analyzing, reporting and protecting privacy of CV data	6%	8%	6%	6%
Implemented a security credential management system (SCMS)	4%	6%	4%	3%
Engaged with USDOT's Equipment Loan and Help Desk program	1%	2%	1%	0%

\*Missing 2 respondents: 1 arterial and 1 transit response

Source: USDOT

Q7. The U.S. Department of Transportation is trying to understand agencies' readiness to deploy connected vehicle technology. For each of the following activities, please indicate your agency's current status. (Select one response per row)



**Table 34: Summary of CV Readiness Factors (Underway or Completed) by Deployment Status**

Readiness Factors	Total	Deploy	Planning to Deploy	No or Don't Know
<i>Number of Respondents</i>	473*	115*	142	216*
Built or upgraded your communications network	48%	73%	61%	26%
Upgraded physical infrastructure (e.g., traffic signal controllers) for connected vehicles	32%	66%	44%	7%
Included connected vehicle technologies and/or applications in agency planning documents	17%	41%	18%	5%
Updated your Regional ITS Architecture to include connected vehicle applications and interfaces	17%	39%	20%	3%
Applied for a Federal grant to fund connected vehicle deployment (even if grant was not awarded)	16%	44%	15%	1%
Conducted a connected vehicle planning study	12%	32%	14%	1%
Procured contractor support for connected vehicles technologies	12%	41%	6%	1%
Secured CV test bed/testing facilities	12%	34%	11%	1%
Instituted Memorandums of Understanding (MOUs) with potential partners for CV projects	12%	37%	8%	0%
Applied for an FCC License to use 5.9 GHz frequency spectrum (Dedicated Short-Range Communication)	11%	32%	6%	2%
Developed Concept of Operations (ConOps) or initial systems engineering planning documents for CV projects	11%	34%	10%	0%
Updated lane markings and infrastructure to support accurate MAP message generation	8%	13%	11%	2%
Created a data repository for storing CV data (e.g., cloud service, new data servers, etc.)	8%	23%	5%	1%
Hired new staff with knowledge about connected vehicles	7%	18%	6%	1%
Created a data management plan for collecting, storing, analyzing, reporting and protecting privacy of CV data	6%	19%	4%	1%
Implemented a security credential management system (SCMS)	4%	15%	2%	0%
Engaged with USDOT's Equipment Loan and Help Desk program	1%	3%	1%	0%

\*Missing 2 respondents: 1 *deploying CV* and 1 *no or don't know* response.

Source: USDOT

Q7. The U.S. Department of Transportation is trying to understand agencies' readiness to deploy connected vehicle technology. For each of the following activities, please indicate your agency's current status. (Select one response per row)

**Table 35: Communication Technologies to Support CV Applications**

Based on Respondents Deploying or Planning to Deploy CV

Communication Technologies	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	258	43	162	53
Cellular (5G or cellular V2X) (CV2X)	58%	58%	52%	74%
Dedicated Short Range Communications (DSRC)	55%	81%	56%	32%
Don't know/Not sure	22%	19%	25%	13%
Other Communication Technology	10%	5%	10%	15%
Satellite	6%	2%	4%	15%

Source: USDOT

Q8: What types of communication technologies does your agency currently use (or plan to use in the future) to support connected vehicle applications (vehicle-to-vehicle or vehicle-to-infrastructure)? (Select all that apply)

**Table 36: Communication Technologies to Support CV Applications by Deployment Status**

Communication Technologies	Total	Deploy	Planning to Deploy	No or Don't Know
<i>Number of Respondents</i>	475	116	142	217
Cellular (5G or cellular V2X) (CV2X)	58%	60%	56%	0%
Dedicated Short Range Communications (DSRC)	55%	67%	45%	0%
Other Communication Technology	10%	9%	11%	0%
Satellite	6%	5%	7%	0%
Don't know/Not sure	22%	14%	28%	0%

Source: USDOT

Q8: What types of communication technologies does your agency currently use (or plan to use in the future) to support connected vehicle applications (vehicle-to-vehicle or vehicle-to-infrastructure)? (Select all that apply)

**Table 37: Communication Technologies to Provide CV Backhaul Communications**

Based on Respondents Deploying or Planning to Deploy CV

Communication Technologies	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	258	43	162	53
Fiber	83%	86%	91%	58%
Cellular	68%	72%	62%	81%
Microwave	29%	44%	29%	15%
Twisted Copper Pair	23%	21%	23%	25%
Data Over Cable Modem	15%	12%	13%	25%
Digital Subscriber Line (DSL)	9%	12%	8%	9%
Mobile or Fixed Satellite Services	9%	7%	6%	19%
Other	5%	7%	4%	8%
Don't know/Not sure	7%	9%	5%	11%

Source: USDOT

Q8a: What types of communication technologies does your agency currently use (or plan to use in the future) to provide backhaul communications in support of connected vehicle infrastructure? (Select all that apply)

**Table 38: Communication Technologies to Provide CV Backhaul Communications by Deployment Status**

Communication Technologies	Total	Deploy	Planning to Deploy	No or Don't Know
<i>Number of Respondents</i>	475	116	142	217
Fiber	83%	80%	86%	0%
Cellular	68%	67%	68%	0%
Microwave	29%	34%	25%	0%
Twisted Copper Pair	23%	19%	27%	0%
Data Over Cable Modem	15%	16%	15%	0%
Digital Subscriber Line (DSL)	9%	10%	8%	0%
Mobile or Fixed Satellite Services	9%	7%	10%	0%
Other	5%	5%	6%	0%
Don't know/Not sure	7%	8%	6%	0%

Source: USDOT

Q8a: What types of communication technologies does your agency currently use (or plan to use in the future) to provide backhaul communications in support of connected vehicle infrastructure? (Select all that apply)

**Table 39: CV Architecture, Tools, and Standards**

<b>CV Tools and Response Categories</b>	<b>Total</b>	<b>Freeway</b>	<b>Arterial</b>	<b>Transit</b>
<i>Number of Respondents</i>	475	66	301	108
<b>a. Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT), encompasses former National ITS Architecture and Connected Vehicle Reference Implementation Architecture (CVRIA)</b>	No data	No data	No data	No data
Use	10%	24%	9%	4%
Don't use, but familiar	23%	35%	21%	20%
Not familiar	68%	41%	70%	76%
No data	No data	No data	No data	No data
<b>b. Systems Engineering Tool for Intelligent Transportation (SET-IT)</b>	No data	No data	No data	No data
Use	13%	32%	12%	6%
Don't use, but familiar	22%	26%	23%	17%
Not familiar	65%	42%	65%	78%
No data	No data	No data	No data	No data
<b>c. Regional Architecture Development for Intelligent Transportation (RAD-IT), formerly TurboArchitecture</b>	No data	No data	No data	No data
Use	15%	41%	11%	7%
Don't use, but familiar	24%	27%	25%	18%
Not familiar	62%	32%	64%	75%
No data	No data	No data	No data	No data
<b>d. US and International Standards associated with CV and AV deployment (e.g. - SAE J2735, SAE J2945 Family, ISO 19091)</b>	No data	No data	No data	No data
Use	9%	24%	7%	6%
Don't use, but familiar	18%	26%	18%	14%
Not familiar	73%	50%	75%	81%

Source: USDOT

Q9. Which of the response categories best describes your agency's usage and familiarity with each of the following? (Select one response per row)

Table 40: CV Architecture, Tools, and Standards by Deployment Status

CV Tools and Response Categories	Total	Deploy	Planning to Deploy	No or Don't Know
<i>Number of Respondents</i>	475	116	142	217
<b>a. Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT), encompasses former National ITS Architecture and Connected Vehicle Reference Implementation Architecture (CVRIA)</b>	No data	No data	No data	No data
Use	10%	22%	11%	2%
Don't use, but familiar	23%	31%	31%	13%
Not familiar	68%	47%	58%	85%
No data	No data	No data	No data	No data
<b>b. Systems Engineering Tool for Intelligent Transportation (SET-IT)</b>	No data	No data	No data	No data
Use	13%	28%	16%	3%
Don't use, but familiar	22%	31%	29%	13%
Not familiar	65%	41%	55%	84%
No data	No data	No data	No data	No data
<b>c. Regional Architecture Development for Intelligent Transportation (RAD-IT), formerly TurboArchitecture</b>	No data	No data	No data	No data
Use	15%	32%	15%	5%
Don't use, but familiar	24%	32%	30%	15%
Not familiar	62%	36%	55%	80%
No data	No data	No data	No data	No data
<b>d. US and International Standards associated with CV and AV deployment (e.g. - SAE J2735, SAE J2945 Family, ISO 19091)</b>	No data	No data	No data	No data
Use	9%	28%	6%	1%
Don't use, but familiar	18%	26%	26%	8%
Not familiar	73%	46%	68%	90%

Source: USDOT

Q9. Which of the response categories best describes your agency's usage and familiarity with each of the following? (Select one response per row)

**Table 41: Types of Assistance and Resources for CV Deployment**

<b>Assistance and Resources for CV</b>	<b>Total</b>	<b>Freeway</b>	<b>Arterial</b>	<b>Transit</b>
<i>Number of Respondents</i>	475	66	301	108
Best practices on connected vehicle deployments	73%	83%	71%	72%
Training	68%	79%	66%	69%
Competitive grant funds	66%	67%	65%	67%
Technical assistance	64%	76%	62%	60%
Education for decision-makers	64%	74%	62%	63%
Information/data on costs of connected vehicle technologies	64%	68%	62%	69%
Information on the benefits/return on investment	62%	71%	61%	59%
Evaluation methods and strategies	61%	74%	60%	57%
Legal/regulatory/policy support at the State/local level	61%	70%	60%	60%
Technology procurement information	59%	65%	57%	61%
Legal/regulatory/policy support at the Federal level	56%	71%	51%	60%
Education for the general public	55%	67%	53%	56%
Information on institutional arrangements and agreements	53%	64%	51%	53%
Don't know/Not sure	13%	8%	15%	9%
Other type of assistance	4%	3%	5%	3%
None	4%	0%	4%	5%

Source: USDOT

Q10: What types of assistance or resources does your agency need to support a connected vehicle deployment?  
(Select all that apply)

**Table 42: Types of Assistance and Resources for CV Deployment by Deployment Status**

<b>Assistance and Resources for CV</b>	<b>Total</b>	<b>Deploy</b>	<b>Planning to Deploy</b>	<b>No or Don't Know</b>
<i>Number of Respondents</i>	475	116	142	217
Best practices on connected vehicle deployments	73%	74%	83%	65%
Training	68%	70%	75%	63%
Competitive grant funds	66%	71%	73%	58%
Technical assistance	64%	58%	70%	63%
Education for decision-makers	64%	61%	68%	64%
Information/data on costs of connected vehicle technologies	64%	58%	74%	62%
Information on the benefits/return on investment	62%	58%	71%	59%
Evaluation methods and strategies	61%	59%	72%	56%
Legal/regulatory/policy support at the State/local level	61%	53%	70%	60%
Technology procurement information	59%	53%	70%	56%
Legal/regulatory/policy support at the Federal level	56%	53%	65%	52%
Education for the general public	55%	57%	57%	53%
Information on institutional arrangements and agreements	53%	43%	58%	55%
Don't know/Not sure	13%	3%	8%	21%
Other type of assistance	4%	5%	4%	5%
None	4%	3%	1%	6%

Source: USDOT

Q10: What types of assistance or resources does your agency need to support a connected vehicle deployment?  
(Select all that apply)

**Table 43: AV Testing/Deployments**

Response Categories	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	475	66	301	108
Yes	39%	58%	39%	28%
No	21%	17%	19%	31%
Don't know/Not sure	40%	26%	42%	42%

Source: USDOT

Q11: Are there any automated vehicle tests or deployments that are being conducted or have been conducted in your region/state? (Please select one)

**Table 44: Primary Role in AV Testing/Deployments**  
Based on Respondents with AV Testing in Region or State

Response Categories	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	185	38	117	30
Agency is/was leading the automated vehicle testing	9%	16%	8%	3%
Agency is/was supporting the planning or execution of the automated vehicle testing	26%	34%	21%	37%
Agency is not involved in the automated vehicle testing	62%	45%	70%	50%
Other	4%	5%	2%	10%

Source: USDOT

Q12: What is your agency's primary role in the automated vehicle testing or deployment? (Please select one)



**Table 45: Leaders or Partners in AV Testing/Deployment**

Based on Respondents Leading or Supporting AV Testing

Leaders or Partners	Leading/Supporting Tests
<i>Number of Respondents</i>	71
Universities	42%
State agencies	41%
Automakers or Original Equipment Manufacturers (OEMs)	39%
Automated Driving Systems (ADS) Developers	34%
Transit agencies	27%
Metropolitan Planning Organizations (MPOs)	23%
Other local agencies	23%
Transportation Network Companies (TNCs) (e.g. Uber or Lyft)	14%
Consultants	6%
Other	1%
Don't know/Not sure	7%
No Answer	13%

*Source: USDOT*

Q13. What entity(ies) are/were involved (leading/partnering) the automated vehicle testing or deployment in your region/state? (Select all that apply)

**Table 46: Automated Transit Vehicle Testing/Deployment**

Based on Respondents with AV Testing in Region or State

<b>Automated Transit Deployments</b>	<b>Total</b>	<b>Freeway</b>	<b>Arterial</b>	<b>Transit</b>
<i>Number of Respondents</i>	185	38	117	30
Automated Fixed Route Shuttle	37%	29%	37%	50%
Automated Flexible Mobility-on-Demand Shuttle Service	11%	11%	8%	27%
Automated Taxi or Ride-hailing (e.g., Uber, Lyft)	10%	5%	10%	13%
Automated Bus Rapid Transit (BRT)	4%	0%	6%	0%
Automation for Maintenance, Yard, and Parking/Storage Operations	2%	0%	3%	3%
Other automated transit vehicle test/deployment	1%	0%	1%	0%
Don't know/Not sure	34%	32%	39%	17%
None	16%	34%	12%	10%

Source: USDOT

Q14A. Which, if any, of the following automated transit vehicle (e.g., bus, shuttle, etc.) tests or deployments are or were being conducted? (Select all that apply)

**Table 47: Automated Transit Vehicle Testing/Deployment by Testing Status**

Based on Respondents with AV Testing in Region or State

Automated Transit Deployments	Total	Agency Has Role in Testing	Agency Has No Role in Testing
<i>Number of Respondents</i>	185	71	114
Automated Fixed Route Shuttle	37%	58%	25%
Automated Flexible Mobility-on-Demand Shuttle Service	11%	13%	11%
Automated Taxi or Ride-hailing (e.g., Uber, Lyft)	10%	10%	10%
Automated Bus Rapid Transit (BRT)	4%	4%	4%
Automation for Maintenance, Yard, and Parking/Storage Operations	2%	4%	1%
Other automated transit vehicle test/deployment	1%	1%	0%
Don't know/Not sure	34%	13%	47%
None	16%	17%	16%

Source: USDOT

Q14A. Which, if any, of the following automated transit vehicle (e.g., bus, shuttle, etc.) tests or deployments are or were being conducted? (Select all that apply)

**Table 48: Automated Commercial Vehicle Testing/Deployment**

Based on Respondents with AV Testing in Region or State

Automated Commercial Deployments	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	185	38	117	30
Truck Platooning	20%	12%	51%	10%
Automated Regional or Long Haul Trucking	13%	10%	23%	7%
Small Delivery Robotic Vehicles	11%	7%	12%	20%
Automated Last Mile Delivery	10%	7%	4%	17%
Other Automated Commercial Vehicle Test/Deployment	3%	1%	4%	7%
Don't know/Not sure	35%	29%	31%	27%
None	21%	12%	43%	23%

Source: USDOT

Q14B. Which, if any, of the following automated commercial vehicle (e.g., delivery truck, large truck) tests or deployments are or were being conducted? (Select all that apply)

**Table 49: Automated Commercial Vehicle Testing/Deployment by Testing Status**

Based on Respondents with AV Testing in Region or State

<b>Automated Commercial Deployments</b>	<b>Total</b>	<b>Agency Has Role in Testing</b>	<b>Agency Has No Role in Testing</b>
<i>Number of Respondents</i>	185	71	114
Truck Platooning	20%	23%	18%
Automated Regional or Long Haul Trucking	13%	11%	15%
Small Delivery Robotic Vehicles	11%	14%	10%
Automated Last Mile Delivery	10%	10%	10%
Other Automated Commercial Vehicle Test/Deployment	3%	3%	3%
Don't know/Not sure	35%	18%	46%
None	21%	37%	11%

Source: USDOT

Q14B. Which, if any, of the following automated commercial vehicle (e.g., delivery truck, large truck) tests or deployments are or were being conducted? (Select all that apply)

**Table 50: Automated Light Duty Passenger Vehicle Tests/Deployments**

Based on Respondents with AV Testing in Region or State

<b>Automated Light Duty Deployments</b>	<b>Total</b>	<b>Freeway</b>	<b>Arterial</b>	<b>Transit</b>
<i>Number of Respondents</i>	185	38	117	30
Automated Light Duty Passenger Vehicle test/deployment	17%	16%	17%	17%
Don't know/Not sure	52%	53%	52%	50%
None	31%	32%	31%	33%

Source: USDOT

Q14C. Are or were any automated light duty passenger vehicle tests or deployments being conducted (other than automated transit)? (Select all that apply)

**Table 51: Automated Light Duty Vehicle Testing/Deployment by Testing Status**

Based on Respondents with AV Testing in Region or State

<b>Automated Light Duty Deployments</b>	<b>Total</b>	<b>Agency Has Role in Testing</b>	<b>Agency Has No Role in Testing</b>
<i>Number of Respondents</i>	185	71	114
Automated Light Duty Passenger Vehicle test/deployment	17%	27%	11%
Don't know/Not sure	52%	32%	64%
None	31%	41%	25%

Source: USDOT

Q14C. Are or were any automated light duty passenger vehicle tests or deployments being conducted (other than automated transit)? (Select all that apply)

**Table 52: Plans to Participate in AV Testing/Deployment**

Based on Respondents with No AV Testing in Region State<sup>10</sup>

Response Categories	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	290	28*	184	78
Yes	11%	11%	11%	12%
No	57%	21%	58%	67%
Don't know/Not sure	32%	68%	30%	22%

\*Small sample size (<30)

Source: USDOT

Q15: Are there plans for your agency to participate in automated vehicle testing or deployment in the future? (Select one)

**Table 53: Expected Time to Participate in AV Testing/Deployment**

Based on Respondents Planning on AV Testing<sup>11</sup>

Response Categories	Agencies planning for AV testing
<i>Number of Respondents</i>	33
Within the next 3 years	67%
In 3 to 6 years	15%
In 7 or more years	3%
Don't know/Not sure	15%

Source: USDOT

Q16: When does your agency expect to participate in automated vehicle testing or deployment? (Select one)

<sup>10</sup> This question also should have been asked of those agencies that are aware of testing, but not involved. Due to this error, the data underrepresent plans to deploy.

<sup>11</sup> Due to the error with Question 15 (noted in footnote #9), this data does not capture the full population of agencies potentially planning for AV.

**Table 54: Challenges in AV Testing/Deployment**

<b>Challenges to AV</b>	<b>Total</b>	<b>Freeway</b>	<b>Arterial</b>	<b>Transit</b>
<i>Number of Respondents</i>	475	66	301	108
Limited funding	56%	56%	56%	56%
Cost of automated technology	55%	53%	53%	63%
Cost of required updates to communications and/or physical infrastructure	53%	56%	52%	51%
Cost to operating and maintaining AV technology	52%	50%	54%	47%
Lack of staff with the right qualifications/expertise	48%	53%	47%	45%
Legal/policy/regulatory issues at the State or local level	48%	53%	46%	52%
Lack of a regulatory framework	47%	53%	46%	44%
Too much technical risk; want to wait until technology and standards mature	47%	42%	46%	50%
Lack of support for long term operations and maintenance	44%	44%	45%	39%
Integrating new technology with current systems	44%	42%	45%	42%
Uncertainty about the information/communications technologies needed	44%	41%	46%	39%
Legal/policy/regulatory issues at the Federal level	40%	44%	39%	44%
Lack of information about automated vehicle technology	39%	30%	41%	40%
Cybersecurity issues	36%	42%	36%	32%
Data governance concerns	36%	41%	38%	29%
Procurement issues	36%	38%	37%	32%
Lack of public acceptance of automated vehicles	34%	20%	33%	45%
Data storage issues	32%	38%	35%	19%
Data access issues	31%	33%	32%	24%
Data privacy issues	30%	26%	31%	29%
Partnerships issues	29%	38%	28%	29%
Worker acceptance issues	26%	20%	22%	42%
Uncertainty about benefits of automated vehicles	26%	18%	25%	32%
Lack of support from leadership and decision-makers	21%	18%	21%	24%
Don't know/Not sure	17%	15%	20%	11%
None	4%	0%	6%	4%
Other	3%	3%	3%	5%

Source: USDOT

Q17. Does/will your agency face any of the following challenges in planning or conducting automated vehicle testing or deployment? (Select all that apply)

**Table 55: Challenges in AV Testing/Deployment by Agency Testing Status**

<b>Challenges to AV</b>	<b>Agency Has Role</b>	<b>Agency Has No Role</b>	<b>No Testing in Region (or Don't Know)</b>
<i>Number of Respondents</i>	71	114	290
Cost of required updates to communications and/or physical infrastructure	59%	46%	53%
Cost of automated technology	52%	49%	58%
Limited funding	51%	48%	60%
Lack of staff with the right qualifications/expertise	44%	39%	52%
Cost to operating and maintaining AV technology	41%	50%	56%
Legal/policy/regulatory issues at the Federal level	39%	36%	42%
Uncertainty about information/communications tech needed	37%	37%	48%
Lack of support for long term operations and maintenance	37%	35%	49%
Data governance concerns	37%	32%	38%
Legal/policy/regulatory issues at the State or local level	35%	40%	54%
Integrating new technology with current systems	35%	37%	49%
Cybersecurity issues	35%	32%	38%
Too much technical risk; want to wait until technology and standards mature	34%	43%	51%
Lack of a regulatory framework	34%	42%	51%
Data privacy issues	31%	25%	31%
Lack of public acceptance of automated vehicles	30%	28%	37%
Lack of information about automated vehicle technology	27%	33%	45%
Procurement issues	25%	32%	40%
Data access issues	24%	29%	33%
Data storage issues	24%	28%	35%
Worker acceptance issues	23%	21%	29%
Uncertainty about benefits of automated vehicles	18%	19%	30%
Partnerships issues	15%	26%	34%
Lack of support from leadership and decision-makers	13%	21%	23%
Don't know/Not sure	11%	23%	16%
None	7%	7%	3%
Other	6%	5%	2%

Source: USDOT

Q17. Does/will your agency face any of the following challenges in planning or conducting automated vehicle testing or deployment? (Select all that apply)



**Table 56: Changed Laws, Regulations, or Policies for AV**

Response Categories	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	474*	65*	301	108
Yes	22%	38%	18%	20%
No	19%	18%	21%	14%
Don't know/Not sure	60%	43%	61%	66%

\*Missing respondents: 1 freeway response

Source: USDOT

Q18: Has your state or locality changed (or is in the process of changing) their laws, regulations or policies to accommodate automated vehicles? (Select one)

**Table 57: Changed Laws, Regulations, or Policies for AV by Testing Status**

Response Categories	Agency Has Role	Agency Has No Role	No Testing in Region (or Don't Know)
<i>Number of Respondents</i>	71	114	289*
Yes	56%	31%	9%
No	14%	17%	21%
Don't know/Not sure	30%	53%	70%

\*Missing Respondents: 1 No testing in region or don't know response

Source: USDOT

Q18: Has your state or locality changed (or is in the process of changing) their laws, regulations or policies to accommodate automated vehicles? (Select one)

**Table 58: Type of Laws, Regulations, or Policies Changed for AV**

Response Categories	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	474*	65*	301	108
State laws for operation of motor vehicles (e.g., licensing, permitting)	11%	20%	8%	13%
State laws for operation of commercial vehicles	7%	17%	6%	6%
State laws pertaining to the insurance of automated vehicles	4%	2%	3%	6%
State laws pertaining to the procurement of AV-equipped vehicles	4%	5%	4%	3%
Other	3%	9%	2%	3%
Don't know/Not sure	5%	5%	5%	3%

\*Missing respondents: 1 freeway response

Source: USDOT

Q18a: What laws, regulations, or policies have been or are being changed? (Select all that apply)

**Table 59: Type of Laws, Regulations, or Policies Changed for AV by Testing Status**

Response Categories	Agency Has Role	Agency Has No Role	No Testing in Region (or Don't Know)
<i>Number of Respondents</i>	71	114	289*
State laws for operation of motor vehicles (e.g., licensing, permitting)	32%	11%	5%
State laws for operation of commercial vehicles	21%	11%	2%
State laws pertaining to the insurance of automated vehicles	13%	4%	1%
State laws pertaining to the procurement of AV-equipped vehicles	10%	5%	2%
Other	7%	5%	1%
Don't know/Not sure	10%	8%	2%

\*Missing Respondents: 1 No testing in region or don't know response

Source: USDOT

Q18a: What laws, regulations, or policies have been or are being changed? (Select all that apply)

Table 60: Readiness Factors for AV Deployment

Readiness Factors and Response Categories	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	474*	65*	301	108
<b>a. Conducted an automated vehicle planning study</b>	No data	No data	No data	No data
Underway or Complete	8%	20%	5%	8%
Not underway, but plan to	14%	15%	15%	10%
No plans to	52%	25%	55%	60%
Don't Know	26%	40%	25%	21%
<b>b. Developed local regulations or other policies regarding automated vehicle testing and operations</b>	No data	No data	No data	No data
Underway or Complete	6%	14%	6%	4%
Not underway, but plan to	13%	22%	13%	7%
No plans to	51%	23%	56%	55%
Don't Know	30%	42%	25%	34%
<b>c. Included automated vehicle technologies and/or applications in agency planning documents</b>	No data	No data	No data	No data
Underway or Complete	11%	22%	10%	6%
Not underway, but plan to	22%	28%	20%	25%
No plans to	42%	20%	46%	43%
Don't Know	25%	31%	24%	26%
<b>d. Partnered with other entities to test automated vehicles</b>	No data	No data	No data	No data
Underway or Complete	13%	28%	9%	14%
Not underway, but plan to	14%	15%	14%	10%
No plans to	49%	22%	53%	53%
Don't Know	25%	35%	24%	23%
<b>e. Developed Concept of Operations (ConOps) or initial systems engineering planning documents for automated vehicle projects</b>	No data	No data	No data	No data
Underway or Complete	3%	6%	3%	1%
Not underway, but plan to	19%	32%	18%	14%
No plans to	51%	29%	53%	57%
Don't Know	27%	32%	25%	28%
<b>f. Updated your Regional ITS Architecture to include automated vehicle applications and interfaces</b>	No data	No data	No data	No data
Underway or Complete	11%	23%	12%	4%
Not underway, but plan to	19%	32%	18%	15%
No plans to	41%	26%	42%	48%
Don't Know	28%	18%	28%	33%

Readiness Factors and Response Categories	Total	Freeway	Arterial	Transit
<b>g. Applied for a Federal grant to fund the testing of automated vehicle technology</b>	No data	No data	No data	No data
Underway or Complete	9%	15%	7%	10%
Not underway, but plan to	16%	18%	17%	14%
No plans to	47%	28%	50%	49%
Don't Know	28%	38%	26%	27%
No data	No data	No data	No data	No data
<b>h. Enhanced infrastructure maintenance (i.e., ensuring roadway striping is visible, removing visibility barriers from signs, etc.)</b>	No data	No data	No data	No data
Underway or Complete	9%	14%	11%	3%
Not underway, but plan to	20%	34%	19%	13%
No plans to	46%	23%	47%	55%
Don't Know	25%	29%	23%	30%
No data	No data	No data	No data	No data
<b>i. Upgraded physical infrastructure for automated vehicles</b>	No data	No data	No data	No data
Underway or Complete	6%	9%	6%	2%
Not underway, but plan to	18%	28%	19%	11%
No plans to	50%	31%	51%	61%
Don't Know	26%	32%	24%	26%
No data	No data	No data	No data	No data
<b>j. Procured contractor support for automated vehicles technologies</b>	No data	No data	No data	No data
Underway or Complete	5%	11%	3%	7%
Not underway, but plan to	12%	22%	11%	8%
No plans to	56%	31%	61%	59%
Don't Know	27%	37%	26%	25%
No data	No data	No data	No data	No data
<b>k. Hired staff with knowledge about automated vehicles</b>	No data	No data	No data	No data
Underway or Complete	4%	9%	4%	2%
Not underway, but plan to	12%	23%	9%	11%
No plans to	59%	32%	63%	64%
Don't Know	25%	35%	24%	23%
No data	No data	No data	No data	No data
<b>l. Created a data management plan for collecting, storing, analyzing, reporting and protecting privacy of AV data</b>	No data	No data	No data	No data
Underway or Complete	3%	8%	2%	3%
Not underway, but plan to	15%	25%	14%	13%
No plans to	54%	23%	59%	58%
Don't Know	28%	45%	25%	26%
No data	No data	No data	No data	No data

Readiness Factors and Response Categories	Total	Freeway	Arterial	Transit
<b>m. Created a data repository for storing AV data</b>	No data	No data	No data	No data
Underway or Complete	3%	8%	3%	3%
Not underway, but plan to	15%	26%	14%	10%
No plans to	54%	25%	58%	59%
Don't Know	28%	42%	26%	28%

\*Missing respondents: 1 freeway response

Source: USDOT

Q19. The US Department of Transportation is trying to understand agencies' readiness to deploy AV technology. For each of the following activities, please indicate your agency's current status. (Select one response per row)

**Table 61: Summary of AV Readiness Factors (Underway or Completed)**

Readiness Factors	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	474*	65*	301	108
Partnered with other entities to test automated vehicles	13%	28%	9%	14%
Updated your Regional ITS Architecture to include automated vehicle applications and interfaces	11%	23%	12%	4%
Included automated vehicle technologies and/or applications in agency planning documents	11%	22%	10%	6%
Applied for a Federal grant to fund the testing of automated vehicle technology	9%	15%	7%	10%
Enhanced infrastructure maintenance (i.e., ensuring roadway striping is visible, removing visibility barriers from signs, etc.)	9%	14%	11%	3%
Conducted an automated vehicle planning study	8%	20%	5%	8%
Developed local regulations or other policies regarding automated vehicle testing and operations	6%	14%	6%	4%
Upgraded physical infrastructure for automated vehicles	6%	9%	6%	2%
Procured contractor support for automated vehicles technologies	5%	11%	3%	7%
Hired staff with knowledge about automated vehicles	4%	9%	4%	2%
Created a data management plan for collecting, storing, analyzing, reporting and protecting privacy of AV data	3%	8%	2%	3%
Created a data repository for storing AV data	3%	8%	3%	3%
Developed Concept of Operations (ConOps) or initial systems engineering planning documents for automated vehicle projects	3%	6%	3%	1%

\*Missing respondents: 1 freeway response

Source: USDOT

Q19. The US Department of Transportation is trying to understand agencies' readiness to deploy AV technology. For each of the following activities, please indicate your agency's current status. (Select one response per row)

**Table 62: Readiness Factors for AV Deployment by Agency Testing Status**

<b>Readiness Factors and Response Categories</b>	<b>Agency Has Role</b>	<b>Agency Has No Role</b>	<b>No Testing in Region (or Don't Know)</b>
<i>Number of Respondents</i>	71	114	289*
<b>a. Conducted an automated vehicle planning study</b>	No data	No data	No data
Underway or Complete	35%	4%	2%
Not underway, but plan to	25%	18%	9%
No plans to	13%	57%	60%
Don't Know	27%	21%	28%
No data	No data	No data	No data
<b>b. Developed local regulations or other policies regarding automated vehicle testing and operations</b>	No data	No data	No data
Underway or Complete	23%	6%	2%
Not underway, but plan to	25%	18%	7%
No plans to	18%	52%	60%
Don't Know	34%	24%	31%
No data	No data	No data	No data
<b>c. Included automated vehicle technologies and/or applications in agency planning documents</b>	No data	No data	No data
Underway or Complete	35%	12%	4%
Not underway, but plan to	34%	31%	16%
No plans to	3%	39%	52%
Don't Know	28%	18%	27%
No data	No data	No data	No data
<b>d. Partnered with other entities to test automated vehicles</b>	No data	No data	No data
Underway or Complete	54%	8%	5%
Not underway, but plan to	24%	18%	9%
No plans to	6%	51%	58%
Don't Know	17%	24%	28%
No data	No data	No data	No data
<b>e. Developed Concept of Operations (ConOps) or initial systems engineering planning documents for automated vehicle projects</b>	No data	No data	No data
Underway or Complete	11%	3%	1%
Not underway, but plan to	46%	21%	12%
No plans to	15%	54%	58%
Don't Know	27%	22%	28%
No data	No data	No data	No data

Readiness Factors and Response Categories	Agency Has Role	Agency Has No Role	No Testing in Region (or Don't Know)
<b>f. Updated your Regional ITS Architecture to include automated vehicle applications and interfaces</b>	No data	No data	No data
Underway or Complete	27%	15%	6%
Not underway, but plan to	32%	19%	16%
No plans to	15%	42%	47%
Don't Know	25%	24%	30%
	No data	No data	No data
<b>g. Applied for a Federal grant to fund the testing of automated vehicle technology</b>	No data	No data	No data
Underway or Complete	35%	8%	3%
Not underway, but plan to	25%	18%	13%
No plans to	8%	50%	55%
Don't Know	31%	24%	29%
	No data	No data	No data
<b>h. Enhanced infrastructure maintenance (i.e., ensuring roadway striping is visible, removing visibility barriers from signs, etc.)</b>	No data	No data	No data
Underway or Complete	17%	12%	6%
Not underway, but plan to	32%	27%	14%
No plans to	14%	44%	54%
Don't Know	37%	17%	26%
	No data	No data	No data
<b>i. Upgraded physical infrastructure for automated vehicles</b>	No data	No data	No data
Underway or Complete	15%	6%	3%
Not underway, but plan to	32%	25%	12%
No plans to	17%	48%	60%
Don't Know	35%	20%	26%
	No data	No data	No data
<b>j. Procured contractor support for automated vehicles technologies</b>	No data	No data	No data
Underway or Complete	27%	1%	1%
Not underway, but plan to	23%	12%	9%
No plans to	21%	62%	63%
Don't Know	30%	25%	27%
	No data	No data	No data
<b>k. Hired staff with knowledge about automated vehicles</b>	No data	No data	No data
Underway or Complete	14%	7%	1%
Not underway, but plan to	24%	8%	10%
No plans to	37%	59%	64%
Don't Know	25%	26%	25%

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Readiness Factors and Response Categories	Agency Has Role	Agency Has No Role	No Testing in Region (or Don't Know)
No data	No data	No data	No data
<b>I. Created a data management plan for collecting, storing, analyzing, reporting and protecting privacy of AV data</b>	No data	No data	No data
Underway or Complete	15%	2%	1%
Not underway, but plan to	35%	18%	10%
No plans to	15%	57%	62%
Don't Know	34%	24%	28%
No data	No data	No data	No data
<b>m. Created a data repository for storing AV data</b>	No data	No data	No data
Underway or Complete	14%	2%	1%
Not underway, but plan to	35%	17%	9%
No plans to	20%	56%	61%
Don't Know	31%	25%	29%

\*Missing Respondents: 1 No testing in region or don't know response

Source: USDOT

Q19. The US Department of Transportation is trying to understand agencies' readiness to deploy AV technology. For each of the following activities, please indicate your agency's current status. (Select one response per row)

**Table 63: Summary of AV Readiness Factors (Underway or Completed) by Testing Status**

Readiness Factors	Agency Has Role	Agency Has No Role	No Testing in Region (or Don't Know)
<i>Number of Respondents</i>	71	114	289*
Partnered with other entities to test automated vehicles	54%	8%	5%
Included automated vehicle technologies and/or applications in agency planning documents	35%	12%	4%
Applied for a Federal grant to fund the testing of automated vehicle technology	35%	8%	3%
Conducted an automated vehicle planning study	35%	4%	2%
Updated your Regional ITS Architecture to include automated vehicle applications and interfaces	27%	15%	6%
Procured contractor support for automated vehicles technologies	27%	1%	1%
Developed local regulations or other policies regarding automated vehicle testing and operations	23%	6%	2%
Enhanced infrastructure maintenance (i.e., ensuring roadway striping is visible, removing visibility barriers from signs, etc.)	17%	12%	6%
Upgraded physical infrastructure for automated vehicles	15%	6%	3%
Created a data management plan for collecting, storing, analyzing, reporting and protecting privacy of AV data	15%	2%	1%
Hired staff with knowledge about automated vehicles	14%	7%	1%
Created a data repository for storing AV data	14%	2%	1%
Developed Concept of Operations (ConOps) or initial systems engineering planning documents for automated vehicle projects	11%	3%	1%

\*Missing Respondents: 1 No testing in region or don't know response

Source: USDOT

Q19. The US Department of Transportation is trying to understand agencies' readiness to deploy AV technology. For each of the following activities, please indicate your agency's current status. (Select one response per row)

**Table 64: Types of Assistance and Resources Needed for AV Testing/Deployment**

Assistance and Resources	Total	Freeway	Arterial	Transit
<i>Number of Respondents</i>	475	66	301	108
Best practices on automated vehicle deployments	66%	74%	64%	65%
Competitive grant funds	62%	59%	61%	67%
Legal/regulatory/policy support at the State/local level	61%	65%	60%	62%
Information/data on costs of automated vehicle technologies	61%	67%	59%	60%
Evaluation methods and strategies	58%	71%	55%	57%
Education for decision-makers	58%	70%	56%	56%
Training	58%	65%	56%	57%
Technical assistance	58%	61%	57%	57%
Information on the benefits/return on investment	57%	68%	55%	55%
Legal/regulatory/policy support at the Federal level	55%	65%	52%	58%
Technology procurement information	55%	62%	52%	58%
Information on institutional arrangements and agreements	53%	65%	51%	52%
Education for the general public	52%	55%	51%	53%
Don't know/Not sure	16%	12%	19%	10%
None	6%	0%	5%	8%
Other type of assistance	5%	3%	5%	0%

Source: USDOT

Q20. What types of assistance or resources does your agency need to support automated vehicle testing or deployment? (Select all that apply)

**Table 65: Types of Assistance/Resources Needed for AV Testing/Deployment by Agency Testing Status**

Assistance and Resources	Agency Has Role	Agency Has No Role	No Testing in Region (or Don't Know)
<i>Number of Respondents</i>	71	114	290
Best practices on automated vehicle deployments	75%	64%	64%
Competitive grant funds	70%	65%	59%
Training	68%	53%	58%
Evaluation methods and strategies	66%	55%	57%
Information/data on costs of automated vehicle technologies	65%	57%	61%
Education for decision-makers	65%	54%	58%
Technical assistance	63%	52%	59%
Legal/regulatory/policy support at the Federal level	62%	56%	53%
Information on the benefits/return on investment	62%	51%	58%
Technology procurement information	62%	50%	56%
Education for the general public	59%	48%	51%
Information on institutional arrangements and agreements	58%	50%	54%
Legal/regulatory/policy support at the State/local level	54%	59%	64%
Don't know/Not sure	7%	18%	17%
None	3%	4%	6%
Other type of assistance	1%	6%	3%

Source: USDOT

Q20. What types of assistance or resources does your agency need to support automated vehicle testing or deployment? (Select all that apply)

# Appendix C. Open-End CV/AV Survey Responses

This Appendix presents the responses from each question in the CV/AV survey that had an option for an open-ended response. The responses are presented as written (i.e., grammar was not edited or corrected).

**Table 66: Other Challenges in Planning or Deploying CV Technology**

Open-End Responses
<i>Working within the limitations of GPS accuracy</i>
<i>Other: 1.) Federal Grant requirements are too constraining and requiring state match and/or staff capability and/or capacity that exceeds existing resources (operating and capital) 2.) Existing state statues lead to a patchwork of regulatory and policy frameworks as each state incorporates and aligns national guidance/recommendations in a manner that aligns with existing rules, regulations and culture.</i>
<i>TSMO; Again, the recurring upgrades to infrastructure requires guidance and specifications.</i>
<i>Replicability across agencies of data sharing and operability of the systems.</i>
<i>Lack of knowledge on the correct vendor or correct application. We had a false start with a vendor on automatic passenger counters.</i>
<i>CV implementation is a cost-benefit improvement that simply doesnt compare well to other enhancements competing for funding</i>
<i>It has been difficult to convince senior management that there is a sufficient benefit to the taxpayers in being a first deployer, to warrant spending local money on a system that may not interoperate with any commercially available technology.</i>
<i>We want to be on the cutting edge but not the bleeding edge. Make sure we are wisely deploying technology. Have upgraded our signal system to Ecnolite Centracs with Cobalt controllers in anticipation of I2V in the future.</i>
<i>Waiting for other installs in the urban areas. This will help guide the rural installations. Would like more integration regionally (data gathering and disseminating).</i>
<i>Adams County is not set up for early adoption of CV technologies at this time.</i>

Source: USDOT

Q6a: Does your agency face any of the following major challenges in planning or deploying connected vehicle technology? (Select all that apply) - Other (please specify) – Text

**Table 67: Other Communication Technologies for CV Support**

<b>Open-End Responses</b>
<i>We are currently in the process of planning for a hybrid system of cellular/DSRC.</i>
<i>Decommissioning 4.9GHz public safety band analogue to DSRC for V2I and V2C communications</i>
<i>Shortest Path Bridging through our cellular gateway</i>
<i>5GHz v2I</i>
<i>Developing full fiber infrastructure network--planning to place all I2V data onto cloud for dissemination. I2V communications methods yet unknown, hoping for cloud based/regional agency based solution.</i>
<i>Fiber to Data Aggregator for disbursement to fleet vehicles, e.g. TTS</i>
<i>Fiber optic cable ant network hardware</i>
<i>Dedicated fiber network</i>
<i>fiber</i>
<i>Fiber</i>
<i>Fiber</i>
<i>Radio and/or Fiber</i>
<i>GPS from Mobile Access Routers. P25 Radios in vehicles that don't have mobile access routers provide GPS for those vehicles.</i>
<i>800 mhz radio</i>
<i>2 way radio</i>
<i>Wireless radios</i>
<i>Radio</i>
<i>802.11 std wifi communication and security</i>
<i>WiFi</i>
<i>Wi-Fi</i>
<i>Central system that polls the CV data from the controllers once per second and publishes it via Internet / Trafficware Tidal Wave site.</i>
<i>Connected Vehicle data portal through our ATMS central system.</i>
<i>Traffic signal data will be furnished to NCTCOG via the Internet for use with CV applications.</i>
<i>Center to Center</i>
<i>We have a BRT coming on-line. As a second phase it will include TSP. We use Opticom for EVP. However, we are looking at going with C2C using our Econolite Centracs system with both the BRT and Tusa FD.</i>

Source: USDOT

Q8a: What types of communication technologies does your agency currently use (or plan to use in the future) to support connected vehicle applications (vehicle-to-vehicle or vehicle-to-infrastructure)? (Select all that apply) - Other (please specify) - Text

**Table 68: Other Technologies for Backhaul Communications**

<b>Open-End Responses</b>
<i>Our agency operates the Trunked Radio System for city, county, and emergency communications.</i>
<i>Wireless Ethernet Radio (5.8GHz)</i>
<i>Some Ethernet radios</i>
<i>Spread Spectrum Radio</i>
<i>Ethernet radios</i>
<i>Point to point wireless radios</i>
<i>RADIO</i>
<i>Wifi</i>
<i>802.11 secured wifi</i>
<i>Wi-Fi</i>
<i>4.9GHz wifi</i>
<i>VLAN over City Network with Fiber backbone</i>
<i>leased point to point ethernet</i>
<i>Looking at 900 mhz mesh currently in place to transport controller data.</i>

Source: USDOT

Q8b: What types of communication technologies does your agency currently use (or plan to use in the future) to provide backhaul communications in support of connected vehicle infrastructure (e.g., Roadside unit to Transportation Management Center)? (Select all that apply) - Other (please specify) - Text

**Table 69: Other Types of Assistance or Resources for CV Deployment**

<b>Open-End Responses</b>
<i>Analytics on data collected</i>
<i>Regional Data collection dissemination and regional implementation strategy.</i>
<i>SCMS deployment plan and guidance.</i>
<i>We could take advantage on design and build assistance at all levels.</i>
<i>Information that relates specifically to the deployment in a suburban community.</i>
<i>Guidance on Data management, sharing, warehousing, cyber security, Edge computing technologies</i>
<i>Definitely information on systems and technology and grant opportunities for implementation</i>
<i>notes on state of the art</i>
<i>agency has no information or analysis done for this type of deployments yet.</i>
<i>We would like to know a clear timeline for when state and federal policy will be established</i>
<i>We need more staff.</i>
<i>Maintenance funding; new staff and funding for these staff - we currently have one traffic engineer for the County</i>
<i>staff</i>
<i>Given the limited resources available to our technical staff, I cannot envision advancing this type of project without the state managing the vast majority of the project.</i>
<i>Mandates and standards regarding technology investments.</i>
<i>Creating and mandating standard for all new cars to follow one standard and universal understanding of deployments. Cannot have Ford implement differently than Tesla about a message received from the infrastructure</i>
<i>Information about competing technology solutions, and on emerging standards (or convergence of technology into a preferred application or vendor).</i>
<i>Cybersecurity standards defined for the industry.</i>
<i>1.) Preserve the 5.9Ghz Spectrum at the Federal Level for Public Safety 2.) Support leveraging the public R/W as an asset for public - private partnerships 3.) National Concept of Operations for Highway Automation that directly connects with deployment/implementation funding</i>
<i>Other 1.) Uncertainty about preserving the 5.9Ghz Spectrum at the Federal Level for Public Safety 2.) Insufficient support for leveraging the public R/W as an asset for public - private partnerships 3.) Lack of a National Concept of Operations for Highway Automation that directly connects with deployment/implementation funding</i>
<i>Major Infrastructure upgrades would be necessary. (ie how would a connected vehicle identify a pothole and be able to safely avoid it if roadway infrastructure is not upgraded?)</i>

Source: USDOT

Q10: What types of assistance or resources does your agency need to support a connected vehicle deployment? (Select all that apply) - Other type of assistance (please specify) - Text



**Table 70: Detail on Types of Assistance and Training Needed for CV Deployment**

Note: Tables 70 to 76 present findings from this open-ended question, grouped into seven main categories:

- Training in CV best practices (including technology solutions being adopted by other agencies), benefits and policy (Table 70)
- Training in CV technology and equipment (Table 71)
- Training in CV communications and data (Table 72)
- Training in CV maintenance (Table 73)
- Various types of training/across the board training (Table 74)
- General training (no specifics provided) (Table 75)
- None, not sure, other (Table 76)

<b>Responses specifying training in CV best practices, benefits, and policy (N=36)</b>
<i>Best practices and benefit evaluation</i>
<i>Documents/briefs describing benefits for decision makers and the general public.</i>
<i>Start with educational material for policy and decision-makers at the executive level that provides an honest picture of CAV challenges, along with potential benefits, including operating and maintenance resources required.</i>
<i>the most important part is legal issues related to this technology and also public education about this technology.</i>
<i>ITS Systems is new transportation technology and I would need to understand its benefits in a small rural transit system.</i>
<i>Need basic training on what systems are available and the benefits.</i>
<i>For local Government Officials, the benefits to implementing connected vehicle technology and availability of grant funding</i>
<i>Need to fully understand why a small city would benefit beyond neighboring towns in use of connected vehicle technology. "What is in it for us"</i>
<i>educating public and decisions makers on the benefit/cost</i>
<i>Examples of deployments that have been successful and how they were implemented.</i>
<i>Available technology solutions adopted by other agencies</i>
<i>We would be interested in training related to specific CV applications and how they have been implemented by agencies.</i>
<i>Training on best practices and examples/details of deployments in other agencies.</i>
<i>Technical assistance on currently available approaches</i>
<i>training on existing technologies currently being deployed by other agencies</i>
<i>We are not in a position to fund or manage any integration efforts with freeway operations, local traffic signal coordination, or with large scale regional efforts involving coordinated vehicle communications. Instead, we need better information about when the technology is ready and appropriate for small agencies to adapt and implement (along with technical information about what level of effort is required).</i>

<b>Responses specifying training in CV best practices, benefits, and policy (N=36)</b>
<i>State of the Practice</i>
<i>General training to get a better in depth understanding of CV and best practices from around country</i>
<i>Webinars on best practices and other communities.</i>
<i>Best practices for connected vehicle deployments. What is working and what isn't.</i>
<i>CVRIA and Case study with IDTO module</i>
<i>We really are just beginning to look into this and are watching technical newsletters and attending ITS seminars. Information from the state and federal agencies on systems being funded and deployed would help us narrow our focus.</i>
<i>Best practices and information on deployments by other agencies of CV technologies.</i>
<i>Training on best practices and other agencies experience on deployments to support CV/AV operations.</i>
<i>Would start with best practices and grant funding opportunities</i>
<i>Best practices in regards to all aspects of funding and competing for grants both federal and state.</i>
<i>Start with an overview and example communities that have deployed. Some simple stuff first, as we are stretched for time. Then, if we want to learn more, additional training/detailed reports would be helpful.</i>
<i>Need in depth details on what the program entails, where it currently is with examples of communities that have implemented and goals and plans for the future of the program.</i>
<i>A clear and update to date explanation of the federal legal/policy/regulatory requirements surrounding deployments, particularly the types of vehicles and infrastructure that is allowed to be deployed on public roads would assist in conducting CV deployments</i>
<i>Grant and funding opportunities</i>
<ul style="list-style-type: none"> <li>- <i>Understanding the technical and safety risks involved in rolling out connected vehicles on the streets.</i></li> <li>- <i>Legal ramifications and liability issues associated with deployment</i></li> <li>- <i>Policy at the Federal and State levels (existing and proposed)</i></li> <li>- <i>Best options for data storage for cybersecurity and privacy</i></li> </ul>
<i>We need to understand the regulations and laws for implementation of this technology. We need to know what is expected of local units of government and what infrastructure improvements are needed to support implementation. We need uniform standards at the federal level.</i>
<i>Standardization of equipment so an agnostic open source platform is able to be utilized region wide</i>
<i>Information regarding Federal Goals for incorporating connected and automated Vehicle technologies into the nation's transportation infrastructure. Suggested best practices.</i>
<i>need more detail information in local level to decide what type of information and/or funding we need.</i>
<i>The struggle with this type of technology is procurement. Writing those specs, doing those Cost Analyses, understanding how to integrate it.</i>

Source: USDOT

Q10a: What types of assistance or resources does your agency need to support a connected vehicle deployment? (Select all that apply) - Other type of assistance (please specify) - Text

**Table 71: Detail on Types of Assistance and Training Needed for CV Deployment**

<b>Responses specifying training in CV technology and equipment (N=35)</b>
<i>An overview and demo of available CV technologies or applications and their system requirements.</i>
<i>Applicability of each technology would be helpful. If there is a way to get auto manufacturers involved to find out what technologies vehicles will be equipped with, and how local agencies can best provide the infrastructure to make that technology the most useful.</i>
<i>As our deployments continue, staff will need to better understand devices, and operations.</i>
<i>Broad overview training and specific training. This training could be implemented through the IDOT T2 program.</i>
<i>Device technology and connection to existing systems, security</i>
<i>Device technology, use, function, application, system components/connections, ITS security</i>
<i>Education on technologies available and their application to transit, as well as potential negative impacts, e.g. increased operator distraction</i>
<i>Explanation of what infrastructure changes are expected. Many of us are under the impression that CV will operate in the existing environment with no infrastructure changes needed.</i>
<i>Hands on training of equipment and technical requirements.</i>
<i>implementing security, working with industry on applications.</i>
<i>information on what equipment needs to be installed in the roadway and/or the controller cabinet schematic information on how a roadside unit interfaces with a controller cabinet</i>
<i>Infrastructure needs for CV operation</i>
<i>Integration and validation.</i>
<i>It would be helpful to have detailed information on hardware/radios available and pricing. Also knowing what applications are commercially available and what hardware they require would help. Right now it does not make sense financially to purchase hardware not knowing if it will support desired applications.</i>
<i>ITS Infrastructure and AV applications.</i>
<i>Migration from current system to future CV/AV connected system CV/AV integration updates benefits and cost</i>
<i>Need to train engineer and technicians on the use and implementation of roadside equipment.</i>
<i>Overview all available V2I technologies.</i>
<i>Road &amp; equipment standards to promote connected vehicles</i>
<i>standards, competing products</i>
<i>System integration with back office and at the field</i>
<i>systems available and capabilities</i>
<i>Technical Training for engineers focused on V2I applications</i>
<i>Technical user groups/networks would be helpful</i>
<i>Testing and implementation of various cv applications</i>

<b>Responses specifying training in CV technology and equipment (N=35)</b>
<i>The infrastructure for the technology to work.</i>
<i>The risks and vulnerabilities of the technology.</i>
<i>Training and technical assistance would be a benefit with respect to programming ATMS to best serve connected vehicles</i>
<i>Training on technical operations of equipment.</i>
<i>Training on the currently use cases for CV Applications and detailed information on how other agencies have deployed CV Applications/Technology.</i>
<i>Training on using and understanding the CV technology</i>
<i>What area the hardware requirements, costs, how to identify priority corridors.</i>
<i>What infrastructure needed on the local agency.</i>
<i>Would like to know more about transit type applications for major facilities such as colleges and airports.</i>
<i>Training on the technology that would be implemented for vehicle inter-connectivity. Technical assistance that would be available 24/7.</i>

Source: USDOT

Q10a: What types of assistance or resources does your agency need to support a connected vehicle deployment?  
(Select all that apply) - Other type of assistance (please specify) - Text

**Table 72: Detail on Types of Assistance and Training Needed for CV Deployment**

<b>Responses specifying training in CV communications and data (N=18)</b>
<i>Application and SCMS/data security training would be most useful.</i>
<i>Basic CV training related to MAP, SPaT, TSP, EVS, data management and Data Security.</i>
<i>Coding classes to help in database and programming the system.</i>
<i>CV data requirements and storage duration and size.</i>
<i>Data collection and storage</i>
<i>Data mining, analysis and operation deployment of the new technology</i>
<i>DSRC deployment</i>
<i>Guidance on what type of technology we should be focusing on, especially if DSRC and CV2X are not compatible.</i>
<i>Need IT and network communications training.</i>
<i>Range of DSRC</i>
<i>Technical assistance on data storage and access as well as V2I communications options.</i>
<i>Technical training on how infrastructure looks like for V2X and C-V2X, how to use back office to push notification to CV, and what is the best specification for the equipment to use</i>
<i>The market is moving so fast that determining who or what will be the winners in standards is difficult. For example DSRC versus 5G, lots of competing information saying each is doomed or each is going to win in the long run. You don't want to be the agency that chose Beta in the Beta VHS war.</i>
<i>Training on DSRC settings and software development.</i>
<i>Understand the backbone or infrastructure needed and the overall operation of CV communications.</i>
<i>Understanding how the vehicles will communicate with each other</i>
<i>What infrastructure and data requirements would the DOT's be required to implement based on the future and direction of the CAV industry.</i>
<i>Which technology tree should we be looking more towards (DSRC v 5G)</i>

Source: USDOT

Q10a: What types of assistance or resources does your agency need to support a connected vehicle deployment? (Select all that apply) - Other type of assistance (please specify) - Text

**Table 73: Detail on Types of Assistance and Training Needed for CV Deployment**

<b>Responses specifying training in CV maintenance (N=19)</b>
<i>Any type of technical training for our Operators and Mechanics will be helpful.</i>
<i>Field technicians are not able to maintain this infrastructure</i>
<i>How to design and maintain a connected vehicle system. How to utilize the data from a CV system.</i>
<i>How to maintain the system.</i>
<i>Installation, Operation, and Maintenance</i>
<i>Integrating with current traffic signals (including those owned and operated by state and by local jurisdictions). Technical information about what other infrastructure is needed except for signal related infrastructure. How do you ensure that what you invest in doesn't become obsolete.</i>
<i>Maintenance, Implementation, Infrastructure.</i>
<i>Maintenance, Installation, Use of system.</i>
<i>Teach our Electronics technicians how to diagnose, repair and test the CV equipment, just like all other ITS equipment on board our coaches.</i>
<i>Technical assistance about maintenance practices of traffic control devices and communication systems.</i>
<i>technical training...installation of equipment and maintenance</i>
<i>There seems to be no defined way to outline the benefits of CV and entice the planning community to include in the TIP as projects since the technologies do not seem to have matured and always seem to be under testing/ changing. We have been installing traditional ITS equipment for many years but the inability to fund the maintenance of this equipment to desired levels seems to not allow venturing into the experimental world on CV. As the work force in the DOT changes due to retirements the need for educating the new individuals exists and specific CV equipment applications, data management and maintenance would be helpful.</i>
<i>Training for implementation and O&amp;M</i>
<i>Training for Operating and Maintaining new technology.</i>
<i>Training on maintenance and operation of RSU's.</i>
<i>Training on the type of communication and infrastructure required. Also training on maintaining this equipment.</i>
<i>Understanding the cost of maintenance</i>
<i>We are a small but growing County and do not have enough technical training for our Traffic Technicians to install and maintain the equipment for connected vehicle technologies. We rely on Georgia Department of Transportation to be a partner and assist in training of our people.</i>
<i>We would need:</i> <i>1. Information on the types of available equipment</i> <i>2. Training on specifying and maintaining equipment</i>

Source: USDOT

Q10a: What types of assistance or resources does your agency need to support a connected vehicle deployment? (Select all that apply) - Other type of assistance (please specify) - Text

**Table 74: Detail on Types of Assistance and Training Needed for CV Deployment**

<b>Responses specifying various types of training – across the board training (N=52)</b>
<i>Training for all aspects of CV would be beneficial - from procurement, to standards, to deployment. Training for engineers but also signal technicians. The industry is still so new we are unsure of which way to go.</i>
<i>Our current City staff is small in numbers and would require the most basic training to provide us the ability to plan, acquire, design, and implement this technology.</i>
<i>Equipment that are compatible with connected vehicles, completed projects using these equipment, lesson learned, agencies contacts if have questions,...</i>
<i>Training and technical assistance on RSU configurations for different applications. Training for operators and users for device installation, maintenance, and data management and analysis. Policy guidance on the data sharing to public, other private partners, research institutes, and other state/local agencies. Training on absolute needs for security.</i>
<i>Training for staff at all levels, including data management, requirements for equipment, cyber security, procurement methods, etc.</i>
<i>CV 101; Demonstration Project Case studies; Knowledge transfer forums between cities</i>
<i>Training for Decision Makers and operators. As well as Technical Knowledge, and what other agencies are doing to deploy the technology.</i>
<i>Training to assist understanding of appropriate technology selection for CV functions from a municipal agency perspective. Evaluation methodologies. Costs, procurement, O&amp;M strategies. Best practices. Generally, answering the question of what is the best strategy for a region, city, collaboration of agencies to pursue CV implementation.</i>
<i>Training - what will the technology be to speak to CAVs and how will that be monitored Technical - additional resources familiar with IT related tasks since organization has CEs/TEs but they are not familiar or have extensive knowledge on the IT side of CAVs/AVs, etc.</i>
<i>Planning, design, implementation, operation and maintenance training associated with advanced/new technologies at the technician and engineer levels.</i>
<i>Some of our current roadway engineers have no expertise in this field at all. Educating the workforce on adapting current systems to CV upgrades would be helpful. Also, how to leverage IT and big data. We simply do not have the brain trust we need. This is a workforce development opportunity.</i>
<i>Training on best practices on connected vehicle technologies, evaluation methods and strategies, technology specification and system engineering tools</i>
<i>Need to know the maturity of CAV applications, deployment, test beds, lessons learned. Technical challenges and available off shelf products.</i>
<i>1.) Public Private Partnerships 2.) Creative / Innovative Financing 3.) Awareness of Grant Opportunities / Competitive Grant Writing 4.) Cybersecurity, Data Management Planning, almost any technical topic associated with CV Implementation.</i>



<b>Responses specifying various types of training – across the board training (N=52)</b>
<i>Marketing and convincing leadership of the importance of CV (V2I) for city municipalities. Helping Engineering minds how to communicate to gain political management support. Technical assistance to help guide vendor and consultant support assigned to CV projects.</i>
<i>training on legislature training on technologies training on strategies so that can be tailored to local agency</i>
<i>Many areas really. Training on governance set up, appropriate data modeling, analytics, ...</i>
<i>use cases for connected vehicle application. Data Storage and distribution</i>
<i>RIDOT staff have no experience with CV yet, so any related training and/or tech. assistance could be useful and/or needed. RIDOT current traffic signal controller and cabinet requirements follow NEMA standards (not ATC, yet), so training and/or tech. assistance RE: design, implementation, operation, maintenance, and use of CV tech. (e.g., SPaT data, RSUs, and all things communication-related) interfacing with NEMA TS2 and TS1 standards would be helpful for RIDOT.</i>
<i>Related to assistance that can benefit executives, management, and staff. How to transition our agency from old-school traffic to these new technologies.</i>
<i>Fewer "high level" overview webinars and seminars; more details on the FCC licensing process (forms, contacts, flow charts, check lists), cyber security key infrastructure and implementation (forms, contacts, flow charts, check lists). A national clearing house to connect agencies that are interested, and meet a certain level of local expertise, with private fleet operators and universities looking for a test bed, and with private, National Science Foundation, and other Federal funding sources.</i>
<i>Training on how to integrate connected vehicle technology with our current system. We need a clear understanding of the benefits, costs, and steps to integrate specific to our operation.</i>
<i>On site; user case studies; O&amp;M, planning and design</i>
<i>How to develop partnerships with companies with data and what data is appropriate for municipality to share. Liability aspects of sharing data.</i>
<i>Training on the role of the transportation management centers in the operation of CV technologies and also on the development of contract documents for such technologies. Training on grant application would be helpful as well.</i>
<i>Training related to equipment configuration, security, data storage, standards, operations.</i>
<i>FHWA Courses on Autonomous and CV. Cross training of existing employees. some Federal mandate / guidelines for DSRC vs CVtoX</i>
<i>ITS MANAGEMENT AND MAINTENANCE PRACTICES, COMMUNICATIONS TRAINING, INTERGRATING EXISTING WITH NEW TECHNOLOGY IN THE INTERIUM, DATA PROBING AND ATSPM INTERGRATION INTO SYSTEM OPERATIONS.</i>
<i>We will need training on how to design, deploy and how to operate and maintain the infrastructure</i>
<i>How the new smart and connected infrastructure can be implemented, managed, operated and maintained. This is true at the technician level and elected official level. Adoption of an "Agile" project management protocol rather than the "SEA." This is much like the IoT of cellular telephones. The universal applicability of the technologies.</i>



<b>Responses specifying various types of training – across the board training (N=52)</b>
<i>Evaluating existing infrastructure for compatibility with CV-AV technologies and creating an upgrade plan, minimum IT and technology requirements for systems, providing standards for technology and certifying products for use.</i>
<i>Successful case studies showing a medium city's (110,000 population) existing signal system, communication system, CV and AV system integration, SPAT output, data output, back end server storage requirements, and have a live running system out of the testing phase.</i>
<i>The actual process of selecting hardware components for installation on the agency-owned infrastructure, communications requirements within the agency's network, how to overcome issues of closely spaced intersections (located within the DSRC coverage area - how do we/user distinguish between two adjacent intersections); what other steps should we be taking as the TSM&amp;O agency/department to ensure we are able to meet the needs of CAV users?</i>
<i>What would be the expected maintenance needs? Do our tech crews need additional training? What sorts of problems would have to be covered by the manufacturer? Could route programming be managed in house?</i>
<i>Selection criteria for CV applications and then how to write up or request specific CV training as a requirement of a private consultant that provides the CV training so that we get the training needed for ongoing O&amp;M after the CV application is deployed.</i>
<i>Technical - Communication methods and how we may integrate them with our current system. Communication standards and preparing for the future. Decision-Makers - Straight forward ways to describe what is necessary to enable CV technologies.</i>
<i>Just going through this survey highlighted CV technology solutions I had never heard of. Combined with the all to well known issues with being on the bleeding edge (too much cost and risk for a questionable amount of value.... if not just a flash in a pan). Technical assistance would focus on specific applications and equipment which have been well developed beyond proofs of concept. Technology which is systems of systems related produce multiple points of failure, therefore, troubleshooting, maintenance, or even general operations is made more complex to exponential levels.... systems not well maintained might as never have been built to begin with..... I can relate many stories of Roadway Weather stations maintained by NEMA trained Traffic signal electricians to show you how well CV systems will perform without good training at every level.</i>
<i>We would need a needs assessment, full background training as well as ROI</i>
<i>It is across the board. We need to get signal technicians that are trained to service the equipment that is at the street level. We need IT training for the networking requirements, and server requirements. We need training on how to "sell this technology" to the policy makers to get funding and staff.</i>
<i>Comprehensive training for full cycle from planning through implementation, management, maintenance, and governance.</i>
<i>How the technology would operate and what safeguards are in place for a successful deployment. Also, legal and liability responsibilities.</i>
<i>Spare field equipment provided. Vehicle units provided for testing. Training on benefits, equipment, maintenance. A 24/7 go-to help-desk for potential issues if this was deployed.</i>
<i>someone to explain how it works and safeguards. also potential liability.</i>
<i>How a system is designed, maintained, implemented, etc.</i>

<b>Responses specifying various types of training – across the board training (N=52)</b>
<i>our local agency would need train on the application, policy, and funding for connected vehicles. Staff understand this is something coming in the near future however, we don't have resources to plan and deploy this transportation technology. At the city level with many other infrastructure priorities, funding and the benefit of this application will need to bring to the government body. Most importantly identify what is the need and benefit for such application for the community</i>
<i>How exactly this technology is a benefit to the public. What and how to do with information that is received via connectivity data.</i>
<i>Assistance with educating agency leadership, both LTD's and partners, about the benefits of CV Technology. help instilling a sense of urgency to develop a plan for how to best use the right technologies for the highest level of regional benefits.</i>
<i>CV education including: concepts, benefits, costs, and technical knowledge needs for management and planning staff.</i>
<i>How CV impact operations - (mini driver training) Technical workshops on data/ITS needs to support CV</i>
<i>Need training on the technology to deploy and maintain AV/CV technology. Need training for elected officials to better understand the benefits of the information. Need training for the data security and data storage needs to better understand the system requirements. Need technical assistance in deployment of a fiber optic network to ensure it meets current and future needs.</i>
<i>Available CV technology that would be accepted by site specific region. Midwest acceptance of CV will differ compared to east and west coast regions. General guidelines on how to gather support from general government and public. Information on what funding are available and can be awarded.</i>
<i>what ever public agencies need to know. Manage infrastructure, traffic signals, etc.</i>

Source: USDOT

Q10a: What types of assistance or resources does your agency need to support a connected vehicle deployment? (Select all that apply) - Other type of assistance (please specify) – Text

**Table 75: Detail on Types of Assistance and Training Needed for CV Deployment**

<b>Responses without any specification – Basic or general training (N=70)</b>
<i>the specifics of deployment</i>
<i>Application of CV technologies to transit agencies that depend on and have invested heavily in proprietary CAD/AVL systems</i>
<i>Aside from DSRC deployments to support the SPaT challenge and some connected pin technology as it relates to work zones, we're not doing much. While there is a clear need for training and support, there is uncertainty in what that is given our minimal investment as an agency due to the uncertainty of the technology. We don't want to simply spend money for something if the technology isn't a standards and commonplace among other agencies.</i>
<i>Currently just have a basic understanding of CV technology, companies are constantly trying to get us to buy hardware/software but we're hesitant to spend without more in depth knowledge.</i>
<i>Basic CAV training for new staff</i>
<i>How the connected vehicle technology works.</i>
<i>Training and assistance for deployment to small to mid-sized transit systems</i>
<i>Our agency, City of Wilmington would require training and technical assistance from the most basic levels and up. We have a small staff in our Transportation division. It would be most likely that we would partner with the state Agency 0 DeIDOT on any initiatives regarding CV. Although training for our staff would be essential, it is likely that we would outsource through consultants on developing and advancing a CV plan.</i>
<i>Broad training for the public on how the technology works and how it can be used.</i>
<i>probably everything, we know nothing.</i>
<i>Generally speaking. I think we are pretty uneducated about connected vehicles</i>
<i>General education and assistance in operation, evaluation.</i>
<i>We are just in the midst of our first SPaT/Connected Corridor for 39 signals and will be pursuing the incorporation of other V2X applications outside of basic SPaT and MAP communication. We have a long way to go.</i>
<i>Have no knowledge or information currently on connected vehicle technology.</i>
<i>Due to financial and staffing limitations, the City of Mesquite's deployment will need to wait.</i>
<i>When training becomes available, the City of Mesquite will require basic training.</i>
<i>SacRT is a very lean organization and would like a blueprint which could be followed with appropriate detail.</i>
<i>Training for academy for maintenance personnel.</i>
<i>Unknown at this time, but I assume it would be training for staff on the overall system architecture and then technical training on specific applications/equipment.</i>
<i>Training/Technical Assistance - As a county, were expecting more &amp; more data from all the devices deployed. We've been unable to hire anyone or train anyone with the technical knowledge needed to impetrate &amp; use the data to our benefit. This help/training would be greatly appreciated, especially with state &amp; county elected officials not desiring any new taxes..</i>
<i>Cutting edge but not bleeding edge information.</i>
<i>Our agency knows very little to nothing about connected vehicle technology. We would need all the help we could get/receive.</i>

<b>Responses without any specification – Basic or general training (N=70)</b>
<i>Most information provided is related to regional or urban environments. As a suburban community, it is hard to know where our community should focus our available resources to make sure we get the best return on investment and to make sure that we are implementing the appropriate technology for the future.</i>
<i>Since most of our transit staff have background on planning, training on Research &amp; Development, need to secure resources for O&amp;M before projects start, and continuous improvement are crucial for technology deployments to maximize its benefits for a long time.</i>
<i>One of key requirements for a connected vehicle infrastructure is a connected signal environment. We have very few connected signals. I am looking for funding and overall support for building a connected signal infrastructure.</i>
<i>All training related to the deployment of the named devices</i>
<i>With our small transit system, we would need major assistance to move forward and/or start this process.</i>
<i>Don't know anything about connected technology.</i>
<i>a more in depth training and assistance program that would educate users in this new system</i>
<i>All training and technical information possible ITS.</i>
<i>We have no one at the City who understand this technology and how it would be used.</i>
<i>Training needs to address the complete lack of knowledge by the staff, management and public. Training should start from the ground up.</i>
<i>All required training</i>
<i>All training related to ITS would be positive</i>
<i>SCDOT just hired a single POC to begin gathering information on CAV so that as the agency transitions to a point where plans for CAV implementation are directed we will have at least one knowledge expert. So any and all training and information is needed as we start the long road toward CAV.</i>
<i>There needs to be more buy-in from management so TA and/or training for decision makers as to why there is a need to start planning now.</i>
<i>Santa Rosa Co. currently does not have the staff to adequately explore the concept of automated vehicles. We would need extensive training in all aspects of this technology.</i>
<i>I believe general knowledge of the training and technical assistance so staff knows what the expectations are.</i>
<i>all of it</i>
<i>There should be training classes and Certifications to help us to perform our job more effectively.</i>
<i>Assistance to me and my staff would prove most beneficial for making decisions for the good of our city.</i>
<i>I don't know enough about connected vehicle technology to know where to start. Introductory training for where this is headed and what we should be doing to prepare. My agency does not have staff or funding to be an early adopter of new technology. However, we do want make the correct decisions to add infrastructure when we are building road project to be prepared when connected vehicle technology is standardize.</i>
<i>Any and all training would be needed</i>
<i>Any training that is available</i>
<i>Hands on Training</i>

<b>Responses without any specification – Basic or general training (N=70)</b>
<i>Relying on engineering consultants for knowledge/experience.</i>
<i>Need capable technical staff that can operate and maintain this type of equipment. Unable to find qualified staff that can learn to install, operate and maintain highly technical equipment.</i>
<i>need to build the staff capable of supporting this product</i>
<i>Persons familiar with operating a CV system.</i>
<i>Personnel on site training, on - line training.</i>
<i>overall training in all aspects</i>
<i>Introductory training to what is CV/AV and how it benefits my agency?</i>
<i>We are a small non-profit operating in rural and small urban areas and do not have any information on these vehicles so we would need all the technical assistance available.</i>
<i>Starting with very Basic to Intermediate training for Technical staff.</i>
<i>Use of existing infrastructure and regional training for agencies in the Puget Sound area so we are all on the same page and working together.</i>
<i>Need everything from the ground up. We are starting from scratch.</i>
<i>All training and technical assistance is useful, from the most basic "this is what technology you need" to advanced "how to maintain your equipment and how to get the most from the system"</i>
<i>Everyone (Public, Elected Officials, Employees) need to be educated on the subject.</i>
<i>basic educational background</i>
<i>General at the moment since we don't have any plans in place.</i>
<i>all training. Lack of staff to even look into CV</i>
<i>General</i>
<i>Seminars / training classes - IDOT?</i>
<i>We haven't started any efforts directly but know the technology is coming. Any and all training/information available will be sought as we approach efforts in this area.</i>
<i>The entire aspect</i>
<i>As much training as possible</i>
<i>Training required for emergency response, police, maintenance, etc</i>
<i>-A general introduction on connective technologies as well as a explanation to the necessary infrastructure improvements that are necessary to accommodate this connectivity</i>
<i>We are a small agency - about 90 paratransit vehicle providing door-to-door services. We don't have a lot of expertise on staff, not the budget and political will to go too far into an innovative program such as this one. So, we would need a lot of training from the most basic level.</i>
<i>Anything new needs to have training. The team we have can pick up what needs to happen and can usually continue it.</i>

Source: USDOT

Q10a: What types of assistance or resources does your agency need to support a connected vehicle deployment? (Select all that apply) - Other type of assistance (please specify) - Text

**Table 76: Detail on Types of Assistance and Training Needed for CV Deployment**

<b>Responses – none, not sure, or other (N=19)</b>
<i>The important points to understand at this time are these: 1. We, (i.e., the local transit agency) recently deployed a state-of-the-art CAD/AVL and Real-time Bus Information system. The local decision-makers value customer-facing technology that makes the system more convenient and user-friendly. The deployment of CV technology would need to meet the same criteria. 2. The established FTA formula grant program appropriations are not keeping pace with capital/preventive maintenance/"state-of-good" repairs costs. New technology are capital intensive and back-end operating costs can be quite expensive, so additional federal funding is needed. This funding must be flexible and available for both the capital investment and recurring/ongoing maintenance costs. 3. New technology needs to be "simple, yet powerful" with clearly defined benefits for the general public, local agencies, and provide enhanced safety for all system users.</i>
<i>No one at our agency has any training on this.</i>
<i>none</i>
<i>Not really sure.</i>
<i>There has been no work done on Connected Vehicle technology in our area. It does not appear to be a priority at the local or state level.</i>
<i>Really don't know much about it.</i>
<i>Not sure.</i>
<i>I cannot think of anything.</i>
<i>Unclear to me. I know the trainings and assistance that have been provided have been informative and useful. Our statewide ITS office and CV/AV personnel would have a better idea of what would be most useful given the challenges they see for further deployment of CV.</i>
<i>Not really sure</i>
<i>I don't know enough about CV technology to know.</i>
<i>Not sure how</i>
<i>I am not sure because we have not considered this type of technology.</i>
<i>We have not looked into connected vehicles, just started our first adaptive system. Until a standard is decided on we will hold off on looking into it and the legal ramifications tested.</i>
<i>We are too small of an agency to lead such an effort with CV.</i>
<i>Working in an urban area with extremely old infrastructure may no be able to support a roll out other than a lengthy phased approach</i>
<i>Currently there is little to no staff on hand at the county with a depth of knowledge on the subject to my knowledge.</i>
<i>There has been very little information regarding this that anyone on our staff has received. The only time this has come up internally is via a sales rep or two over the last two years has mentioned it briefly. Much of our existing signal infrastructure is already 10+ years old and we are only now getting some more connected corridors, and at no time was connected vehicle improvements discussed with these projects.</i>
<i>I don't have enough knowledge of the technology at this point to even identify what we need to know.</i>

Source: USDOT

Q10a: What types of assistance or resources does your agency need to support a connected vehicle deployment? (Select all that apply) - Other type of assistance (please specify) - Text



Table 77: Agency Activity Related to AV Testing

Open-End Responses
Northern Virginia Region / testing of several automated vehicles
Robotics Research in Montgomery County has a test run of their Olli shuttle. Montgomery County supported the project and helped deploy.
pilot AV route at Panasonic smart city facility
City of Arlington had two pilot programs for autonomous shuttle service as part of its ride share program. One pilot used autonomous shuttle (EasyMile) driving on dedicated route without mixing into regular traffic area. The second pilot program were more robust with Drive.AI which included autonomous shuttle service on city streets with mix traffic condition navigating through signals and other traffic controls.
The Florida Department of Transportation has collaborated in several planned AV pilots the Central Florida AV Proving Ground, Driver Assistive Trucking Platooning (DATP) Pilot, Florida's Turnpike Enterprise (FTE) SunTrax, Gainesville AV, Downtown Tampa Autonomous Transit, etc. Please refer to <a href="https://www.fdot.gov/traffic/its/projects-deploy/cv/connected-vehicles.shtm">https://www.fdot.gov/traffic/its/projects-deploy/cv/connected-vehicles.shtm</a> for more details.
Partnering with Mercedes to pilot test their AV technology, with first deployment aimed at providing shuttling service between 2 major points of interest.
Ongoing AV testing on the campus of the University of Michigan. City of Ann Arbor is supporting the planning for future testing on City streets.
We are one of the founding member of Arizona's Institute of Automated Mobility (IAM) which is a consortium of global industry, academic, and government members committed to embracing innovation, collaborating in state-of-the-art research, development, testing, and evaluation that advances safety, science, and policy associated with automated driving systems (ADS-equipped vehicles). The IAM is part of the Arizona Commerce Authority.
We have done several AV bus shuttle demos using ezmile 10 products. We have done several demos and research projects testing different supporting technologies like lidar testing and GPS lane keeping. Will be conducting an automated crash cushion test and deploying on work zones next summer.
100 mile mountain corridor injunction with a private company
SunTrax, Central Florida Automated Vehicle Partnership (CFAVP)
In process of implementing automated shuttles, contracted awarded to EasyMile in 2019 with planned implementation early 2020.
DriveOhio is leading ADS Grant activities, Columbus May Mobility Smart Circuit, and is in discussion with the AV industry.
Agency has a proving ground and manage AV testing with private partners
Deploying the RSU's to support connected vehicle communication through DSRC. Now, doing the same with 4G LTE instead to understand the latency issues
Oak Ridge CV testing.
Waymo
Testing AV for short hall trips. Small AV vehicles.

<b>Open-End Responses</b>
<i>Founding partner in the Central Florida Automated Vehicle Partnership</i>
<i>Leader-Follower TMA</i>
<i>Following BUILD grant award. City is implementing autonomous shuttles.</i>
<i>Deploy self-driving shuttle through residential roadways to connect a transit center to a community center.</i>
<i>Evaluating and testing CAV with County Roadway Infrastructure</i>
<i>Shuttles in downtown Las Vegas; Aptiv and Lyft offer automated rides on the Las Vegas Resort Corridor.</i>
<i>One of our districts is working on an Autonomous TMA (Truck Mounted Attenuator). The idea is to build a driverless follow vehicle to protect the lead vehicle that contains a driver and to remove the person from the follow vehicle so they don't get hurt if it gets hit by another vehicle.</i>
<i>Civic Lab Experiment: Run by the Sacramento Area Council of Governments where Sacramento State, SacRT and the City started a new incubator experiment to test automated vehicles.</i>
<i>TxDOT is currently leading the Texas Connected Freight Corridor project.</i>
<i>The Department has worked with a number of CV software providers to allow the testing of their software on our highways</i>
<i>Upgrade signal controllers to ATC standards, coordinate with FDOT and contractors on deployment of RSU's.</i>
<i>Deploying appropriate signage for test area</i>
<i>Working on P3 for AV shuttle deployment.</i>
<i>Supportive of local research efforts at academic level. Currently operate electric shuttle vehicle program that may serve as benchmark.</i>
<i>Pilot project in conjunction with Drive ai in Frisco, Texas. Pilot ended and could not justify the cost to continue.</i>
<i>set policy framework, application process, rules, ODD, and oversees operations from approved testing bodies</i>
<i>The Iowa DOT has worked with the National Advanced Driving Simulator (NADS) group at the University of Iowa to conduct automated vehicle testing using a Lincoln MKZ that has upgraded with additional sensors and technology to utilize HD mapping data.</i>
<i>VDOT typically provides technical and communications support during the planning process, research and route maintenance/operations support during the testing, and research/communications support following the conclusion of testing.</i>
<i>Support agency, metropolitan planning organization. Support to state (DOT and Governor's office), local agencies considering testing.</i>
<i>We allow full closure to freeways to test AV at our Proving Ground routes. In return, we participate on those testing to learn where are the technology now and what is their challenges/opportunities. Also, we learn what AV really needs from our infrastructure</i>



<b>Open-End Responses</b>
<i>A company is testing out in Marina Airport. We gave them the roadway to use for the testing by encroachment permit.</i>
<i>SPaT testing in Palo Alto, CA.</i>
<i>Providing infrastructure support i.e traffic signals Identifying location for testing Possible cost sharing</i>
<i>Transportation logistical support - civil roadway and permitting.</i>
<i>Provide SPaT data</i>
<i>Initial planning of a pilot, we would be responsible for the Operations and Maintenance contractor of the automated vehicle.</i>
<i>MassDOT has developed an application process, per the guidance set forth in Gov Baker's EO and following federal USDOT AV guidance, and in partnership with the local municipality. The application requires testing entities provide documentation of prior testing experience, testing and safety plans, insurance coverage, vehicle registration, and operator licensure and training information. In the Commonwealth, a licensed driver must also be in the vehicle and able to take immediate control as necessary. The current application process requires municipal participation and approval for testing on designated roadways and environmental conditions.</i>
<i>Assisted with communications and routing</i>
<i>The Pennsylvania Department of Transportation (PennDOT), Pennsylvania Turnpike Commission (PTC) and Penn State University (PSU) are partnering to explore and advance PennSTART, a state-of-the-art training and testing facility to address the transportation safety and operational needs of Pennsylvania and the Mid-Atlantic Region.</i>
<i>Daimler Connected Truck Research is being conducted in Oregon.</i>
<i>SunTrax</i>
<i>We are in a process of purchasing the deploying automated crash attenuation system</i>
<i>Agency is not involved in the actual auto vehicle testing; however, we are allowed to visit &amp; ask questions of FDOT. Our ITS Florida Annual Mtg included field visit to site.</i>
<i>Collaborate researches with universities.</i>
<i>Submitted proposals for AV pilot program</i>
<i>See <a href="http://www.dot.ri.gov/projects/TRIP/LittleRoody.php">http://www.dot.ri.gov/projects/TRIP/LittleRoody.php</a></i>
<i>We are doing many things.</i>
<i>To be determined.</i>
<i>observe</i>
<i>Outside agency testing and we installed on to our system. It failed</i>

Source: USDOT

Q12a: Please describe your agency's activities with respect to automated vehicle testing:

**Table 78: Other Challenges in Planning or Conducting AV Testing**

<b>Open-End Responses</b>
<p>1.) Federal Grant requirements are too constraining and requiring state match and/or staff capability and/or capacity that exceeds existing resources (operating and capital)</p> <p>2.) Existing state statues lead to a patchwork of regulatory and policy frameworks as each state incorporates and aligns national guidance/recommendations in a manner that aligns with existing rules, regulations and culture.</p> <p>3.) Uncertainty about preserving the 5.9Ghz Spectrum at the Federal Level for Public Safety</p> <p>4.) Insufficient support for leveraging the public R/W as an asset for public - private partnerships</p> <p>5.) Lack of a National Concept of Operations for Highway Automation that directly connects with deployment/implementation funding</p>
<p>With respect to low speed shuttle testing, it would be helpful to have data or more information regarding the transportation benefits of low-speed shuttles when tested or deployed on public roads in a mixed traffic environment (not campus environment or fixed-guideway), compared to human driven shuttles or transit buses. With respect to automated transit, additional research is needed on the safety benefits and hazards of equipping transit buses with automated technologies. With respect to deployment of AV ride-hail fleets, the authority to regulate private AV testing on public roadways falls within state jurisdiction. Automated vehicles are not required to demonstrate that they can safely operate on public roads which is a barrier to deployment and obtaining public trust. Without having an understanding of the safety benefits of AVs that are currently testing based on real safety data (i.e. collisions, disengagements their locations and circumstances, or another metric) there is no clear reason for deployment. With respected to automating transit, more research is needed on the implications to transit drivers given their many functions besides directly operating the vehicle.</p>
<p>Technology not fully developed, and uncertainty about safety and liability issues. Insurance issues not clear (regarding public agency deep pocket exposures).</p>
<p>As of now there are currently no AV platforms that are NHTSA certified. I cannot deploy a technology into my public space until certifications, and insurability issues are addressed at Fed and State levels.</p>
<p>Insurance coverage.</p>
<p>Liability</p>
<p>Not sure if they are 100% safe to operate in our local roads.</p>
<p>lack of standards in technology and overall between mfg.</p>
<p>Waymo is operating independently from Transportation Departments in my region and has indicated they do not require any data from us.</p>
<p>Because we are a commuter railroad, these automobile-based technologies are not usable for our service.</p>
<p>lack of equipped cars on the road</p>
<p>U.S. Coast Guard</p>
<p>never been approached to have these technologies tested or deployed</p>
<p>At this point, I would argue that we don't know what we don't know. Most people have heard of this technology and know it's coming/is already here, but nobody knows what to do with it.</p>
<p>companies not interested in testing in our City</p>

Source: USDOT

Q17: Does your agency face any of the following challenges in planning or conducting automated vehicle testing or deployment? (Select all that apply) - Other (please specify) - Text

**Table 79: Other Laws, Regulations, or Policies Changed for AV**

<b>Open-End Responses</b>
1.) The laws pertaining to insurance of automated vehicle testing are being discussed through a collaborative WA State AV Work Group (Considering a \$5M per occurrence liability requirement for testing AVs)
2.) In 2017 the Governor issued and Executive Order directing the Department of Licensing to establish a self-certification process to facilitate testing of AVs with/without a driver in the vehicle.
joint application for testing of AV's
introducing law for testing automated vehicles.
State laws for testing purposes.
Existing autonomous vehicle state law needs more flexibility for pilot testing to attract industry, make it easier to implement pilots and better align with national best practices & standards. A framework / pathway to deployment is also needed.
I believe the state of CT has authorized several AV demonstration projects and has applied for an FTA grant to test AVs on the CTfastrak bus rapid transit line in Hartford.
State passed law prohibiting local agencies from regulating autonomous vehicles.
State law passed which states local agencies may not enact ordinances prohibiting AV operation.
Local tax passed to tax future AV trips
Don't know about "State laws pertaining to the insurance of auto vehicles" since Florida is a No Fault insurance state.
State passed law prohibiting local agencies from regulating AV operation.

Source: USDOT

Q18a: What laws, regulations, or policies have been or are being changed? (Select all that apply) - Other (please specify) - Text

**Table 80: Other Types of Assistance or Resources for AV Testing or Deployment**

Open-End Responses
<i>Automated vehicle technology is so new that Local agencies, particularly smaller agencies, need education and guidance. There are a lot of specialty traffic control equipment involved that would impact maintenance operations and require special staff training and knowledge. A high level flow-chart may be helpful for local agencies to show the appropriate path to take as we embark into the realm of automated vehicle technology.</i>
<i>1.) NHTSA Exemption Process 2.) Crash Testing Analysis and results for all vehicles (e.g. AV Shuttles) being deployed within the United States that have received an exemption</i>
<i>Maintenance strategies</i>
<i>More than just capital funds/grants - maintenance and staffing funds would be needed too.</i>
<i>Infrastructure upgrades needed</i>
<i>Regional Data collection/dissemination location</i>
<i>Safety concerns/education on how reliable the technology is.</i>
<i>Job titles, job duties, and pay structure for new employees to manage AV applications.</i>
<i>Non-Competitive grants</i>
<i>We need guidance and support from the federal level. Local government is not in a position to lead implementation.</i>
<i>Support needs will be identified in a Concept of Operations for a future CAV program.</i>
<i>Information on how automated vehicles are likely to deploy in suburban settings</i>
<i>We would also have to be approached by agencies/the state/constituents/vehicle companies for this to hit our radar as a need</i>
<i>AV in my region has not being lead by Public agencies and the private companies have made no request of us.</i>
<i>all of the above. we have not researched the topic.</i>
<i>US DOE and DOT need to approach this as a joint program directive. At the local level we see tremendous synergy between the efforts undertake by and not yet coordinated between the two agencies.</i>
<i>A truly automated vehicle should be self sufficient and function in whatever environment it encounters. Taxpayers cannot afford to chase after this ever evolving technology.</i>

Source: USDOT

Q20: What types of assistance or resources does your agency need to support automated vehicle testing or deployment? (Select all that apply) - Other type of assistance (please specify) - Text

**Table 81: Detail on Types of Assistance and Training Needed for AV Deployment**

Note: Tables 81 to 85 present findings from this open-ended question, grouped into five main categories:

- Training in AV best practices, benefits, costs, and policy (Table 81)
- Training in AV technology and maintenance (Table 82)
- Various types of AV training/across the board training (Table 83)
- General training (no specifics provided) (Table 84)
- None, not sure, other (Table 85)

<b>Responses specifying training in AV best practices, benefits, costs, and policy (N=47)</b>
<i>Information on the return on investment.</i>
<i>Education of public officials and general public on the need or benefits of Connected and Automated Vehicles.</i>
<i>Again what is the benefit to spending large sums of money on procuring technologies for a very limited market of users.</i>
<i>What are the requirements (specs for pavement markings and the like), what are the associated costs.</i>
<i>-Information that shows the usefulness of implementation of this type of technology</i>
<i>education for decision makers/ planners</i>
<i>What are best practices for preparing for AV deployments</i>
<i>Education on system design and use cases</i>
<i>Compatible equipment with AV and lesson learned with completed projects.</i>
<i>Current state of AV technology, its relationship to field infrastructure</i>
<i>Best practices and benefit evaluation.</i>
<i>Best practices. How to position for AV technology adoption for public agencies.</i>
<i>Standards and best practices in how different built environments can accommodate this technology.</i>
<i>Training regarding best practices would be beneficial.</i>
<i>Training and best practices for small to mid-size transit agency</i>
<i>data storage best practices</i>
<i>Best practices and examples of deployment by other agencies of roadway improvements which support AV deployment.</i>
<i>What would be required from local agencies to support AV testing and deployment?</i>
<i>Best practices and early-action items.</i>
<i>All elements of the State of the Practice</i>
<i>assistance and best practices. specifically around governance, and operational practices.</i>
<i>General training and best practices. Funding would be next</i>
<i>best practices and what other communities are doing</i>
<i>Blueprint detailing the process to achieve (end-to-end) along with a project plan to implement.</i>

<b>Responses specifying training in AV best practices, benefits, costs, and policy (N=47)</b>
<i>Training regarding testing methods and best practices.</i>
<i>Same as Connected Vehicles. We really are just learning like everyone else. We see this technology likely improving our toolbox and making people's lives better and safer but need more information on how a deployment or testing can be done.</i>
<i>Information and training on best practices and deployment of technologies to support AV deployment.</i>
<i>Training on best practices and other agencies experiences regarding deployments to support AV operations.</i>
<i>Training that addresses executive/board questions regarding cost/benefits and cyber security risk.</i>
<i>best practices</i>
<i>Concept of operations</i>
<i>First step would be literature with all programs out there currently and the pro's and con's of all.</i>
<i>Updates on where other communities and states are at with the technology; an understanding of what is all needed to deploy.</i>
<i>Overview of available automated vehicle technologies.</i>
<i>Type of technology that our agency should be purchasing for existing systems that will function in the future with CV. (Roadside communication, etc...)</i>
<i>What is currently allowed in CA? What kind of funding is available? What is needed from local agency?</i>
<i>Direction and training on standards.</i>
<i>First knowing what - from the federal perspective what will be incumbent upon state and local agencies. Without that most agencies - NMDOT included - will be reticent in moving on a path forward that involves resource commitment.</i>
<i>Laws. Standards.</i>
<i>Regulatory and Workforce Development</i>
<i>Elected official and decision-makers understanding of the need for Legislative action, regulations and implementation protocols.</i>
<i>We don't know which way the industry is going, DSRC or 5G. Until we have this answered we are reluctant to do any significant investment.</i>
<i>Don't know if we are legally allowed in my state to deploy automated vehicles. Not sure if and how they would safely function locally with our current infrastructure.</i>
<i>Specify types of roadway and signage improvements needed. Educate local leaders and public.</i>
<i>details of current and future of this program.</i>
<i>Procurement</i>
<i>Developing a Masterplan to assist in the procurement and implement of this technology, including staffing needs.</i>

Source: USDOT

Q20a: Please provide more detail on the type of training or technical assistance that would be most useful to you (be as specific as possible).

**Table 82: Detail on Types of Assistance and Training Needed for AV Deployment**

<b>Responses specifying training in AV technology and maintenance (N=27)</b>
<i>Training on maintenance and operation of RSU's.</i>
<i>what equipment needs to be installed? who procures and installs the equipment? who maintains the equipment?</i>
<i>ITS/AV systems seem to require that many devices and communications equipment be in pristine condition and operating properly at all times. This creates a maintenance challenge for limited municipal budgets and is the area where technical assistance will be needed the most.</i>
<i>Technical assistance on AV software and hardware options and applicability on different settings.</i>
<i>Assistance for evaluation on safety and cyber security.</i>
<i>Highly technical training regarding technology and what agency could do to prepare for this technology.</i>
<i>certification of testing avs for deployment</i>
<i>Training on the specific infrastructure needs that must be considered prior to and during AV deployments would be helpful.</i>
<i>Training on technical operations.</i>
<i>How to use AV data? Currently, it's too much to manage</i>
<i>To be trained on the operation of the vehicle inter-connected equipment including troubleshooting. Technical assistance that is available 24/7.</i>
<i>Information about what network or infrastructure investments are necessary for autonomous technologies to be successful (communication systems, lane marking and other roadway and freeway infrastructure improvements, interface with other connected vehicle systems or controls).</i>
<i>DSRC or cellular?</i>
<i>Information on use case, maintenance and operations of Automated technology.</i>
<i>Train the maintenance crew in the operating the automated vehicles once they are available.</i>
<i>Coding classes, training engineers in the technology and how to maintain it, and understanding systems and how they function.</i>
<i>Infrastructure needed to support AV.</i>
<i>System Architecture and applications</i>
<i>installation and maintenance</i>
<i>Need training on what infrastructure is required to support Automated Vehicles</i>
<i>Information on integration with existing ITS systems.</i>
<i>ITS, ATMS</i>
<i>Data mining, analysis and operation deployment and safety controls of the new technology.</i>
<i>Infrastructure needs for AV operation</i>

<b>Responses specifying training in AV technology and maintenance (N=27)</b>
<i>Communications and overall infrastructure requirements and data governance</i>
<i>How ATS would work in a public transit system</i>
<i>Training on technology and operational standards. Spare equipment and technical support provided 24/7</i>
<i>How to integrate existing fiber systems to support AV systems.</i>

Source: USDOT

Q20a: Please provide more detail on the type of training or technical assistance that would be most useful to you (be as specific as possible).



**Table 83: Detail on Types of Assistance and Training Needed for AV Deployment**

<b>Responses specifying various types of AV training/Across the board training (N=35)</b>
<i>Technology is so new training in all aspects would be beneficial. Procurement, training for decision makers and general public, cost benefits, training for signal technicians.</i>
<i>For automated buses, it would be beneficial to learn how to manage within general traffic, handle the data and collision avoidance applications.</i>
<i>Training on SCMS Planning for CAVs</i>
<i>Technical assistance to develop concept of operations, pilot deployment and evaluation of various technologies in terms capital and maintenance cost, reliability and user friendliness etc.</i>
<i>Need to know the maturity of the CAV applications. Any deployment, test beds, lessons learned, technical challenges and COTS products.</i>
<i>Training on the infrastructure needs for AV's, and what DOT's can do to facilitate deployment of AV's.</i>
<i>training on legislature training on technology training on strategies applicable to local agency</i>
<i>Training and/or tech. assistance related to the roles, responsibilities, and rights RE: AV operational/performance/safety data (sharing, use, reporting, etc.) between the AV operator(s) and the public roadway agency/owner</i>
<i>Any AV deployment would be through a partnership with a private company. Having more detail on how the legal and technical agreements need to be structured for both initial deployment and longer term O&amp;M would be very useful. Also, information on the support needed and structure for an AV deployment, beyond "better signing and marking" and into curb space management, AV fueling and maintenance space requirements, rapid assistance deployment to AV vehicles experiencing problems, training for first responders who may need to deal with AV during crashes, working with AV if construction activities are going to be in the AV operating space.</i>
<i>Need to know benefits, costs, and next steps to integrate specific to our system</i>
<i>on-site; planning, design; O&amp;M</i>
<i>Information on how suburban communities can prepare for automated vehicles and coordination with regional/urban efforts. Training to inform staff of what technology should be procured now as part of other projects (cabinet, fiber, etc.) so that the framework is in place and that capital improvements don't have to be replaced or redone.</i>
<i>Training related to equipment, security, implementation, configuration, data storage, operations</i>
<i>With the uncertainty on how AVs are going to impact transit, all kinds of training for staff and also to stakeholders are needed for sure.</i>
<i>Training on pros and cons of automated public transit vehicles carrying general public. Technical assistance on the technology functionality, logic and fail proof system.</i>
<i>CAV deployments planning and infrastructure upgrade</i>
<i>Best practice and peer-to-peer training to get CV pilots (e.g. SPaT, Transit Signal Priority) and AV pilots (ADS buses) off the ground. This training would address financial resources needed, staff</i>

<b>Responses specifying various types of AV training/Across the board training (N=35)</b>
<i>resources needed, technical equipment needed, and technical skills needed, maintenance needed, policies needed, etc.</i>
<i>How to Prepare for AV technology integration Benefits of Future AV technology Cost and Strategies to migrate</i>
<i>Understanding how one even starts the process on this innovative technology that is being explored across the country. Also, how can paratransit move in this direction in the future as it is a more complex entity than fixed route.</i>
<i>We need help in understanding the needs of automated vehicles. Does an automated vehicle need different pavement markings or other features in the field? What can we do to ensure that any equipment we purchase will be compatible or we will be replacing all of our equipment soon?</i>
<i>Successful case study of medium city (110,000 population) with type of existing signal system, communications systems, AV equipment integration, SPAT data output, server storage needs, archive data output examples, FTE size for engineers and maintenance to operate and maintain the AV systems with a successful ongoing live AV deployment out of the testing stages.</i>
<i>Same types of issues as with CV. We need to know what infrastructure to put on the street. Everything we hear is either high level, or talks about the vehicles, or is still unsettled about Cellular vs. DSRC. We need to know how to make our upcoming projects future-proof so we can jump into CAV as soon as possible when it becomes wide spread.</i>
<i>Training on O&amp;M of AV from a local agencies point of view (i.e. how to keep the lights on once the project is complete). Training on communication and troubleshooting of problems that could occur in the I2V technologies deployed or required.</i>
<i>Infrastructure needed and costs of implementing and maintaining.</i>
<i>Webinars across all transportation-related job functions regarding how AVs will affect their work area(s). • Understanding potential AV impacts on Complete Streets plans is a crucial emerging area of interest, in the somewhat short term, this may be more about delivery robots on sidewalks and bike lanes o How does curbside EV charging today make curbs less flexible as we seek to begin to regulate curbs to ease congestion around deliveries, TNC use, and eventually AV systems, and/or create bike lanes? Also, does curbside charging further ingrain cars' perceived ownership of streets and curb space as exclusively for automobile traffic and parking? • As we build out AV networks – how to we still encourage walking and other active transit modes? How do we design cities for AVs and active transportation? How do we thoughtfully integrate AVs into existing public transit options? • How do we design AV networks that actually encourage sharing, and not single-occupancy vehicles – or worse, zero occupancy vehicles? The price of driving needs to reflect the asset of the roads as electrification scales and driving potentially becomes even cheaper. How do we design policy for this? • How do we ensure transportation access to all populations? We've had the technology to address transportation inequity for at least 60 years. What we lack is the political will to fix it. AV has the potential to fix many problems, but it also has the potential to exacerbate existing problems if we don't act thoughtfully: <a href="http://greenlining.org/publications/2019/autonomous-vehicle-heaven-or-hell-creating-a-transportation-revolution-that-benefits-all/">http://greenlining.org/publications/2019/autonomous-vehicle-heaven-or-hell-creating-a-transportation-revolution-that-benefits-all/</a></i>
<i>We would need a needs assessment, full background training as well as ROI</i>

<b>Responses specifying various types of AV training/Across the board training (N=35)</b>
<i>Comprehensive training for full cycle from planning through implementation, management, maintenance, and governance.</i>
<i>legal and technological.</i>
<i>Similar to the first part of this survey, training/technical assistance on all aspects of planning, maintenance, deployment, etc.</i>
<i>how local communities with limited funding resources could educate staff and community about this technology and benefit. How to apply for funding for deployment, operation and maintenance. Understand how the existing technology such as traffic signal and database could be upgraded to support autonomous vehicles - what expertise can be bring to local communities without negatively affecting our community budgets</i>
<i>Produce Selection, Installation, Operation, and Maintenance</i>
<i>Assistance with educating leadership, both the District's and its partner agencies, in the benefits of this evolving technology and its relevance in the future development of the next generation of transportation infrastructure. Success of this foundational task would be measured by the sense of urgency created at all levels of leadership to be part of this wave of change.</i>
<i>More technical assistance on preparation local agencies can take to prepare for automated vehicles. More opportunity for state agencies to include local agencies in technology procurement/consulting initiatives.</i>
<i>Training on "How to Get Started and Develop a Successful System" with automated vehicle technology. For Example: 1) Prepare an Automated Vehicle Concept of Operation Plan 2) Identify Agency Goals and Plan of Action 3) Secure Funding for Pilot Project 4) Deploy project 5) Conduct before / after study 6) Access Automated Vehicle infrastructure maintenance program and requirements 7)... etc.</i>
<b>THE AGENCY NEED DETAILED INFORMATION REGARDING THE STUDY, ANALYSIS, COST AND BENEFIT.</b>

Source: USDOT

Q20a: Please provide more detail on the type of training or technical assistance that would be most useful to you (be as specific as possible).

**Table 84: Detail on Types of Assistance and Training Needed for AV Deployment**

<b>Responses without any specification – general AV training (N=46)</b>
<i>any training is helpful</i>
<i>General training from how to address the public to how is this technology being maintained.</i>
<i>The general public needs to see and use this technology... More demonstrations and learning efforts</i>
<i>Applicable training for transportation planners, engineer technicians and Engineers.</i>
<i>How to Deploy AV while there are two competing technology still in progress</i>
<i>We don't have much/any background. "We don't know what we don't know" at this time.</i>
<i>Just general guidance on what local jurisdictions need to do to prepare.</i>
<i>Maybe just knowing what we can do and what we should be planning for locally and regionally for what you see coming our way</i>
<i>How the AV system works.</i>
<i>Locally we have not deployed automated vehicle technology so we could use all the training and technical assistance, certainly for planning and testing purposes.</i>
<i>I believe we need some assistance in the required infrastructure. Although we have a consultant on board already. Any assistance would be helpful.</i>
<i>Very basic training</i>
<i>More information to decision makers through the professional organizations that they would attend.</i>
<i>AV so far have been discussed with CV but infrastructure owners and operators don't know much about it. May be a national initiative to educate them will help.</i>
<i>Assistance in understanding AVs and how to start a pilot.</i>
<i>All training related to the deployment of AVs</i>
<i>this technology is very new, especially for public transportation, and so the more training there is, the more people are comfortable with the idea of AV.</i>
<i>All Training possible for AV.</i>
<i>Would like to know more about AV for fleet use</i>
<i>Again, this is all new technologies with which the staff, management and public are not familiar. Training needs to address these three groups and should start from the very basics.</i>
<i>All required training</i>
<i>Any/all ITS related training would be useful</i>
<i>We are just starting in this area so any and all available training and information is appreciated.</i>
<i>Again, reach out to policy makers to incorporate planning activities for AV/CV tech.</i>
<i>Trading on all aspects</i>
<i>Santa Rosa Co. Fl. needs all aspects of training to better understand our role in the implementation of AV technology.</i>

<b>Responses without any specification – general AV training (N=46)</b>
<i>General workshop for all levels of local/county government detailing the current/future goals for deployment of AV technologies.</i>
<i>all of it</i>
<i>Presentation at our County Board meeting</i>
<i>Comprehensive information for me and my staff so that we are able to make the best decisions for the city.</i>
<i>Any and all</i>
<i>Any training that is available</i>
<i>when staff is available, they will need to be fully educated</i>
<i>Hands on training and IT assistance would be required.</i>
<i>Training for local personnel from staff familiar with the development and operation of a system.</i>
<i>Overall Training for all aspects</i>
<i>Introduction AV training and benefits</i>
<i>Again, we would be starting from scratch so need to have the training and technical assistance to just begin a discussion.</i>
<i>As much training as possible from the most basic to advanced for technicians.</i>
<i>We would need to see where this is working in a similar environment and need to be educated on all of the the technology and required infrastructure.</i>
<i>basic education</i>
<i>Training on deployment of systems for smaller agencies.</i>
<i>Working in an old urban area</i>
<i>We haven't started any efforts directly but know the technology is coming. Any and all training/information available will be sought as we approach efforts in this area.</i>
<i>the entire aspect of AV</i>
<i>As much training as possible</i>

Source: USDOT

Q20a: Please provide more detail on the type of training or technical assistance that would be most useful to you (be as specific as possible).

**Table 85: Detail on Types of Assistance and Training Needed for AV Deployment**

<b>Responses – none, not sure, or other (N=23)</b>
<i>Our main concern is the operation of AVs on our local roads, especially around schools.</i>
<i>for the public</i>
<i>We can't afford to be on the bleeding edge of technology. We need to deploy mainstream equipment, and train staff accordingly.</i>
<i>Need corporation from agencies who have deployed these type technologies</i>
<i>We have developed our application and testing protocols based on researching other states and national guidance, but we are not drawing significant interest in the industry with coming to MA to test.</i>
<i>Not yet determined.</i>
<i>At this time, I don't see our agency interested.</i>
<i>We are a small agency and all training will be important to embrace these concepts.</i>
<i>Cannot think of any</i>
<i>Unclear to me. Staff in our statewide ITS office and CV/AV program would best know what resources would be useful.</i>
<i>Unknown</i>
<i>I don't know enough about it to know what I'd need.</i>
<i>We are a small urban transit system. Most of this is way beyond us. Transit bus manufacturers have not shared any information on their work on CVs and AVs, so we are in the dark. We are sharing research on level 2 automation through our Washington State Transit Insurance Pool (WSTIP)</i>
<i>Not sure</i>
<i>I am not sure.</i>
<i>We are a small non-profit operating in rural and small urban areas. We would be interested in this technology but do not have any experience, infrastructure or capability to do so.</i>
<i>we have not looked at automated vehicle systems yet, do not have the personnel to make a plan yet.</i>
<i>Not known</i>
<i>CV and AV need to be accepted more by local/state/fed agencies and rolled out so that, over time, the public can become more familiar and comfortable.</i>
<i>These questions appear to be doubled/same as prior. In general the answer would be the same, it has really not been something discussed by our agency at all. The only time it has come up is by a sales rep or two and even that was talked as a long way off. Our current signal infrastructure is already behind, and we are just beginning to get more coordination between corridor(s).</i>
<i>AV is very new to the Midwest regional area. First step would be introducing more technologies in our connected vehicles which eventually lead to automated vehicles.</i>
<i>Douglas County does not have currently anyone trained to handle vehicle connectivity projects. We rely on Georgia Department of Transportation to assist us in what we need to implement new technologies in our County.</i>
<i>training on what kind of training is needed</i>

Source: USDOT

Q20a: Please provide more detail on the type of training or technical assistance that would be most useful to you (be as specific as possible).

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