Intelligent Transportation Systems: Findings from the Small Urban and Rural Transit Provider Survey

Final Report

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16. Abstract

This Report presents findings from the 2019 Small Urban and Rural Transit Survey. The ITS JPO conducted this survey in response to a General Accountability Office (GAO) recommendation that the ITS JPO track ITS deployment in small urban and rural areas. The survey explores the use and usefulness of ITS technologies deployed by small urban and rural transit providers, along with reasons why the technologies are or are not being used. In addition, the survey addresses the challenges to deployment, the benefits of these technologies, and the sources of funding and technical support, including use of ITS JPO resources. The survey was administered September 9 – October 28, 2019 and achieved a 74 percent response rate, resulting in a final sample of 244 small urban and rural transit providers. Based on the survey findings, the Report also presents the ITS JPO and FTA with recommendations related to accelerating the deployment of ITS among small urban and rural transit providers.

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Acronyms

AV	Automated Vehicle
APC	Automatic Passenger Counters
AVL	Automatic Vehicle Location
CAD	Computer-Aided Dispatch
CV	Connected Vehicle
DTS	Deployment Tracking Surveys
EFP	Electronic Fare Payment Systems
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GAO	General Accountability Office
GIS	Geographic Information Systems
GPS	Global Positioning System
GTFS	General Transit Feed Specification
ITS	Intelligent Transportation Systems
JPO	Joint Program Office
MMS	Maintenance Management Systems
MPO	Metropolitan Planning Organizations
MOD	Mobility on Demand
NTD	National Transit Database
OST	The Office of the Secretary of Transportation
PCB	Professional Capacity Building
RTAP	Rural Transit Assistance Program
SCS	Security Cameras and Systems
TAM	Transit Asset Management
TSP	Transit Signal Priority
USDOT	US Department of Transportation
WMATA	Washington Metropolitan Area Transit Authority

Executive Summary

Introduction

This report summarizes findings from the 2019 Intelligent Transportation Systems (ITS) Small Urban and Rural Transit Providers Survey, administered by the US Department of Transportation (USDOT) Volpe National Transportation Systems Center in support of the USDOT ITS Joint Program Office (JPO). The ITS JPO conducted this survey in response to a General Accountability Office (GAO) recommendation that the ITS JPO should track the deployment of ITS within small urban and rural areas.

The ITS JPO has been conducting ITS Deployment Tracking Surveys (DTS) since 1997. The ITS JPO uses the results of the DTS to, among other things, respond strategically to ITS deployment gaps and execute technical transfer activities that help states and local agencies plan and execute ITS deployments. Recent DTS targeted freeway, arterial, and transit agencies in 75 large metropolitan areas and 30 medium sized cities. This 2019 Survey of Small Urban and Rural Transit Providers represents an effort by the ITS JPO to cover small urban and rural transit agencies, providing a more representative picture of ITS technologies deployed nationally by transit agencies, and a better understanding of the factors that affect deployment for smaller providers.

Survey Methodology

To provide data comparable to the 2015 Small Urban and Rural Transit Provider Survey, the research team replicated the GAO's sampling methodology as well as the questionnaire, adding a few new questions related to Connected Vehicles (CV), Automated Vehicles (AV), and partnerships with private transportation providers. An overview of the sampling approach and data collection are provided below.

The research team identified the population of small urban and rural transit providers using the definitions employed by the GAO in the 2015.

- Small Urban Transit Providers were identified as recipients of Federal Transit Administration's (FTA) Urbanized Area Formula Grants (49 U.S.C. 5307) with populations of 200,000 or fewer.
- Rural Transit Providers were identified as sub-recipients of the FTA's Rural Area Formula Grants (49 U.S.C. 5307).[1] In order to target rural transit providers that are most likely using ITS, agencies with fleets of 10 or fewer vehicles were excluded.

The sample frame was constructed from the National Transit Database using these definitions and resulted in 325 small urban and 621 rural transit providers. To provide data comparable to the 2015 Small Urban and Rural Transit Provider Survey, the research team replicated the GAO's sampling methodology. A stratified sampling approach was used to select separate samples of small urban and rural providers that would each produce response estimates with confidence intervals of 10 percentage points or less, at

[1] Statutory References: 49 U.S.C. Section 5311 / Fixing America's Surface Transportation Act (FAST) Section 3007.

the 95 percent confidence level. An outgoing sample of 152 small urban and 177 rural transit providers was used to field the 2019 Small Urban and Rural Transit Provider Survey.

The research team fielded the online survey between September 9, 2019, and October 28, 2019. Contacts received multiple follow-up reminders, by email as well as telephone, to encourage participation. The final response rate was 74 percent, providing a final sample of 244 transit agencies (107 small urban and 137 rural). The research team weighted the data to reflect accurately the distribution of small urban and rural transit providers within the population.

Key Findings

Key survey findings are presented in this section. Trend data with the 2015 GAO survey are included, and responses are discussed by agency type (small urban versus rural) where relevant. Generally, only differences found to be significant at a level of $p<0.05$ are highlighted in the report (including differences between 2015 and 2019 or by agency type).

Service Types

The research team used the 2019 National Transit Database to identify the types of service offered by the small urban and rural transit agencies responding to the survey. Most agencies (92 percent) provide demand response service, a smaller proportion (64 percent) offer bus service, and only a few agencies provide commuter bus (7 percent) or vanpool service (4 percent). A greater proportion of small urban agencies provide bus service compared to their rural counterparts (85 percent vs. 53 percent). This is largely due to differences in population size and density, which makes small urban areas more compatible with scheduled bus service.

Use of Communications Technologies and Smartphones

Small urban and rural transit providers use a range of communication devices in their operations. Overall, 90 percent report use of cellular telephones, up 6 percentage points since 2015, and 88 percent utilize the internet in their operations. Older technologies such as land lines (86 percent) and two-way radios (78 percent) are still used by most providers, although two-way radio use has declined 7 percentage points since 2015. Two technologies that were not widely used in 2015, wireless local-area networks and mobile data terminals, show increased usage, now at 59 percent and 54 percent, respectively.

The 2019 survey results show that smartphones are becoming a more important part of transit network operations. Since 2015, smartphone use has increased significantly across four surveyed transit functions. Sixty percent of surveyed transit providers are using smartphones for transit communications and 56 percent use them for operations management. A smaller number of agencies use smartphones for vehicle location (37 percent) or scheduling (25 percent), and 11 percent cite use for other functions.

Use of ITS Technologies

Security Cameras and Systems (SCS) and Automatic Vehicle Location (AVL) are the ITS technologies showing the highest use among small urban and rural transit providers, at 83 percent and 75 percent, respectively. SCS play a vital role in transit safety and security and are noted to be helpful in dealing with incidents that happen in and around transit vehicles, especially with respect to liability. AVL has both

safety and operational benefits that can be realized in the context of both small urban and rural areas. Use of AVL increased significantly from 2015 to 2019 (51 percent to 75 percent), while SCS showed a smaller but still significant increase from 75 percent in 2015 to 83 percent in 2019.

Computer Aided Dispatch (CAD), Geographic Information Systems (GIS), and Traveler Information Systems (TIS) show moderate usage levels, ranging from 51 percent to 56 percent. It is worth noting that use of Traveler Information Systems increased from 32 percent in 2015 to 51 percent in 2019. One lesser used ITS technology, Maintenance Management Systems (MMS), is the only surveyed ITS technology to see a significant reduction in usage since 2015 (moving from 38 percent to 27 percent). Other lesser used ITS technologies include Electronic Fare Payment (EFP) at 20 percent, Automatic Passenger Counters (APC) at 16 percent, and Transit Signal Priority (TSP) at 3 percent. Of these, EFP is the only ITS technology to see a significant increase in usage since 2015 (up 6 percentage points in 2019). For ITS technologies in the moderate and low usage tiers, the rural context is an important factor in explaining the lower use (discussed further in Use of ITS by Agency Type).

Use of ITS Across Service Types

Transit providers were asked about the service types (demand response, bus, vanpool, commuter bus) on which they use ITS technologies. EFP and APC tend to be used more for bus services, and less for demand response services. Among transit providers using APC, 93 percent use this system on bus service, and only 19 percent on demand response vehicles. Likewise, EFP is used significantly more on buses, though the difference is not quite as stark, 77 percent on bus and 46 percent on demand response. By contrast, transit providers using CAD tend to use it more on demand response vehicles compared to buses, 94 percent on demand versus 50 percent on buses. Users of SCS and AVL are somewhat more likely to use them on demand response vehicles (85 percent each), yet roughly two-thirds are also using them on buses.

Use of ITS by Agency Type

According to the survey, small urban transit providers use more ITS technologies than rural providers, an average of 4.8 ITS technologies per small urban agency versus 3.4 ITS technologies per rural agency. Usage levels are similar by agency type for the high usage ITS technologies—SCS and AVL—as well as CAD and MMS. However, small urban providers are significantly more likely than rural providers to use GIS, Traveler Information Systems, EFP, APC, and TSP. For most of these ITS technologies (specifically EFP, APC, TSP, and Traveler Information Systems), this difference can be explained by the fact that the ITS technologies are more likely to be used on bus systems (rather than on demand response systems), and bus systems are disproportionately operated in small urban areas.

Reasons for Non-Use

Transit providers were asked to cite the reasons for their non-use of ITS technologies. Cost and funding are among the top barriers for most of the ITS technologies surveyed. For all ITS technologies except APC and TSP, 52 percent to 61 percent of agencies cite lack of funding for operational costs as a reason for non-use, and 49 percent to 62 percent cite technology costs. Across the ITS technologies, unclear costs are also listed as an issue by many transit providers, and particularly for Traveler Information Systems (52 percent). For APC and TSP, cost issues are eclipsed by the fact that a relatively large number of non-users see ***no perceived need*** for these ITS technologies. For TSP, 53 percent cite lack of need, as do 47 percent of transit agencies who are not using APC.

For some ITS technologies such as CAD and Traveler Information Systems, technical complexity can also be a barrier. These technologies skew higher on reasons such as being difficult to integrate with current systems (CAD – 36 percent; Traveler Information Systems – 35 percent) and lack technical expertise in the workforce (CAD – 33 percent; Traveler Information Systems – 39 percent). AVL and MMS also skew higher for lack of technical expertise in the workforce (38 percent and 31 percent respectively). For five of the eight ITS technologies shown, between 30 percent and 44 percent of transit providers cited that technology benefits are not clear. Relatively few transit agencies (less than 30 percent) indicated lack of support from leadership or vendor issues as reasons for not using the listed ITS technologies.

Usefulness of ITS Technologies

A majority of transit providers rate the ITS technologies they use as ***very useful***, with ratings ranging from 52 percent to 79 percent. SCS (79 percent) and EFP Systems (73 percent) come out on top, while the lowest ratings are given to MMS (54 percent) and APC (52 percent). For all ITS technologies—with the exception of APC—large majorities (between 82 percent and 91 percent) give a rating of either very or moderately useful (this compares to 69 percent for APCs). It is worth noting that for APC 12 percent respond that it is ***Too Soon to Tell*** and do not provide a rating***.*** Presumably, these agencies have just started using this ITS technology, and are not yet ready to rate its usefulness.

Since 2015, the proportion rating an ITS technology as ***very useful*** has increased significantly for Travel Information Systems, moving from 47 percent to 63 percent in 2019. By contrast, ratings for MMS declined significantly in the same period from 72 percent to 54 percent. These changes track with changes in usage for these same ITS technologies. While nearly all of the other ITS technologies are trending upward (with the exception of EFP), none of these other ITS technologies (SCS, EFP, CAD, AVL, and GIS) saw statistically significant changes during this period.

Use of Next Generation Technologies

While use of commercially available ITS technologies is increasing for small urban and rural transit providers, Connected Vehicle (CV) technologies have not yet reached smaller transit markets. Only 1 percent of survey respondents report current use of CV technologies, and just 8 percent plan to deploy them in the future. Relatively few small urban and rural transit providers—only 14 percent—reported that AV tests or deployments have been or are being conducted in their region or state; 51 percent reported no AV tests or deployments and 36 percent responded don't know. Among those agencies reporting AV activity, 94 percent indicate that they are not involved in the deployment/testing.

ITS Technology Benefits, Challenges and Costs

Survey responses indicate that small urban and rural transit providers are not yet recognizing many "great benefits" from the use of ITS technologies. The benefit that stands out the most in the 2019 survey is ***improved record-keeping, reporting, or data analysis*** *(51 percent)*. The next tier of benefits—***safety*** *(35 percent)*, ***efficient scheduling and routing*** *(35 percent)*, ***increased customer satisfaction*** (*32 percent*), and ***improved on time performance*** (*29 percent*) are recognized by only about one-third of respondents as providing a great benefit, with roughly another third recognizing a slight benefit. Many other benefits that might be expected as a result of ITS deployment, such as ***increased operator satisfaction***, ***efficient staffing, reduced wait times, increased ridership, reduced travel time,*** and ***costs savings*** fall to the bottom of the list—with less than 25 percent saying they are a great benefit.

Benefit Measurement

Only a small fraction (17 percent) of surveyed agencies report that they have been able to quantitatively measure ITS technology benefits.

Challenges to ITS Technology Deployment

Transit providers were asked the extent to which different issues posed a challenge to ITS deployment. When looking at the proportion of respondents who rated issues as "very great or great challenges," funding issues—***limited funding opportunities*** (48 percent) and ***competition for funding*** (26 percent) and cost issues—***operational costs*** (38 percent) and ***maintenance costs*** (28 percent) rise to the top. Outside of funding and cost issues, agencies have to overcome technical issues including a ***lack of expertise in the workforce*** (27 percent), ***integrating new technologies with current systems*** (27 percent), and ***vendor solutions designed for larger-scale systems*** (25 percent). Other challenges cited as very great or great by at least 20 percent of agencies surveyed include ***workforce apprehension to introduction of technology*** (25 percent), ***unclear benefits and/or costs*** (21 percent), and ***data management*** (21 percent). ***Limited vendor support*** (16 percent), ***support from leadership*** (14 percent) and ***cybersecurity issues*** (11 percent) were seen as lesser challenges.

Unexpected Costs

In addition to the known costs of deploying ITS technologies, about one-quarter of survey respondents described facing unexpected costs. The unexpected costs cited include employee training and staff hours; equipment maintenance, repair, and replacement; software fees and licenses; and mobile data plans and technology upgrades.

Funding and Technical Support

Small urban and rural transit agencies tend to receive funding from the same sources. Overall, 81 percent of agencies receive Federal funding, 78 percent receive local funding, and 74 percent receive state funding. Only 12 percent receive funds from the private sector.

Small urban and rural transit providers most often receive technical support from State DOTs (52 percent), other transit agencies (51 percent), and ITS transit vendors (48 percent). Just over one-third of agencies (36 percent) report receiving technical support from the Federal Transit Administration (FTA) and 31 percent from Rural Transit Assistance Program (RTAP).

Use of ITS JPO Resources

Only a small number of small urban and rural transit providers are **aware** of ITS JPO training and technology transfer resources. While 25 percent are aware of the ITS Professional Capacity Building (PCB) Training Program, only 9 percent are aware of ITS JPO PCB Technical Support and even fewer (7 percent) are aware of Knowledge Resources (the ITS benefits and cost databases). Only 15 percent of agencies have used the PCB Training Program, and a significantly smaller number have used the ITS JPO Knowledge Resources (4 percent) or PCB Technical Support (3 percent). Compared to the 2015 survey, however, there has been a significant increase in awareness of the PCB program (from 17 percent to 25 percent).

Next Steps

Based on the findings from the survey, the research team has developed a series of suggestions that the ITS JPO (and FTA) might consider when moving forward. Results of the survey demonstrate the need for continued support of small urban and rural transit providers in order to accelerate the deployment of ITS. With this goal in mind, a number of suggested next steps revolve around increased outreach to small urban and rural transit providers, and those organizations that work with them. In addition, follow-on research is also suggested in order to better understand agencies' needs and thus more effectively target support over time.

1. ***ITS JPO should consider revising the DTS sampling methodology to better account for small urban and rural areas.***

The 2019 ITS JPO Small Urban and Rural Transit Survey addresses the GAO recommendation to track ITS deployment in small urban and rural areas. Historically, the ITS JPO DTS have measured the deployment of ITS in large and medium sized metropolitan areas, and have not included small urban or rural areas. The ITS JPO is currently redesigning its DTS sampling methodology to address this gap, so that in the future, the survey population will include small urban and rural agencies. This will enable the ITS JPO to continue to track ITS deployment among small urban and rural transit providers.

2. ***ITS JPO could conduct more targeted outreach to small urban and rural transit agencies as part of its overall evaluation and technology transfer approach for emerging technologies (such as AV, CV, and new mobility services).***

The survey found that a relatively small number of small urban and rural agencies are aware of and using ITS JPO resources. By starting a line of communication with small urban and rural transit agencies, the ITS JPO can increase awareness of the many resources it has to offer transit providers. In addition, the survey found that small urban and rural transit providers have very specific needs and often operate in very different contexts. The ITS JPO should tailor its outreach to small urban and rural transit providers, acknowledging the different context(s) in which small urban and rural providers operate. The ITS JPO may want to establish a database of small urban and rural transit providers to facilitate information sharing specifically with this group, and/or it could create an "opt-in" mailing list for special outreach events like webinars and training opportunities. The ITS JPO should coordinate these efforts with FTA and the FTA regional offices.

In the near term, two specific and related near term activities could include (among other possible activities):

- **Develop a one- to two-page summary of findings from this survey and distribute it to small urban and rural transit provider contacts in the National Transit Database (NTD).**

- **Conduct a webinar that highlights survey findings, targeting small urban and rural transit providers, and State DOT and FTA staff who work with small urban and rural transit agencies**. The webinar would provide the opportunity to hear directly from small urban and rural transit agencies regarding the survey findings, and would offer insight on the type of support that they need. In addition, the webinar offers FTA regional offices the opportunity to learn about the survey findings, to better support small urban and rural transit agencies. The ITS JPO should work with FTA to coordinate a widely-advertised webinar, ideally reaching out to all small urban and rural transit agencies in the NTD.

Other targeted outreach activities that the ITS JPO or FTA could undertake include:

- Facilitate peer exchanges among small urban and rural transit agencies deploying ITS.
- Share evaluation best practices and performance measurement guidance.

3. JPO should consider conducting additional qualitative research, such as case studies with small urban and rural transit agencies.

Case studies with small urban and rural agencies to better understand their needs with respect to certain ITS technologies, including GIS, Traveler Information Systems, CAD, EFP, and MMS. These ITS technologies had middling or lower use, although their usefulness ratings were positive (particularly EFP). For some ITS technologies, such as Traveler Information Systems and CAD, technological complexity appears to be a reason for non-use, so case studies would provide the opportunity to explore these challenges, as well as others (such as cost) in more detail. In addition, for rural areas that tend to rely more heavily on demand response systems, it would be helpful to better understand whether and how ITS technologies such as GIS, Traveler Information Systems, and EFP can serve their needs. Finally, case studies could provide insight on the decline in use and usefulness of MMS. The case study explorations could then be fed into the ITS JPO outreach efforts (see #1 and #2 above).

Chapter 1. Study Purpose

This report summarizes findings from the 2019 Intelligent Transportation Systems (ITS) Small Urban and Rural Transit Providers Survey, administered by the US Department of Transportation (USDOT) Volpe National Transportation Systems Center in support of the USDOT ITS Joint Program Office (JPO). The ITS JPO conducted this survey in response to a General Accountability Office (GAO) recommendation that the ITS JPO should track the deployment of ITS within small urban and rural areas.[2] The 2019 survey represents an ongoing effort by the ITS JPO to understand the extent to which ITS technologies are being deployed nationally and the factors that affect deployment. This survey focuses specifically on small urban and rural transit providers, a population that the ITS JPO has not typically surveyed. The survey explores the use and usefulness of ITS technologies deployed by small urban and rural transit providers, along with reasons why the ITS technologies are or are not being used. In addition, the survey addresses the challenges to deployment, the benefits of these ITS technologies, and the sources of funding and technical support, including use of ITS JPO resources.

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.[3] Based on this mandate, the survey population was initially comprised of the 75 largest metropolitan areas, as the initial 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.[4]

The ITS JPO uses the results of the DTS to, among other things, respond strategically to ITS deployment gaps and execute technical transfer activities that help states and local agencies as they plan and execute their ITS deployments, particularly in overcoming the challenges to ITS deployment. With this 2019 survey, the ITS JPO is reaching out to small urban and rural transit providers, per the recommendation of the GAO. In 2015, the GAO conducted a comprehensive study to assess:

- The extent to which selected transit providers in large urbanized areas are using ITS;
- The extent to which transit providers in small urban and rural areas are using ITS;
- The benefits and challenges these transit providers' experience in deploying ITS; and

[2] General Accountability Office (GAO), *Intelligent Transportation Systems: Urban and Rural Transit Providers Reported Benefits but Face Deployment Challenges*. GAO-16-638. June 2016.
[3] Speech delivered at the Transportation Research Board in Washington, DC on January 10, 1996:
[4] Steve Gordon and Jeff Trombly. *Creating a Deployment Baseline for Statewide and Rural Intelligent Systems: A White Paper*. May 2002.

- The extent to which transit providers have utilized DOT resources to promote and support ITS.

The GAO reviewed USDOT ITS deployment tracking data and ITS studies, interviewed USDOT officials and public transit stakeholders, conducted site visits and interviews with transit agencies, and administered a survey of small urban and rural transit providers. The survey sampled 233 small urban and rural transit providers.

Based on its study, GAO recommended that the Secretary of Transportation develop a strategy to raise awareness of federal resources for ITS deployment in the transit community and include ITS adoption by small urban and rural transit providers in its ITS monitoring efforts. The USDOT concurred with the GAO recommendation, and the 2019 survey was conducted to track the deployment of ITS among small urban and rural transit providers. The USDOT intends to include this population in its ongoing survey efforts.

Chapter 2. Survey Methodology

This chapter describes the sample plan, questionnaire, and data collection procedures used for the 2019 Small Urban and Rural Transit Provider Survey.

Sample Development

The research team identified the population of small urban and rural transit providers using the definitions employed by the GAO in the 2015 Small Urban and Rural Transit Provider Survey.

- Small Urban Transit Providers were identified as recipients of Federal Transit Administration's (FTA) Urbanized Area Formula Grants (49 U.S.C. 5307) with populations of 200,000 or fewer.
- Rural Transit Providers were identified as sub-recipients of the FTA's Rural Area Formula Grants (49 U.S.C. 5307).[5] In order to target rural transit providers that are most likely using ITS, agencies with fleets of 10 or fewer vehicles were excluded.

GAO identified the small urban and rural transit providers using the National Transit Database (NTD). The 2013 NTD's urban and rural modules were used to identify agencies who met the criteria described above. The outcome was a survey sample frame of 314 small urban and 582 rural providers.

The research team used two 2017 NTD tables to develop the sampling frame of small urban and rural transit providers for the 2019 Small Urban and Rural Transit Provider Survey.[6] Three data fields (reporting module, reporter type, and population) from the 2017 Agency Information table were used to identify small urban transit providers that met the definition set by GAO. Rural transit providers were identified using three fields (reporting module, reporter type, and fleet vehicles) found in two different NTD tables, 2017 Agency Information and 2017 Revenue Vehicle Inventory. A total of 325 small urban and 621 rural transit agencies were identified using the criteria shown in

[5] Statutory References: 49 U.S.C. Section 5311 / Fixing America's Surface Transportation Act (FAST) Section 3007
[6] NTD Tables: 2017 Agency Information.xls (https://www.transit.dot.gov/ntd/data-product/2017-annual-database-agency-information); 2017 Revenue Vehicle Inventory.xls (https://www.transit.dot.gov/ntd/data-product/2017-annual-database-revenue-vehicle-inventory)

Table 1 (see next page), providing a sample frame of 946 agencies

Table 1. Sample Identification Criteria

Agency Type	NTD Table(s)	Reporting Module[7]	Reporter Type	Population (UZA)	Fleet Vehicles
Small Urban	2017 Agency Information	Urban	Full Reporter Reduced Reporter	200,000 or fewer	Not Applicable
Rural	2017 Agency Information 2017 Revenue Vehicle Inventory	Rural	Rural Reporter	Not Applicable	11 or more

Source: National Transit Database 2017

Differences between the 2019 and 2015 population

The 2019 sample frame included 81 percent of the rural agencies who were in the 2015 sample frame, with differences resulting from changes in reported fleet size (<11) and changes to the agencies included in the NTD tables. The rural agency population increased from 575 to 621 providers during this period. For small urban providers, 91 percent of the 2019 population overlapped with the 2015 population. Differences resulted from changes in the agencies included in the NTD agency table. The small urban population increased from 314 to 325 during this period.

Sample Methodology

To provide data comparable to the 2015 Small Urban and Rural Transit Provider Survey, the research team replicated the GAO's sampling methodology. A stratified sampling approach was used, with the two agency types—small urban and rural—as the strata. A goal was set to produce response estimates for each agency type with confidence intervals of +/- 10 percentage points or less, at the 95 percent confidence level. In keeping with the GAO methodology, a 50 percent response rate was assumed, providing minimum outgoing sample sizes of 150 small urban and 168 rural transit agencies. The minimum outgoing sample results in an oversampling of small urban providers that is necessary to achieve the precision levels described above. The sample was weighted to account for the oversampling (see Table 4. Data Weighting).

To achieve an outgoing sample of at least 150 small urban and 168 rural transit agencies, a working sample of 165 small urban and 186 rural agencies was randomly selected from the sample frame to develop sample contact information (assuming ~10 percent sample loss due to refusals or non-contacts). The research team merged agency contact information from the 2015 sample frame where information was available (90 percent of the small urban and 82 percent of the rural agency working sample matched) and reached out to the listed contact to confirm that they were still the appropriate respondent (and obtained new contacts as needed). In cases where there was no contact (10 percent of small urban agencies and 18 percent of urban agencies), the research team called the transit provider to identify a

[7] The Reporter Type field of the Agency Information table was used to exclude agencies that did not fit the definition or did not include data to identify qualifying small urban or rural agencies. Excluded reporting fields included: building reporter, asset reporter, planning reporter and state reporter.

contact who could complete the survey. A final outgoing sample of 152 small urban and 177 rural transit providers was used to field the 2019 Small Urban and Rural Transit Provider Survey.

Questionnaire

The 2019 Small Urban and Rural Transit Provider Survey used the same survey fielded by the GAO in 2015 with one exception: a short battery of questions on emerging ITS technologies (e.g., Connected Vehicles and Automated Vehicles) was included. Table 2 shows the question categories and the technologies within each category (see Appendix A for the questionnaire).

Table 2. Questionnaire Outline

Question Category	Specific Technologies
Communications	Communication Technologies (e.g., mobile data terminals, wireless local area networks, landline telephone networks, cellular telephone communications, internet, two way radios)
	Smartphone
ITS Technology Batteries	Computer-Aided Dispatch (CAD)
	Automatic Vehicle Location (AVL)
	Geographic Information Systems (GIS)
	Security Cameras and Systems (SCS)
	Maintenance Management Systems (MMS)
	Traveler Information Systems (TIS)
	Automatic Passenger Counters (APC)
	Electronic Fare Payment Systems (EFP)
	Transit Signal Priority (TSP)
Emerging Technologies	Connected Vehicle (CV)
	Automated Vehicle (AV)
	Mobility on Demand Services (MOD)
Cross Technology Batteries	Questions asked in reference to ALL types of ITS technologies

Source: USDOT

For the Communications category, the survey included a question on agencies' use of different communications technologies, as well as a question on their use of smartphones for different functions.

For each of the nine ITS Technologies, the survey included questions on:

- ITS Technology Use
- Type of Transit Services Using the ITS Technology
- ITS Technology Usefulness
- [FOR EACH TECNOLOGY NOT USED] Reasons for Not Using
- [FOR EACH TECHNOLOGY NOT USED] Plans for Future Use

The questionnaire included several questions on Emerging Technologies. With regard to Connected Vehicles, agencies were asked about their current deployment status, and the timeframe for future deployments. The survey also asked about Automated Vehicles, including: (1) current testing/deployment in State/region, (2) [IF YES] agency role in deployment, and (3) [IF NO] plans for future deployment. With regard to Mobility on Demand Services, agencies were asked questions about (1) partnerships with private transportation providers, and (2) services provided.

Finally, the questionnaire included a cross-technology battery of questions that were asked about agencies' ITS deployments in general:

- Unexpected Costs
- Benefits of ITS
- Quantitative Benefit Measurement
- Challenges of ITS Deployment
- Sources of Funding for ITS
- Sources of Technical Support
- Awareness/Use of ITS JPO Programs

The survey was programmed online using Qualtrics, a survey software program. Since the ITS JPO was replicating an online survey conducted by the GAO, there was no need for extensive pre-testing. The research team conducted pre-testing with only internal staff to ensure that the survey logic functioned as designed.

Data Collection

The research team fielded the online survey between September 9, 2019, and October 28, 2019. The research team sent survey invitations to a subset of the sample (50 transit providers) on September 9, 2019, so that if there were any problems, they could be addressed prior to sending the survey to the full sample. Since the initial rollout went smoothly, the research team sent the remaining survey invitations (279 transit providers) on September 10, 2019. Contacts received two reminder emails. The research team made two additional attempts to reach contacts by phone, reminding them to complete the survey. After the second telephone contact attempt, a final reminder was sent by voicemail and/or email.

The final response rate was 74 percent, providing a final sample of 244 small urban and rural transit agencies. Table 3. Data Collection Results provides information on the population, the sample, the final number of respondents, and the response rate for the total effort, as well as separately for small urban and rural transit providers.

Table 3. Data Collection Results

Sample Type	Population Size	Initial Sample Size (# Survey Invites)	Respondents (unweighted)	Response Rate
Rural	621	177	137	77%
Small Urban	325	152	107	70%
Total	946	329	244	74%

Source: USDOT

The research team weighted the data to reflect accurately the distribution of small urban and rural transit providers within the population. Table 4. Data Weighting displays the unweighted and weighted distributions.

Table 4. Data Weighting

Sample Type	Population Size	Unweighted Sample	Weighted Sample
Rural	621 (66%)	137 (56%)	161 (66%)
Small Urban	325 (34%)	107 (44%)	83 (34%)
Total	946	244	244

Source: USDOT

Statistical Significance

Within this report, statistical significance is used to identify response differences between waves of the survey (2015 vs. 2019) and between sub-groups of 2019 survey (small urban vs. rural). Generally, only differences found to be significant at a level of $p<0.05$ are discussed in the report.

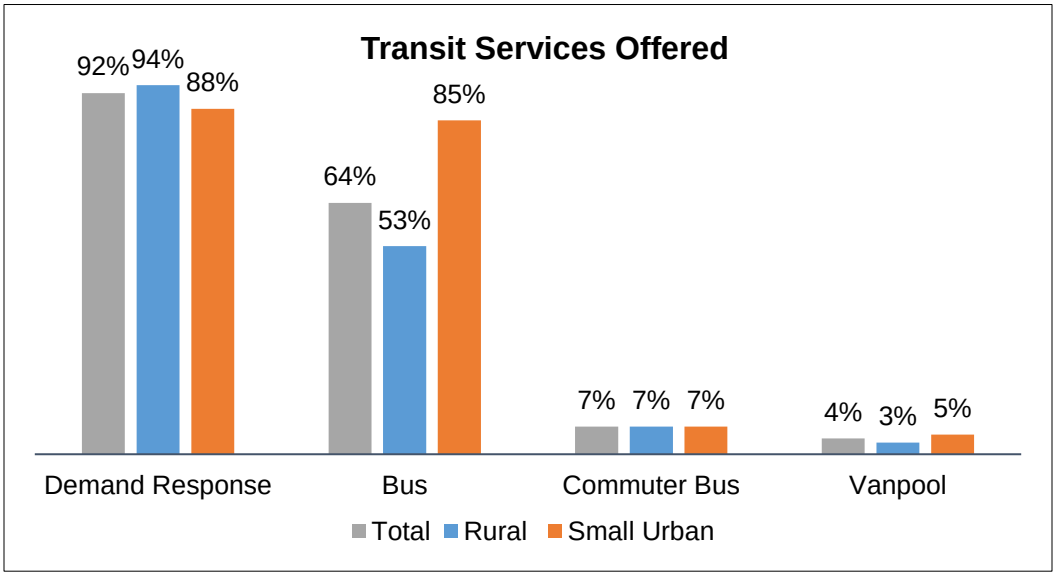
Due to privacy restrictions, the research team did not have access to the raw data from the 2015 GAO survey. However, GAO was able to provide standard errors for each of the response proportions. Two methods were used to determine statistical significance:

- Significant differences between sub-groups of the 2019 survey were calculated using the Qualtrics crosstabs functionality. Significance testing was conducted on the weighted dataset using a two-tailed t-tests at level of $p<0.05$.
- Significant differences between the 2015 and 2019 survey were calculated using a customized approach. Response proportions and standard errors from the 2015 and 2019 samples were used to

calculate a test statistic that incorporated the sample strata and weighting. Test statistic values exceeding the threshold value of +/- 1.96 were considered significant ($p<0.05$).[8]

Service Types

The research team used the 2019 NTD to identify the types of service offered by the small urban and rural transit agencies responding to the survey.[9] This provides important contextual information for interpreting the findings. Figure 1 shows that in 2019 most agencies (92 percent) provide demand response service, a smaller proportion (64 percent) offer bus service, and only a small number of agencies provide commuter bus (7 percent) or vanpool service (4 percent). A greater proportion of small urban agencies provide bus service compared to their rural counterparts (85 percent vs. 53 percent). Several factors explain the difference in service types offered by small urban and rural areas. Rural areas, by definition, have fewer residents, and rural residents tend to travel longer distances compared to their urban counterparts. In 2012, the median trip distance was 3 miles in urban areas and 6 miles in rural areas.[10] The cost of providing bus service in this context is relatively expensive. Data collected by the Rural NTD in 2011 show rural areas have an average operating cost per mile of $2.83 for fixed-route services and $2.06 for demand-response services, and farebox revenues cover only about 8 percent of operating costs in rural areas.[11] Hence, some rural transit agencies may not perceive a fixed route bus service as a viable investment.



Source: National Transit Database, 2019

Figure 1. Services Offered by Small Urban and Rural Transit Agencies

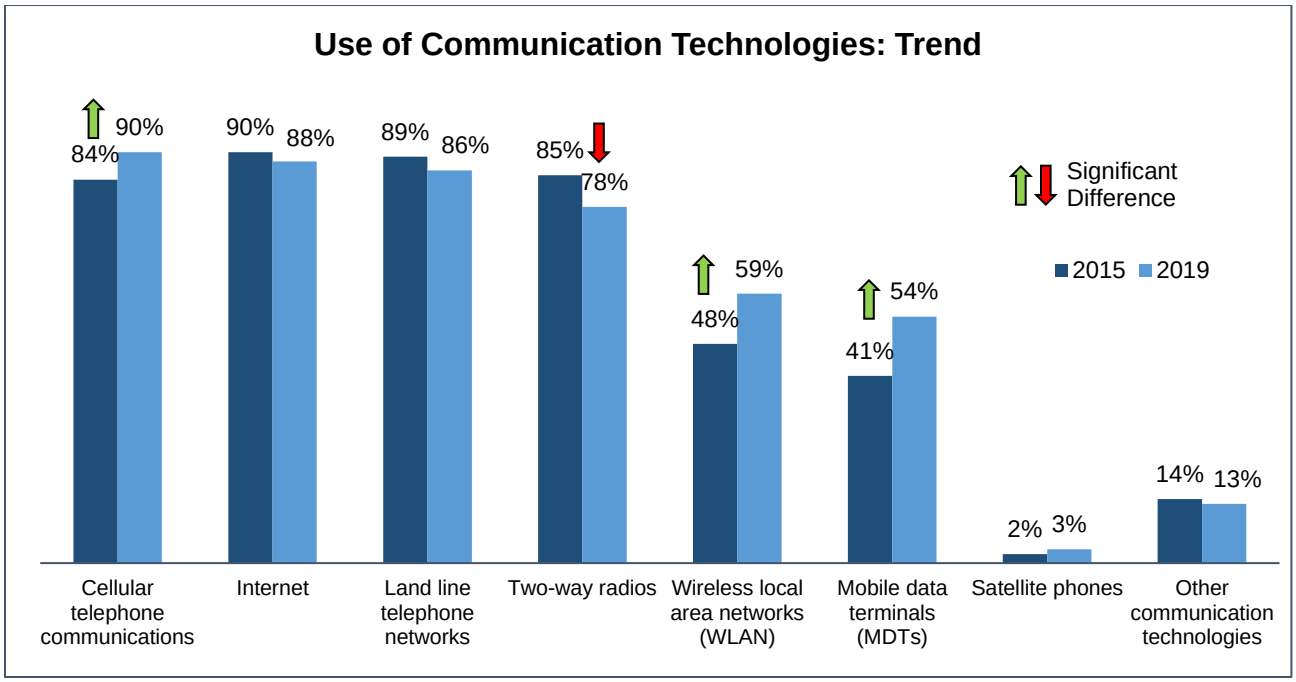
[8] The test statistic assumes the two samples are independent, which is not the case due to many of the same agencies being in both samples; since the raw data is not available and the 2015 and 2019 samples to cannot be matched, we're unable to account for that correlation.
[9] Types of service identified using NTD identifiers (NTD-ID) from the 2019 Small Urban and Rural Transit Provider Survey sample, and the National Transit Database (Table TS4.1 Asset Inventory Time-Series_Active Fleet).
[10] Godavarthy, R., Mattson, J. and Ndembe, E. *Cost-Benefit Analysis of Rural and Small Urban Transit*, National Center for Transit Research. July 2014. pg. 19.
[11] Godavarthy, R., Mattson, J. and Ndembe, E. *Cost-Benefit Analysis of Rural and Small Urban Transit*, National Center for Transit Research. July 2014. pg. 29.

Chapter 3. Survey Findings

This chapter presents survey findings for small urban and rural transit providers on their use of ITS technologies, the perceived usefulness of these ITS technologies, reasons for non-use, the challenges and the benefits of deployment, and sources of funding and technical support. Trend data (2015 GAO survey) are shown, and responses are broken out by agency type (small urban versus rural) where relevant.

Use of Communications Technologies

Figure 2 shows that small urban and rural transit providers use a range of communication devices in their operations. Overall, 90 percent report use of cellular telephones, up 6 percentage points since 2015, and 88 percent utilize the internet in their operations. Older technologies such as land lines (86 percent) and two-way radios (78 percent) are still used by most providers, although two-way radio use has declined 7 percentage points since 2015. Two technologies that were not widely used in 2015, wireless local-area networks and mobile data terminals, show increased usage, now at 59 percent and 54 percent, respectively. Satellite phones continue to show minimal use (3 percent). In their “other” responses, 13 respondents specified that they were using tablets for communication purposes. Other responses included Global Positioning Systems (GPS) (N=7) and Automatic Vehicle Location (AVL) (N=6).



Source: USDOT

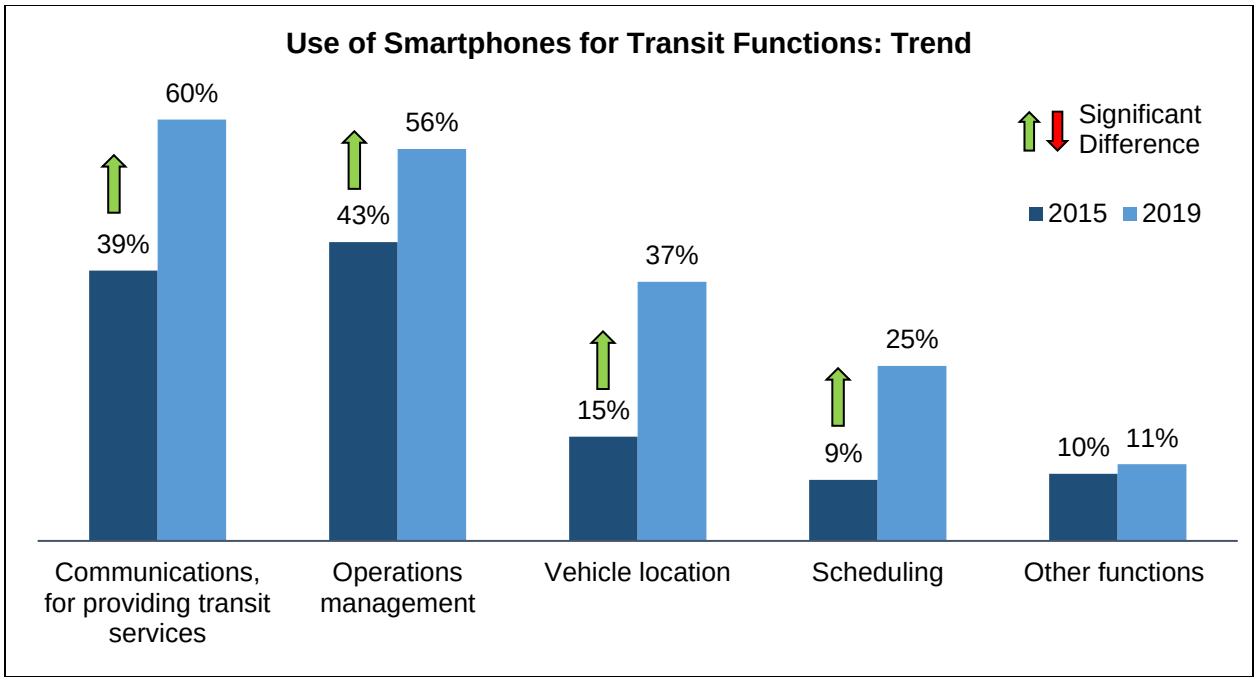
Q: Do transit personnel at your organization use any of the following technologies or systems to assist in providing transit services? (% Yes)

Figure 2. Use of Communication Technologies

For some technologies, usage differs by agency type. A greater proportion of small urban providers use two-way radios (90 percent vs. 72 percent) and landline networks (93 percent vs. 83 percent) in comparison to rural providers (see Appendix B). Overall, small urban providers are using a statistically significant greater number of communication methods, on average, compared to rural providers—5.1 vs. 4.5.

The 2019 survey results show that smartphones are becoming a more important part of transit network operations for small urban and rural transit providers. Since 2015, smartphone use has increased significantly across all four surveyed transit functions. Figure 3 shows that 60 percent of surveyed transit providers are using smartphones for transit communications and 56 percent use them for operations management. A smaller number of agencies use smartphones for vehicle location (37 percent) or scheduling (25 percent) and 11 percent cite use for other functions. Overall, 78 percent of agencies responding to the survey are reporting smartphone use for transit operations. During this same period (2015 to 2019) smartphone ownership within the public increased from 69 percent to 81 percent.[12] Those who provided an "other" response indicated that they were using smartphones to communicate with other staff (N=7), for example with respect to vehicle maintenance or breakdowns.

[12] *Demographics of Mobile Device Ownership and Adoption in the United States.* Pew Research Center, November 2015; February 2019. https://www.pewresearch.org/internet/fact-sheet/mobile/#mobile-phone-ownership-over-time



Source: USDOT and GAO

Q: Do transit personnel at your organization use smartphones for any of the following functions? (% Yes)

Figure 3. Use of Smartphones for Transit Functions

When the findings are analyzed by agency type, the only difference is that rural transit providers are more likely than their small urban counterparts to use smartphones for scheduling purposes (28 percent rural vs. 19 percent small urban). Appendix B shows the findings on smartphone use by agency type.

Use of ITS Technologies

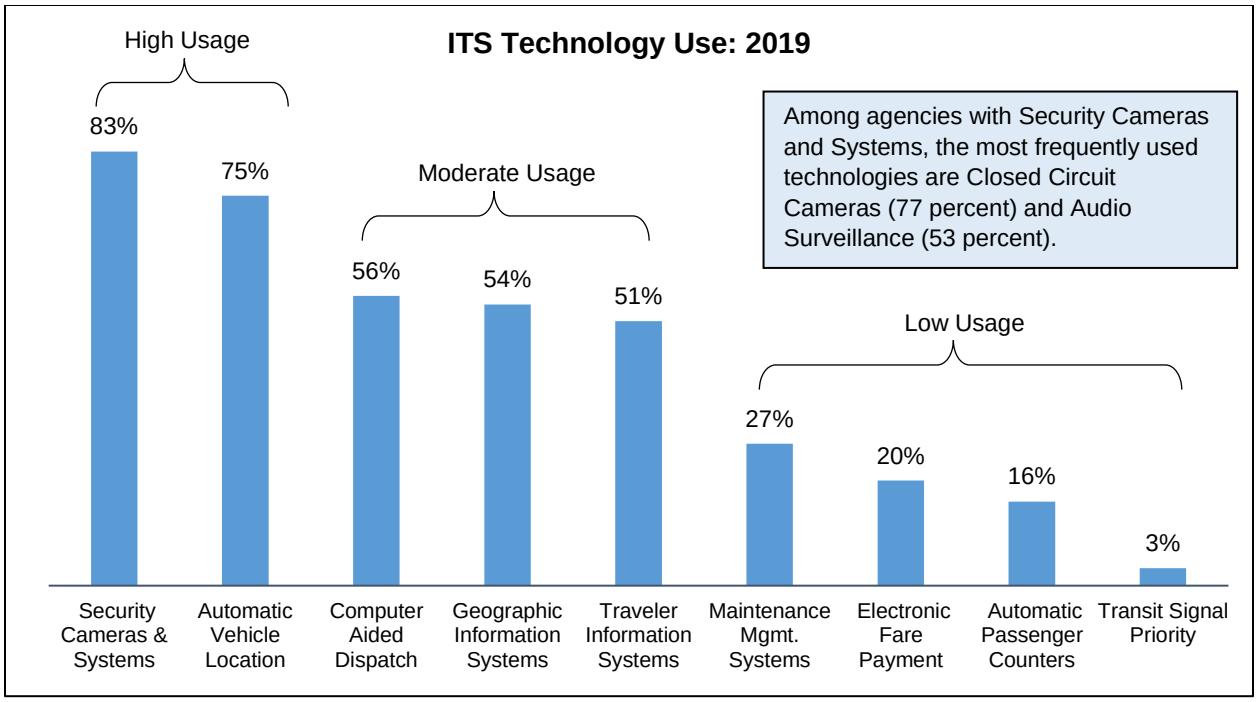
Figure 4 provides an overview of small urban and rural transit providers' use of nine ITS technologies and highlights the three usage tiers (high, moderate, and low) that were found in the data. In 2019, Security Cameras and Systems (SCS) and Automatic Vehicle Location (AVL) are the ITS technologies showing the highest use, at 83 percent and 75 percent, respectively. Transit agencies place a premium on safety, and respondents noted that SCS are helpful in dealing with incidents that happen in and around transit vehicles, especially with respect to liability. AVL has both safety and operational benefits that can be realized in the context of both small urban and rural areas.

Benefits of SCS:

"Security cameras have aided us in pursing and defending insurance claims, complaints, lawsuits, and other matters."

Computer Aided Dispatch (CAD), Geographic Information Systems (GIS), and Traveler Information Systems show moderate usage levels, ranging from 51 percent to 56 percent. CAD, which is typically used in conjunction with AVL, connects vehicle location information to back office scheduling and dispatching software. GIS is a system for gathering, managing, analyzing, and presenting spatial data.

Less used ITS technologies include Maintenance Management Systems (MMS) at 27 percent, Electronic Fare Payment (EFP) at 20 percent, Automatic Passenger Counters (APC) at 16 percent, and Transit Signal Priority (TSP) at 3 percent. For ITS technologies in the moderate and low usage tiers, the rural context is an important factor in explaining the lower use. That is, in rural areas there is a greater reliance on demand response systems rather than fixed route bus service (see Figure 1), lower ridership and less congested conditions relative to urban areas. The following sections of this report provide additional survey findings that help explain the different usage rates of the surveyed ITS technologies.



Source: USDOT

Q: Is your organization currently using [ENTER TECHNOLOGY]? (% Yes)

Figure 4. ITS Technology Use 2019

For each ITS technology that transit providers reported using, they were asked to indicate the service type on which the ITS technology is used.[13] Table 5 displays the mix of service types for each ITS technology. While the ITS technologies are used across multiple services types, the table highlights in orange the ITS technologies that are highly skewed towards a particular service type. For example, EFP and APC tend to be used more for bus services, and less for demand response services. Among transit providers using APC, 93 percent use this system on their bus service, while 19 percent use it on their demand response vehicles. Likewise, EFP is used significantly more on buses, though the difference is not quite as stark: 77 percent use EFP on buses and 46 percent on demand response vehicles. Given the different operating practices of demand response services (e.g., advanced scheduling, varied pickup/drop-off locations, and the possibility of payment mechanisms other than a fare box), EFP and APC may not be as relevant to providers who depend more on demand response service, which includes many rural providers. Figure 7 shows that EFP and APC are mainly used by small urban providers.

By contrast, transit providers using CAD (also highlighted in orange) tend to use it more on demand response vehicles compared to buses (94 percent vs. 50 percent, respectively). While users of SCS and AVL are somewhat more likely to use these ITS technologies on demand response vehicles, roughly two-thirds are also using them on buses.

[13] Survey respondents were provided with the following response options: **Bus** (*fixed-route and/or deviated-fixed-route*); **Commuter bus** (*fixed-route bus systems that are primarily connecting outlying areas*); **Demand-Response** (*scheduled in response to calls from passengers; includes paratransit, door-to-door, and curb-to-curb services*); **Vanpool** (*commuting service operating under pre-arranged schedules for previously formed groups of riders in vans*); **Other**

Table 5. Types of Service Using ITS Technology

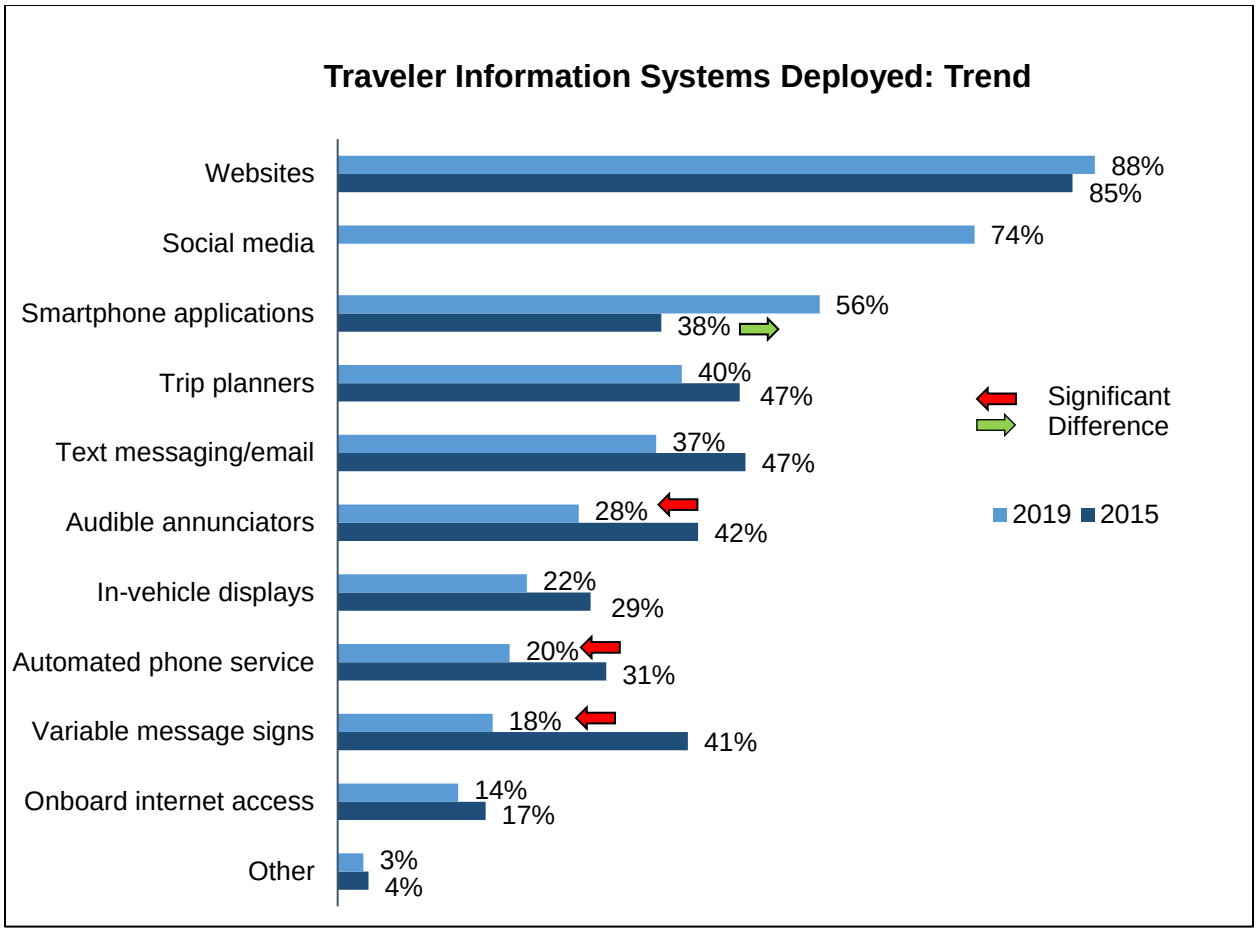
Service Type	Security Cameras & System	Automatic Vehicle Location	Computer-Aided Dispatch	Geographic Information Systems	Traveler Information Systems	Maintenance Management Systems	Electronic Fare Payment	Automatic Passenger Counters
Demand Response	85%	85%	94%	76%	67%	86%	46%	19%
Bus	70%	66%	50%	68%	80%	77%	77%	93%
Commuter Bus	18%	16%	13%	14%	21%	23%	29%	21%
Vanpool	2%	3%	2%	3%	4%	3%	2%	0%
Other	11%	1%	1%	3%	2%	4%	0%	0%

Source: USDOT (Base: Agencies Using Each ITS Technology)

Q: For which of the following services does your organization use [TECHNOLOGY]? Base: Users of each technology.

Types of Traveler Information Systems

Agencies deploying Traveler Information Systems were asked about the type of systems they are deploying. In the 2019 survey, the large majority of small urban and rural transit providers are deploying websites (88 percent) and social media (74 percent), and slightly more than half are deploying smartphone applications (56 percent). About 40 percent use trip planners and text messaging/email to provide traveler information, and about 22 percent use in-vehicle displays or an automated phone service. As Figure 5 illustrates, there has been a significant increase in the use of alternatives that can be accessed via smartphones, such as smartphone applications (38 percent to 56 percent). By contrast, there has been a decrease in the usage of variable message signs (41 percent to 18 percent), audible annunciators (42 percent to 28 percent), and automated phone services (31 percent to 20 percent).



Source: USDOT and GAO

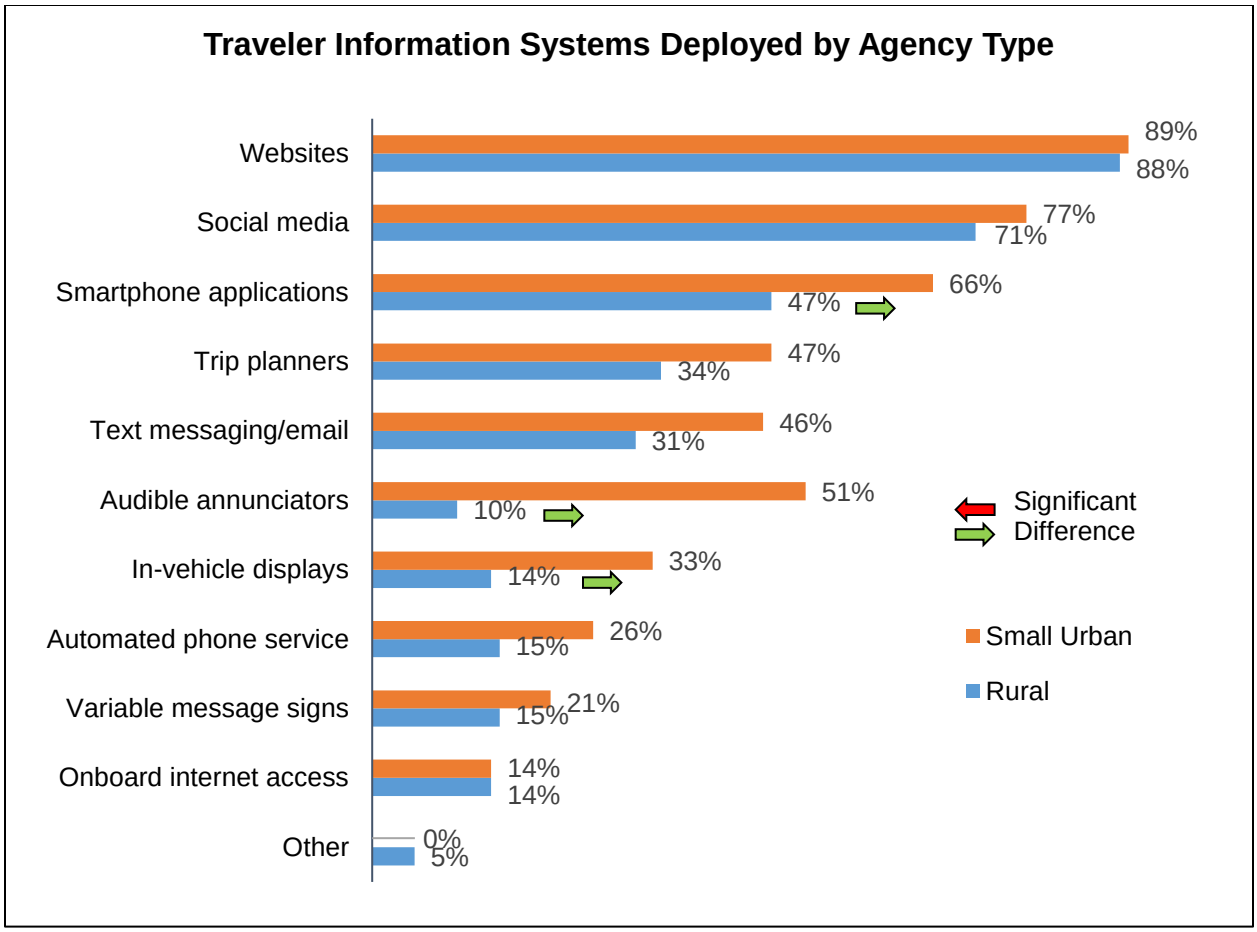
NOTE: "Social Media" was not included as a response in the 2015 survey.

Q: Which of the following types of Traveler Information Systems have you deployed? Base: Respondents who have deployed Traveler Information Systems. 2019 Unweighted Sample Size: Rural (n=59), Small Urban (n=70)

Figure 5. Trend in Types of Traveler Information Systems Deployed

While nearly all small urban and rural agencies are using websites for traveler information purposes, high numbers are also using social media (77 percent small urban and 71 percent rural). There are significant differences by agency type in other methods; small urban transit providers are more likely than their rural counterparts to use audible annunciators (51 percent vs. 10 percent)[14], in-vehicle displays (33 percent vs. 14 percent), and smartphone applications (66 percent vs. 47 percent). It is worth noting that audible annunciators and in-vehicle displays are more common in fixed route buses, which are more frequently used by small urban providers (see Figure 1).

[14] The greater use of audible annunciators within small urban systems may be due to Federal regulation. Per the American Disabilities Act, "Vehicles in excess of 22 feet in length, used in multiple-stop, fixed-route service, shall be equipped with a public address system permitting the driver, or recorded or digitized human speech messages, to announce stops and provide other passenger information within the vehicle." *Authority: 42 U.S.C. 12101-12213; 49 U.S.C. 322. Source: 56 FR 45756, Sept. 6, 1991.*



Source: USDOT

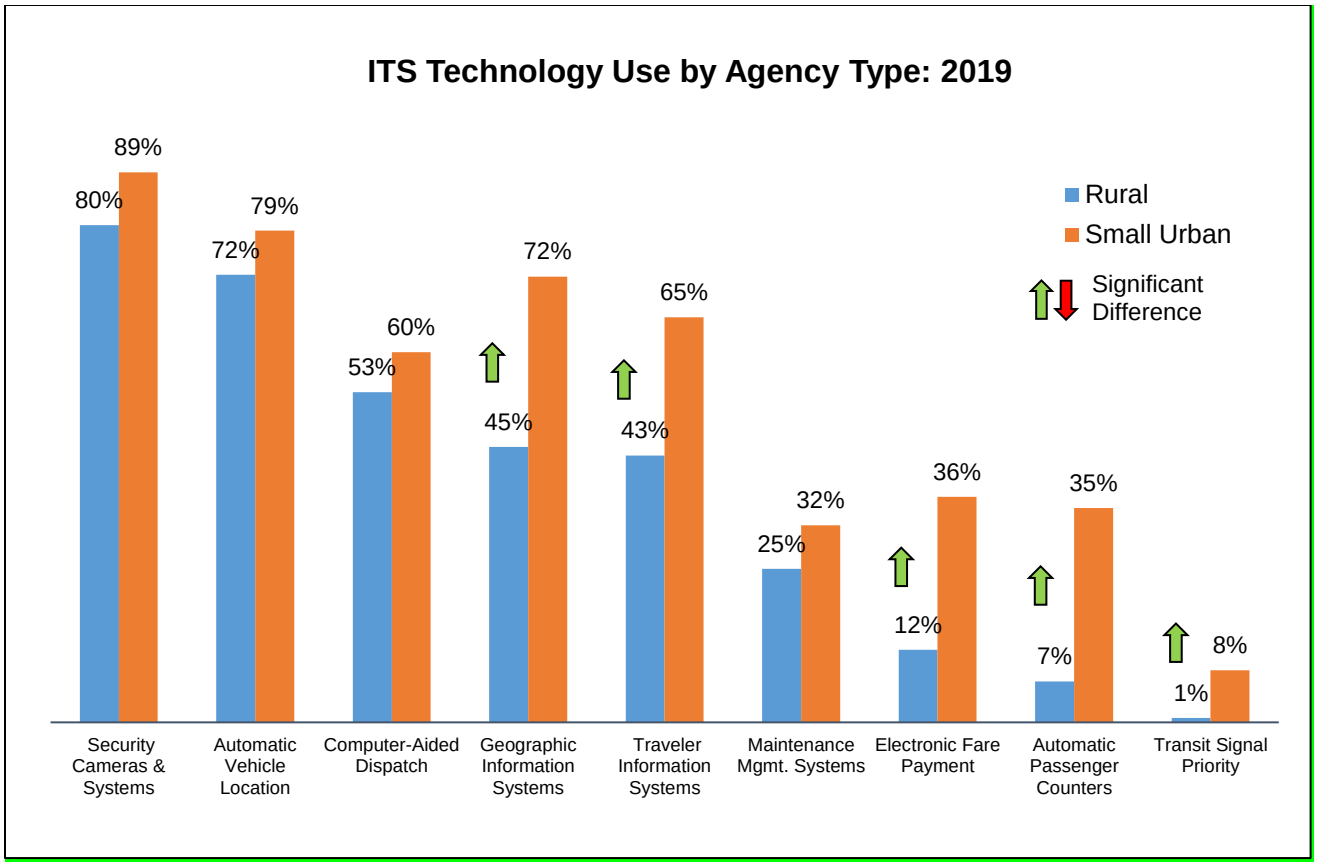
Q: Which of the following types of Traveler Information Systems have you deployed? Base: Respondents who have deployed Traveler Information Systems. Unweighted Sample Size: Rural (n=59), Small Urban (n=70).

Figure 6. Type of Traveler Information Systems Deployed by Agency Type

ITS Technology Use by Agency Type

According to the survey, small urban transit providers use significantly more ITS technologies than rural providers, an average of 4.8 ITS technologies per small urban agency versus 3.4 ITS technologies per rural agency. Figure 7 shows that usage levels are similar by agency type for the high usage ITS technologies—SCS and AVL—as well as CAD and MMS. However, small urban providers are significantly more likely than rural providers to use GIS, Traveler Information Systems, EFP, APC, and TSP. For most of these ITS technologies (specifically EFP, APC, TSP, and Traveler Information Systems), this difference can be explained by the fact that the ITS technologies are more likely to be used on bus systems (rather than on demand response systems—see Table 5), and bus systems are disproportionately operated by small urban agencies (see Figure 1). GIS is a notable exception. The number of respondents using GIS on demand response systems (76 percent) is similar to the number using it on bus systems (68 percent), yet small urban providers are significantly more likely than rural providers to use this ITS technology (72 percent vs. 45 percent, respectively). This suggests that small urban agencies are using GIS in both their buses and their demand response systems (as Figure 1 shows, small urban agencies are equally likely to operate demand response systems (88 percent) as bus systems (85 percent).

Discussions with small urban and rural providers would help FTA and ITS JPO better understand whether and how these ITS technologies could be used more for demand response services in the future, thus helping the ITS JPO target its assistance more effectively to a small urban and rural context.



Source: USDOT

Q: Is your organization currently using [TECHNOLOGY]? (Percent Yes), Base: All respondents by agency type. Unweighted Sample Size: Rural (n=137), Small Urban (n=107)

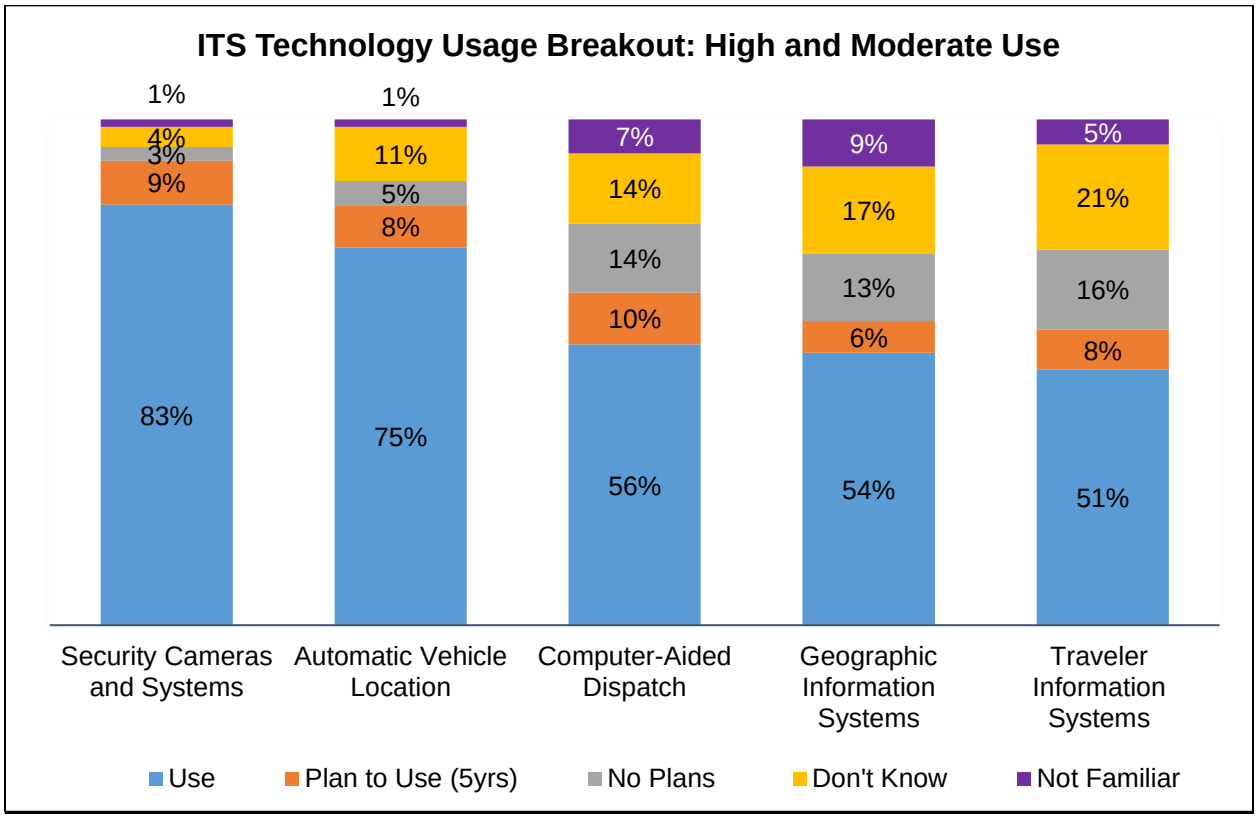
Figure 7. ITS Technology Usage by Agency Type

Breakdown of Usage and Planning

In addition to current usage, the survey asked agencies who are not deploying a given ITS technology about their plans to deploy it in the next five years. The usage breakdown provides information that can help FTA/ITS JPO plan for future ITS support efforts. Figure 8 shows the usage spectrum for ITS technologies with high and moderate use. A total of 92 percent report current or planned use of SCS, leaving only 8 percent who will not use the ITS technology, don't know, or are not familiar with the ITS technology. Three quarters of those surveyed indicate they have deployed AVL and 8 percent are planning to do so in the near future. Only 5 percent say they have no plans to use the ITS technology but 11 percent of the transit providers surveyed indicate they don't know.

Figure 8 shows that although more than half of small urban and rural agencies are using CAD, GIS, and Traveler Information Systems, between 13 percent and 16 percent say they have no plans to deploy, and another 14 percent to 21 percent of respondents report they don't know. Surprisingly, 9 percent of respondents are not familiar with GIS and 7 percent are not familiar with CAD. Report section **Reasons**

for Non-Use, provides more information on reasons the transit agencies are not currently deploying. It may be the case that more information about the benefits of these ITS technologies would encourage adoption. As seen in the previous section, Figure 7. ITS Technology Usage by Agency Type shows there is opportunity to grow CAD and Traveler Information Systems usage with both small urban and rural transit markets, but GIS usage is already high with small urban agencies, so efforts to increase usage should focus on rural providers.



Source: USDOT

Q: Is your organization currently using [TECHNOLOGY]? [If No] Does your agency currently plan to deploy [TECHNOLOGY.] in the next 5 years?

Figure 8. High and Moderate Use ITS Technology Breakout

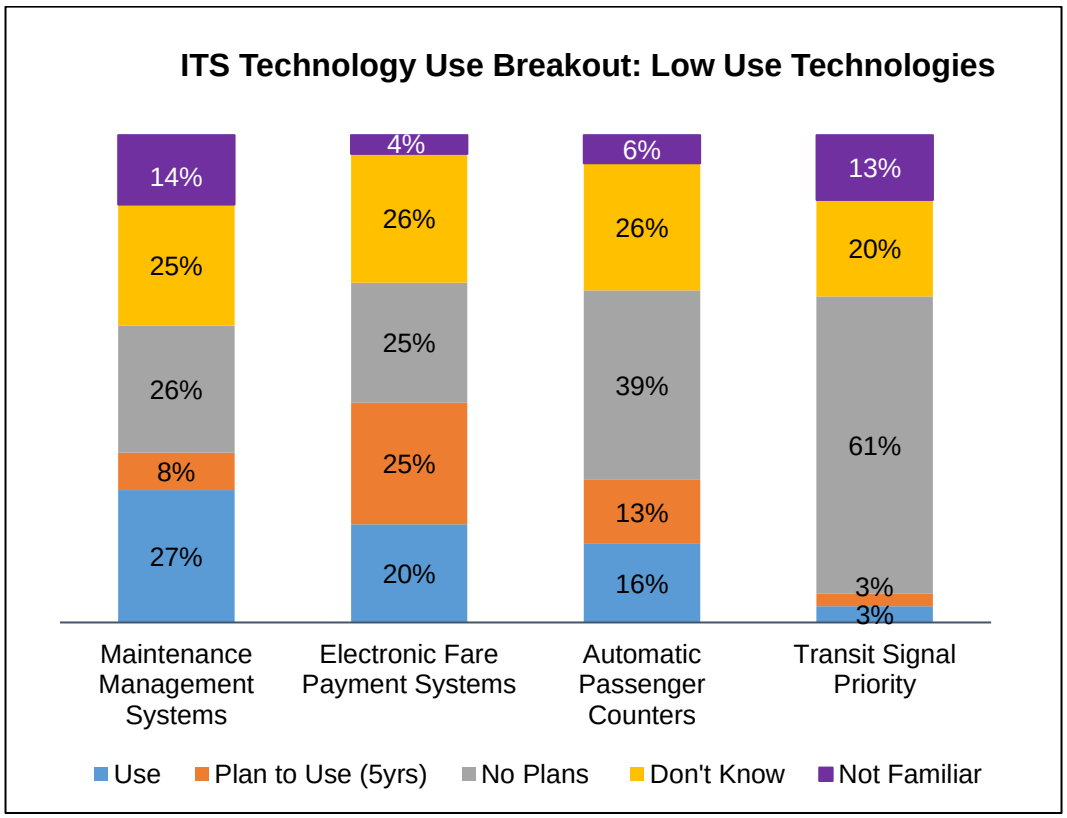
Figure 9 shows that current and planned usage is substantially lower for the remaining four ITS technologies. Only 27 percent of respondents are using MMS, with just 8 percent planning to deploy the ITS technology in the near future. A quarter of respondents have no plans to deploy MMS and an equal number indicate they don't know. Notably, 14 percent are unfamiliar with MMS. Usage of this ITS technology is similar between small urban and rural providers (see Figure 7), so there is room for growth for both agency types if transit providers find value in deploying this ITS technology in their context.

Only 20 percent of transit providers currently use EFP, though a substantial number (25 percent) indicate that they have plans to use the ITS technology in the next five years. Although small urban agencies make up most of the current usage (see Figure 7), those planning to use EFP are split relatively evenly between rural and small urban providers, indicating that future usage could expand in rural transit

markets. Despite increased interest, more than half of all respondents will not be deploying EFP in the near future; 25 percent indicate they will not deploy this ITS technology and 26 percent don't know of their plans.

For APC, 16 percent of surveyed agencies are currently using the ITS technology and a similar proportion (13 percent) plan to deploy, but a plurality is not planning to deploy (39 percent) and one quarter indicate they don't know (see Figure 9). Near term efforts to increase EFP and APC usage should focus on assisting planners with making informed decisions about whether these ITS technologies are appropriate in their context, or whether another solution may exist.

TSP shows only 3 percent usage and only another 3 percent plan to deploy the ITS technology in the next 5 years (see Figure 9). With 61 percent of surveyed providers indicating that they do not plan to use TSP, 20 percent saying don't know, and an additional 13 percent indicating they are unfamiliar with the ITS technology, it is likely that schedule compliance is less of an issue in small urban and rural communities, where there may not be sufficient traffic congestion to justify the use of funds for TSP. In addition, the local traffic agencies would need to have updated their signal control systems to enable TSP, which may also present a barrier.



Source: USDOT

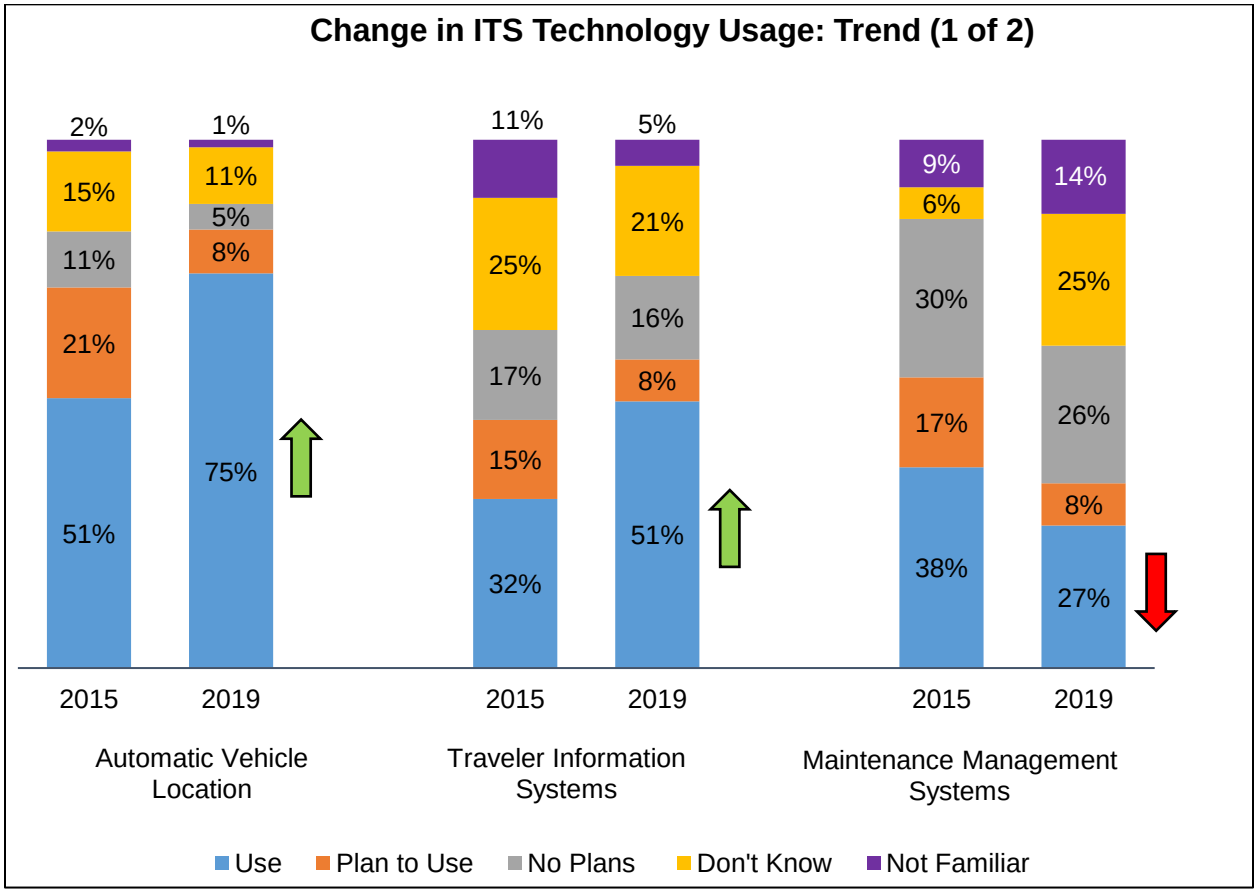
Q: Is your organization currently using [TECHNOLOGY]? [If No] Does your agency currently plan to deploy [TECHNOLOGY.] in the next 5 years?

Figure 9. Low Use ITS Technology Breakout

When the detailed usage breakouts are analyzed by agency type, there are no significant differences between small urban and rural transit providers in their use or planned use of SCS, AVL, CAD, and MMS. As previously described, the other surveyed ITS technologies, including GIS, Traveler Information Systems, EFP, APC, and TSP, are more likely to be used by small urban than by rural transit providers (see Figure 7). For these ITS technologies, the detailed usage breakouts (see Appendix B) reflect the lower usage levels, and also show that there is greater uncertainty within the rural transit market (compared to small urban) regarding deployment plans, and in one case (TSP) significantly greater lack of familiarity with the ITS technology (18 percent of rural transit providers were unfamiliar vs. 1 percent small urban). Please see Appendix B for tables on the detailed usage of the ITS technologies by agency type.

Usage Comparisons — 2015 and 2019

Figure 10 shows that since 2015, usage levels have increased significantly for two ITS technologies and declined for another. The biggest usage change is seen for AVL, moving from 51 percent deployment in 2015 to 75 percent in 2019. It is likely that many who reported that they were planning to deploy AVL in 2015 (21 percent) converted to use by 2019. Use of Traveler Information Systems also increased significantly, from 32 percent in 2015 to 51 percent in 2019. In the current survey, fewer agencies indicate they are planning to deploy Traveler Information Systems in the next five years (8 percent) compared to 2015 (15 percent). Only one ITS technology, MMS, saw a reduction in usage since the 2015 Small Urban and Rural Transit Provider Survey. Figure 10 shows that usage declined from 38 percent to 27 percent, while planning estimates declined from 17 percent to 8 percent. The next section, **Usefulness of ITS Technologies**, presents findings on usefulness ratings, which also have declined for MMS since 2015 (see Figure 13. Trend in "Very Useful" Ratings for ITS Technologies). The ITS JPO could do further research to better understand the reasons for the decline, particularly if this was an ITS technology that was expected to expand further in the transit sector.



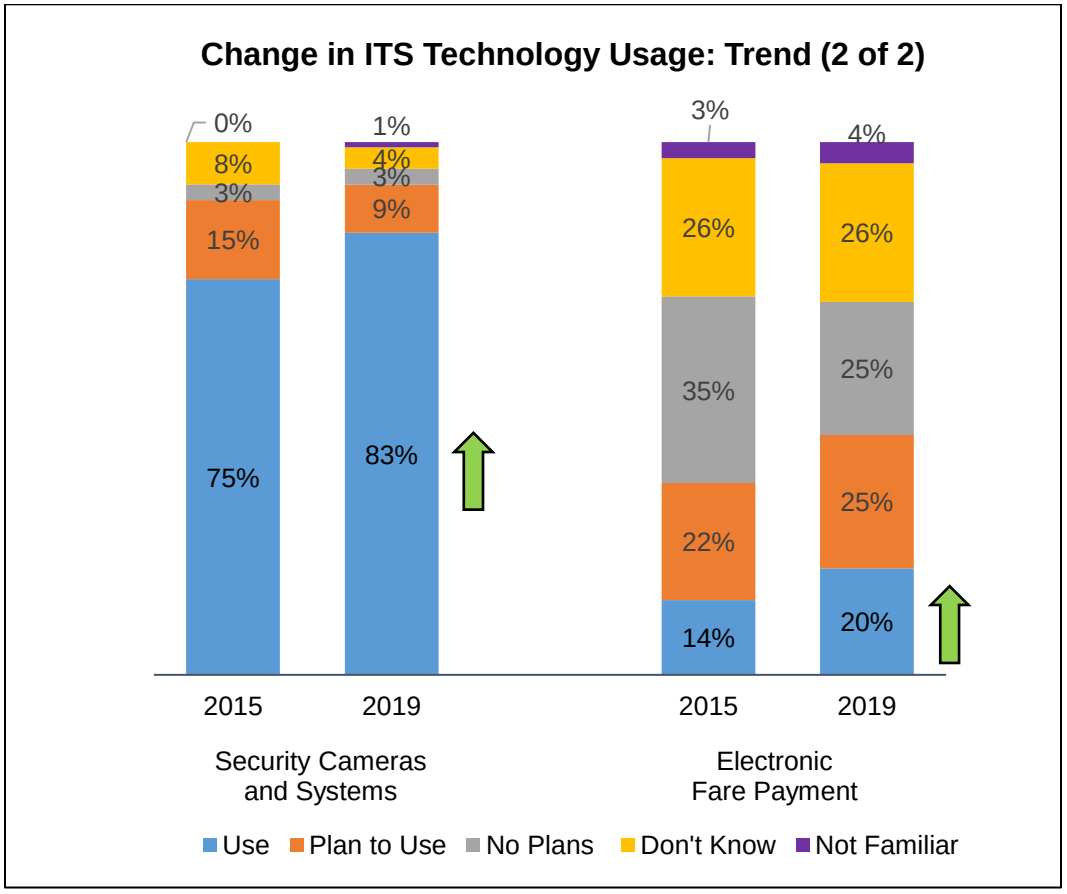
Source: USDOT

Q: Is your organization currently using [TECHNOLOGY]? [If No] Does your agency currently plan to deploy [Technology] in the next 5 years?

Figure 10. Changes in ITS Technology Usage – Trend (1)

Two additional ITS technologies showed smaller, but still significant usage increases from 2015 to 2019 (see Figure 11). SCS increased 9 percentage points from 74 percent to 83 percent, and EFP systems increased 6 percentage points from 14 percent to 20 percent. Although 22 percent indicated they were planning to deploy EFP in 2015, usage during this period only increased 6 percentage points. Nonetheless, the proprotion of those planning to deploy EFP remains high in 2019 (25 percent), suggesting continued interest in this ITS technology. Furthermore, the proportion with no plans to deploy decreased from 35 percent in 2015 to 25 percent in 2019.

Finally, from 2015 to 2019, there was no statistically significant change in the use of APC (15 percent to 16 percent), CAD (55 percent to 56 percent), TSP (3 percent to 3 percent), or GIS (47 percent vs 54 percent); however, the use of GIS is trending higher.



Source: USDOT

Q: Is your organization currently using [TECHNOLOGY]? [If No] Does your agency currently plan to deploy [Technology] in the next 5 years?

Figure 11. Changes in ITS Technology Usage – Trend (2)

Reasons for Non-Use

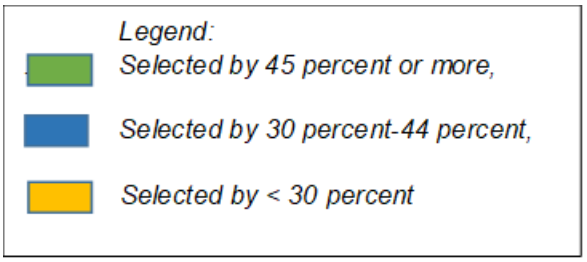
Table 6 depicts the various reasons why transit providers have not deployed ITS technologies. Each column represents transit agencies who have **not** deployed the listed ITS technology. The cells of the table are color coded to represent the proportion of those who have not deployed the ITS technology selecting each reason. Cells shaded in green were selected by 45 percent to 62 percent of non-users, blue cells were selected by 30 percent to 44 percent of non-users, and orange cells were selected by less than 30 percent of non-users.

Table 6. Reasons for Non-Use

Reasons for Non-Use	AVL	EFP	GIS	TIS*	CAD	MMS	APC	TSP
Lack of funding for operational costs								
Cost of technology is too great								
Cost of technology unclear								
No perceived need								
Difficult to integrate technology with current systems								
Lack of technical expertise in workforce								
Benefits of technology are unclear								
Lack of support from leadership and/or decision makers								
Vendor issues								
Other								
Unweighted Sample size	56	180	84	103	90	141	184	204

Source: USDOT

**TIS stands for Traveler Information Systems*



Example "Other" Reasons for Non-Use:

CAD: *"Our geography is a challenge for communications. We do not have wifi coverage or cell service throughout most of our county."*

GIS: "*We have one van. We operate in a cluster of small communities. We don't get lost."*

MMS: *"Difficult to find MMS for small rural systems with limited amount of buses."*
"As a county department there is a motor pool which we take our vehicles and also outsource as well."

Traveler Information Systems: *"We have one van and we transport elders. It's not needed for what we do."*

APC: *"Our reservation system counts riders so this would be a duplicated cost- so we see no need."*
"The Automatic Counters don't help us know what type of rider is riding and we need that info for our grant reports so doesn't seem cost effective"

EFP: *"Our service is free to the public."*

TSP: *"We only have one stop light in our city -- so no need."*
"City would not grant permission."

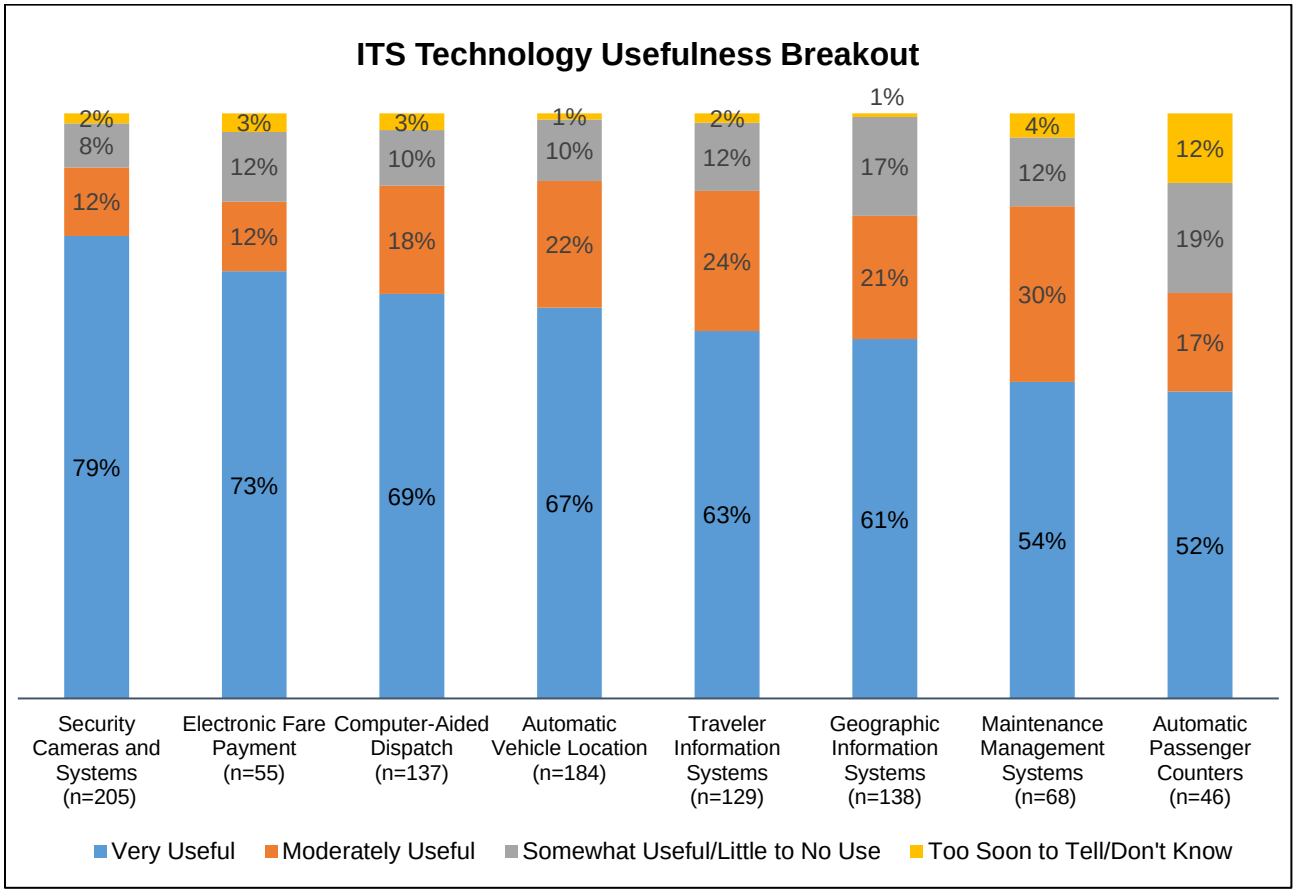
Cost and funding issues are among the top barriers for most of the ITS technologies surveyed. ***Lack of funding for operational costs*** and ***high technology cost*** are listed as top barriers to use for six of the eight ITS technologies shown. With the exception of APC and TSP, 52 percent to 61 percent of agencies cite lack of funding for operational costs as a reason for not using the ITS technology, and 49 percent to 62 percent cite ITS technology costs. Across the ITS technologies, unclear costs are also listed as an issue by many transit providers, and particularly for Traveler Information Systems (52 percent).

For APC and TSP, cost issues are eclipsed by the fact that a relatively large number of non-users see ***no perceived need*** for these ITS technologies. For TSP, 53 percent cite lack of need, as do 47 percent of transit agencies who are not using APC.

For some ITS technologies such as CAD and Traveler Information Systems, technical complexity also appears to be a barrier to use for a plurality of non-users. Table 6 shows that these ITS technologies skew higher on reasons such as being difficult to integrate with current systems (CAD – 36 percent; Traveler Information Systems – 35 percent) and lack technical expertise in the workforce (CAD – 33 percent; Traveler Information Systems – 39 percent). AVL and MMS also skews higher for lack of technical expertise in the workforce (38 percent and 31 percent respectively). For five of the eight ITS technologies shown, between 30 percent and 44 percent of transit providers citied that ITS technology benefits are not clear. Relatively few transit agencies (less than 30 percent) indicated lack of support from leadership or vendor issues as reasons for not using the listed ITS technologies. Transit providers were most likely to cite a lack of leadership support for TSP (20 percent), and they were most likely to cite vendor issues for AVL (17 percent).

Usefulness of ITS Technologies

Figure 12 shows that a high proportion of respondents see the ITS technologies they use as ***very useful***, with ratings ranging from 52 percent to 79 percent. SCS (79 percent) and EFP Systems (73 percent) come out on top, while the lowest ratings are given to MMS (54 percent) and APC (52 percent). For all ITS technologies—with the exception of APC—large majorities (between 82 percent and 91 percent) give a rating of either very or moderately useful (this compares to 69 percent for APC). It is worth noting that for APC the 12 percent shown in yellow ***(Too Soon to Tell/Don't Know***) only consists of those saying ***Too Soon to Tell*.** Presumably, these agencies have just started using this ITS technology, and are not able to rate its usefulness based on their limited experience to date. When the responses are based on those who are able to provide a rating (i.e., excluding the 12 percent), the usefulness ratings for APC increase slightly (59 percent very useful, and 19 percent moderately useful).



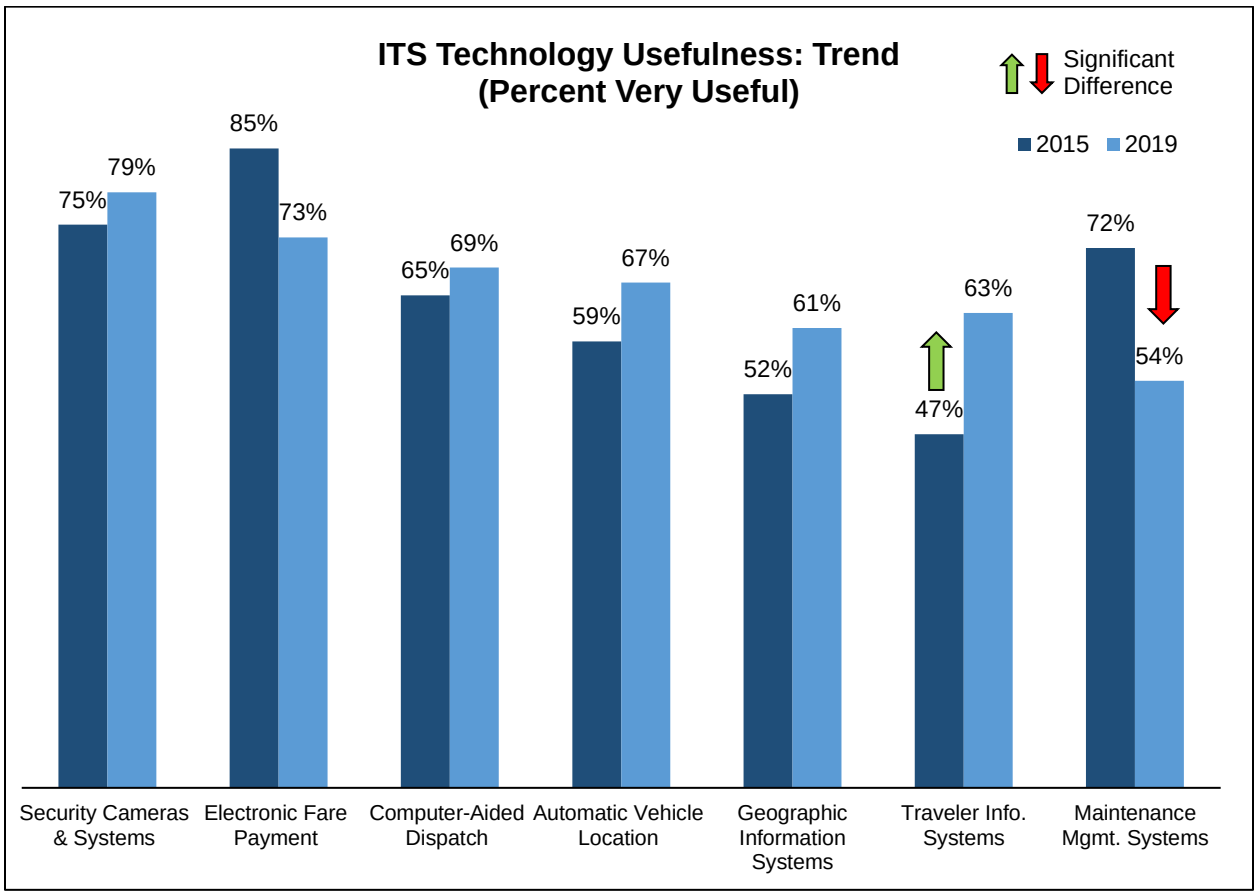
Source: USDOT

Q: Overall, how useful has [TECHNOLOGY] been for your organization? (% Very Useful)

Base: Technology users – unweighted sample size shown. TSP not shown due to small sample size.

Figure 12. ITS Technology Usefulness Breakout

Since 2015, the proportion rating an ITS technology as ***very useful*** has increased significantly for Travel Information Systems, moving from 47 percent in 2015 to 63 percent in 2019 (see Figure 13. Trend in "Very Useful" Ratings for ITS Technologies). By contrast, ratings for MMS declined significantly in the same period from 72 percent to 54 percent. These changes track with changes in usage for these same ITS technologies. While nearly all of the other ITS technologies are trending upward (with the exception of EFP), none of these other ITS technologies (SCS, EFP, CAD, AVL, and GIS) saw statistically significant changes during this period.



Source: USDOT and GAO

Q. Overall, how useful has [TECHNOLOGY] been for your organization? (% Very Useful)
Base: Technology users. APC not shown due to small 2015 sample size

Figure 13. Trend in "Very Useful" Ratings for ITS Technologies

The research team analyzed the usefulness ratings by agency type, but there were no significant differences between small urban and rural transit providers.

Trends in Use/Usefulness

Table 7 summarizes changes in both use and usefulness from 2015 to 2019, with statistically significant increases shaded in green and significant reductions shown in red. In many cases, use and usefulness show movement in the same direction, as with Traveler Information Systems—showing significant increases in use and usefulness, and MMS showing a significant decline in both. With MMS, it may be that agencies have had some poor experiences with the ITS technology, and without a change in the ITS technology, the current generation has topped out on its deployment potential.

With EFP, there appears to be a trend toward increased use (by six percentage points) and decreased usefulness, although neither change is statistically significant. In this case, usefulness was at 83 percent in 2015 and went down to 75 percent in 2019, which is still a high proportion.

Table 7. Trend in Use/Usefulness

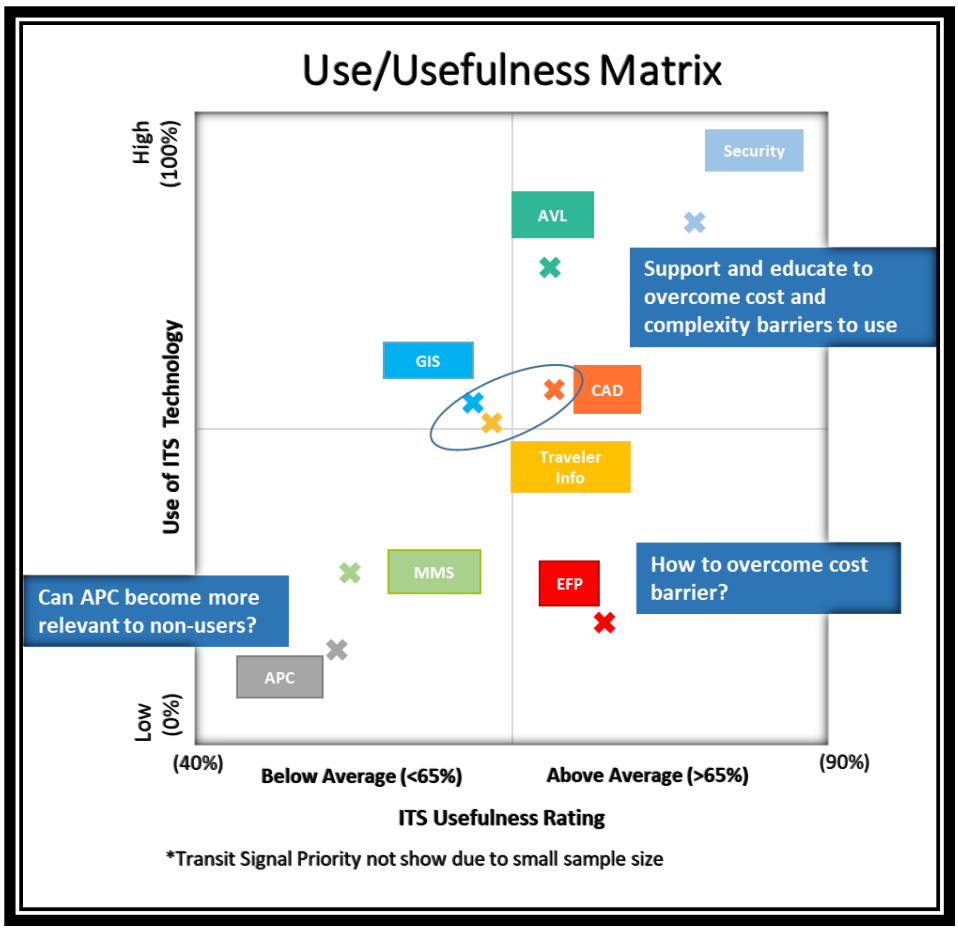
ITS Technology	Change in Use (2015-2019) Percentage Pts.	Change in *Very Useful* Rating (2015-2019) Percentage Pts.
Security Cameras & Systems	+9	+4
Electronic Fare Payment	+6	-12
Computer-Aided Dispatch	+1	+4
Automatic Vehicle Location	+24	+8
Traveler Information Systems	+19	+16
Geographic Information Systems	+7	+9
Maintenance Management Systems	-11	-18
Automatic Passenger Counters	+1	

Source: USDOT

TSP not shown due to small sample size

Use/Usefulness Matrix

By combining the survey information on ITS technology use and perceived usefulness, the research team developed a Use/Usefulness Matrix (see Figure 14. ITS Technology Use/Usefulness Matrix). The x-axis represents the proportion rating an ITS technology as very useful. The axis ranges from 40 percent to 90 percent, with the mean usefulness (65 percent) used as the midpoint. The y-axis shows percent use of the ITS technology. The axis ranges from 0 to 100 percent, with the midpoint at 50 percent. The top right corner of the matrix represents technologies that have both high use and usefulness, an optimal point. The lower left hand quadrant represents ITS technologies that have lower use and usefulness ratings. The upper left hand quadrant represents higher use, but less useful ITS technologies, whereas the bottom right quadrant includes ITS technologies that have lower use but higher usefulness ratings.



Source: USDOT

Figure 14. ITS Technology Use/Usefulness Matrix

The following section summarizes the findings from the use/usefulness matrix for each of the surveyed ITS technologies. It draws on other survey findings (e.g., reasons for non-use, trend data) in an effort to identify areas for FTA/ITS JPO support and to highlight questions for future research.

Top Right: Higher Use and Usefulness

SCS: This ITS technology has the highest use and usefulness rating of all the surveyed ITS technologies, and its use has increased since the 2015 survey. Use of SCS is widespread among both rural and small urban areas, reflecting the overall importance of safety to transit providers.

AVL: Use of this ITS technology is relatively high and has increased substantially since 2015. Transit providers tend to rate it highly with regard to usefulness, and like SCS, AVL is used widely in both small urban and rural contexts. The reasons for non-use, indicate that cost is a barrier, and in addition, technical complexity in integrating the ITS technology and vendor issues tend to stand out as reasons for not using AVL. In thinking about ways to expand the use of AVL, the ITS JPO may want to consider providing technical assistance to agencies to overcome these challenges.

Middle: Moderate Use and Usefulness

CAD: The survey found lower usage of CAD relative to AVL (despite the fact that CAD is often deployed in tandem with AVL); however, the usefulness ratings for CAD were as high as AVL, and CAD is used in both small urban and rural contexts. In addition to cost, transit providers tended to cite technical challenges as reasons for not using the ITS technology. Indeed, studies have shown that CAD can save money but that it can be tricky to implement because there are a limited number of vendors and it requires coordination among jurisdictions.[15] To boost the deployment of this ITS technology, the ITS JPO should consider the ways in which it can support transit providers in overcoming the technical challenges to use. In addition 38 percent of non-users indicate no need for CAD, perhaps because AVL provides the functionality that small urban and rural transit providers need most. ITS JPO may need to tailor their outreach to explain the added benefits of CAD.

Traveler Information Systems: Although both the use and usefulness ratings of Traveler Information Systems have increased significantly since 2015, usage remains moderate overall and usefulness is slightly below the average for all ITS technologies. There may be several reasons for this. On the one hand, the survey indicates that cost and technical challenges are reasons for non-use. At the same time, the survey finds that small urban providers are significantly more likely than their rural counterparts to use this ITS technology, likely due to the greater need for this ITS technology in areas that that rely on bus systems (vs. rural areas that rely more heavily on demand response systems) and that have greater traffic congestion. ITS JPO could do additional research to better understand whether rural transit providers see this as an ITS technology that could be adapted to serve systems that are focused on demand response.

GIS: Use of GIS is slightly above average (i.e., average use of all the surveyed ITS technologies), but the usefulness ratings for GIS were somewhat below average. Nonetheless, the data show positive trends in both the use and usefulness of GIS since 2015 (though the differences are not statistically significant). GIS sees significantly greater use in small urban contexts compared to rural contexts, as rural transit providers may have less need and fewer resources to devote to data mapping systems. Among those who are not using GIS, cost-related factors are cited as a reason for non-use, and in addition about one-third of agencies indicate no perceived need for the ITS technology and one third say they are unclear about the benefits of the ITS technology. The ITS JPO should consider additional research, such as case studies, to better understand the uses and benefits of GIS in small urban and rural contexts in order to target outreach to these contexts.

Bottom Right: Low Use and Higher Usefulness

EFP: This ITS technology has relatively low use among small urban and rural transit agencies, but high usefulness ratings. EFP has been successful in larger transit systems such as Washington Metropolitan Area Transit Authority (WMATA), an early adopter who implemented their own system at relatively high cost but also with high customer satisfaction. It is unclear at this point, whether this is an ITS technology that is suited to smaller transit agencies. Among non-users, cost appears to be a barrier. EFP is changing rapidly, however, and lower cost solutions are becoming available. New digital payment systems are eliminating the need for agencies to invest in their own, more costly EFP system when they can use a custom app (see Tampa's Flamingo pass) or have customers pay directly via Apple Pay or Google wallet.

[15] Carolina Burnier, Amy Jacobi, Gwo-Wei Torng, and Yehuda Gross. *Uncover the Impacts of Coordinating Human Services Transportation – One Study, Two Locations, and Three What-if Coordination Scenarios.* Transportation Research Board. January 2014.

The situation is somewhat analogous to the Traveler Information Systems of the 2010s: agency-produced trip planners were overtaken by Google and Waze once the General Transit Feed Specification (GTFS) was introduced. Rural and small urban transit systems may be taking a wait-and-see approach, anticipating that costs will go down as the industry coalesces around a smaller set of solutions. In particular, rural transit agencies that rely more heavily on demand response systems, may not see the value in deploying a customized EFP system, but would consider a lower cost digital payment system. Given the high usefulness ratings for EFP, there may be an opportunity to educate agencies about the usefulness of the ITS technology, based on the experience of agencies that are currently deploying the ITS technology.

Bottom Left: Lower Use and Usefulness

MMS: Compared to the other ITS technologies, MMS has lower use and usefulness ratings, and both of these measures have declined since the 2015 survey. The reasons for the decline in use and usefulness are unknown, but may be due to poor experiences with MMS and/or that it has been overtaken by newer Transit Asset Management (TAM) systems, of which MMS is included in a suite. The FTA and ITS JPO should consider further investigating MMS to better understand these trends, as well as how the technology fits in to agencies' overall TAM plans and adherence to FTA's 2016 TAM rule.

APC: This ITS technology has lower use and relatively low perceived usefulness (i.e., compared to the other ITS technologies). Not surprisingly, use is almost exclusive to small urban transit providers, as an overwhelming majority use APC on bus systems rather than on demand response systems (93 percent vs. 19 percent, respectively – see Table 5). Due to the relatively small number of passengers on demand response systems, rural transit providers are less likely to need APC, as demonstrated in the survey findings related to non-use of this ITS technology. Overall, nearly one-half of agencies who have not deployed the ITS technology indicate that they have no perceived need. To move the needle on APC, the ITS JPO may want to focus its outreach efforts on small urban providers.

Not Shown (small sample size)

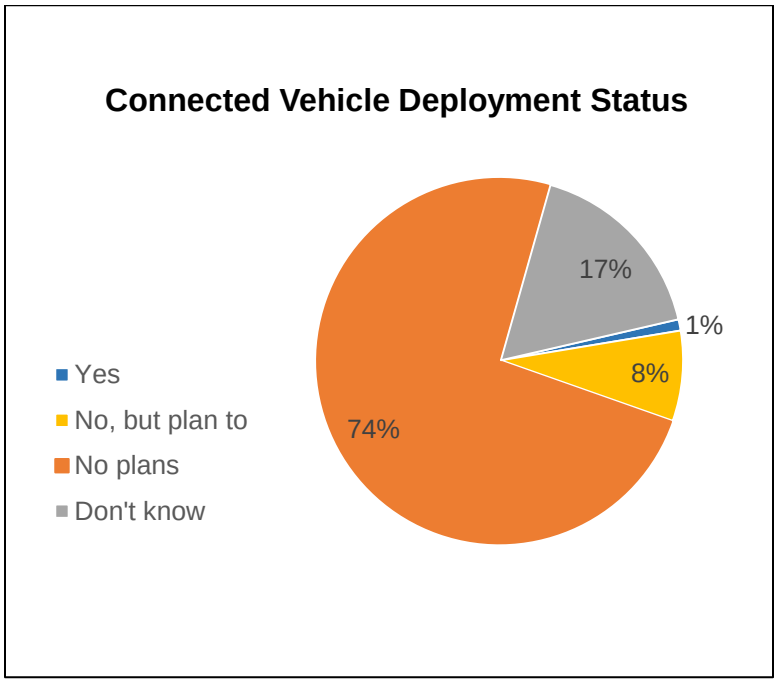
TSP: This ITS technology has low use and a majority of agencies have no plans to use it. Current adoption of TSP is almost exclusively in small urban areas, and it is likely that many small urban and rural areas do not have a level of traffic congestion that justifies the expense of a TSP system. As evidence of this point, the reason cited most often for non-use is no perceived need (53 percent). In accelerating deployment of this ITS technology, ITS JPO may want to target small urban areas that operate bus systems and experience a higher level of traffic congestion.

Use of Next Generation Technologies

This section looks at use of emerging technologies and services including Connected Vehicles, Automated Vehicles, and Mobility on Demand.

Connected Vehicles

While use of commercially available ITS technologies is increasing for small urban and rural transit providers, Connected Vehicle (CV) and Automated Vehicle (AV) technologies have not yet reached smaller transit markets. Figure 15. Connected Vehicle Technology Use shows that only 1 percent of survey respondents report current use of CV technologies, and just 8 percent plan to deploy them in the future.

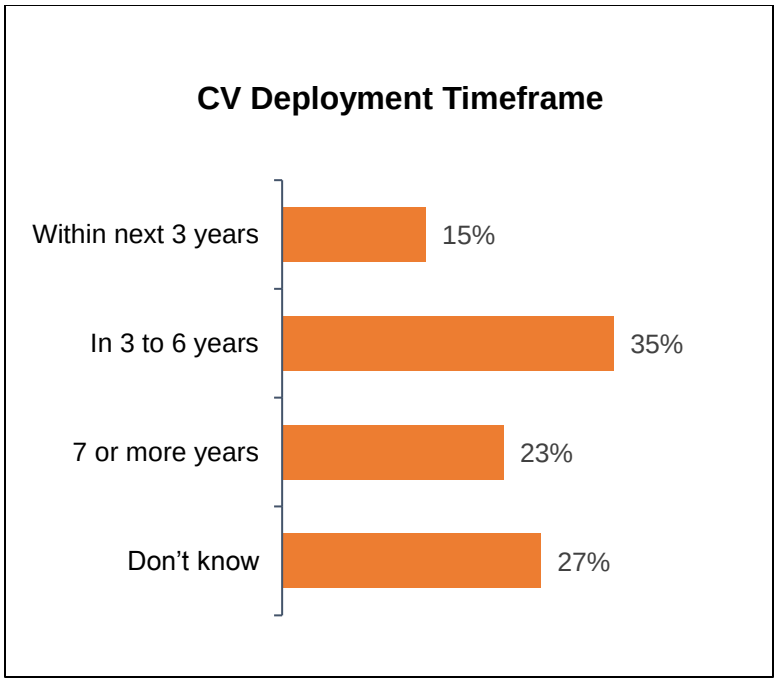


Source: USDOT

Q: Is your agency currently deploying CV technology?

Figure 15. Connected Vehicle Technology Use

Figure 16. Timeframe for Deploying Connected Vehicle Technology charts the findings from those who plan to deploy CV; however, the sample sizes are very small and the results should be interpreted with caution. The findings suggest it could be more than three years before there is notable connected vehicle deployment in small urban and rural areas.



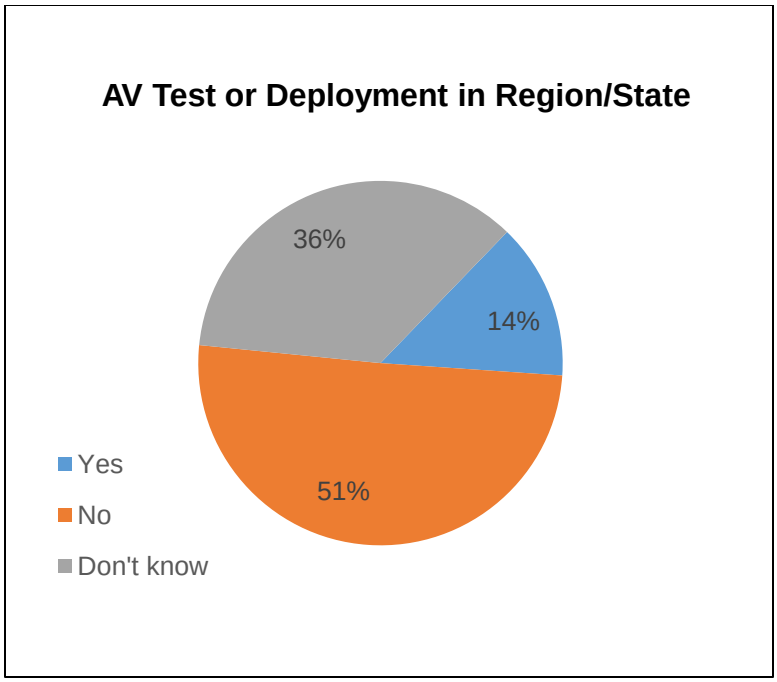
Source: USDOT

Q: When do you plan to deploy Connected Vehicle technology? Base: Respondents planning to deploy CV – small sample size (n=22).*

Figure 16. Timeframe for Deploying Connected Vehicle Technology

Automated Vehicles

Relatively few small urban and rural transit providers—only 14 percent—reported that AV tests or deployments have been or are being conducted in their region or state. As shown in Figure 17. Automated Vehicle Tests and Deployments, 51 percent reported no AV tests or deployments and 36 percent responded don't know.



Source: USDOT

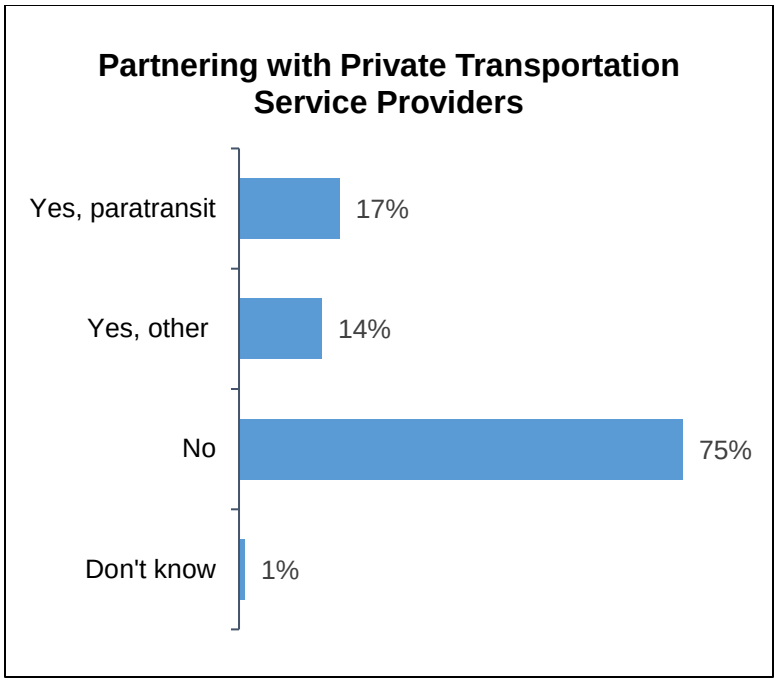
Q: Are there any AV tests or deployments that are being/have been conducted in your region/state?

Figure 17. Automated Vehicle Tests and Deployments

Among those agencies reporting AV activity, 94 percent indicate that they are not involved in the deployment/testing. Additionally, those agencies that reported no AV activity or don't know were asked a follow-up question on whether they have plans to participate in AV testing or deployment in the future. Less than 1 percent responded in the affirmative.

Partnering with Private Transportation Providers

Overall 24 percent of small urban and rural transit providers are partnering with private transportation providers. As shown in Figure 18, 17 percent are using private companies to provide paratransit and 14 percent partner to provide other services.



Source: USDOT

Q: Does your agency partner with private transportation service providers?

Note: Multiple responses allowed, so percentages sum to greater than 100 percent

Figure 18. Partnering with Private Transportation Providers

Table 8 shows the type of partnerships that are used for providing paratransit services and for providing "other" services. Human service providers and taxis are the most frequently used partners for paratransit, while taxis and various other providers are used for other types of services.

Table 8. Type of Partnerships

Partnerships	Paratransit Services	Other Services
Human service providers	51%	Not Applicable
Taxis	27%	40%
Microtransit	2%	2%
Ridesourcing	7%	3%
Other	29%	57%
Don't know	0%	9%

Source: USDOT

Q: With which paratransit/other services does your agency partner?

**Small sample size (Paratransit: n=44, Other n=34)*

ITS Technology Benefits, Challenges and Costs

This next section looks at ITS benefits, benefit measurement, challenges to deploying ITS, and unexpected ITS costs. The questions in this section were asked across the ITS technologies used.

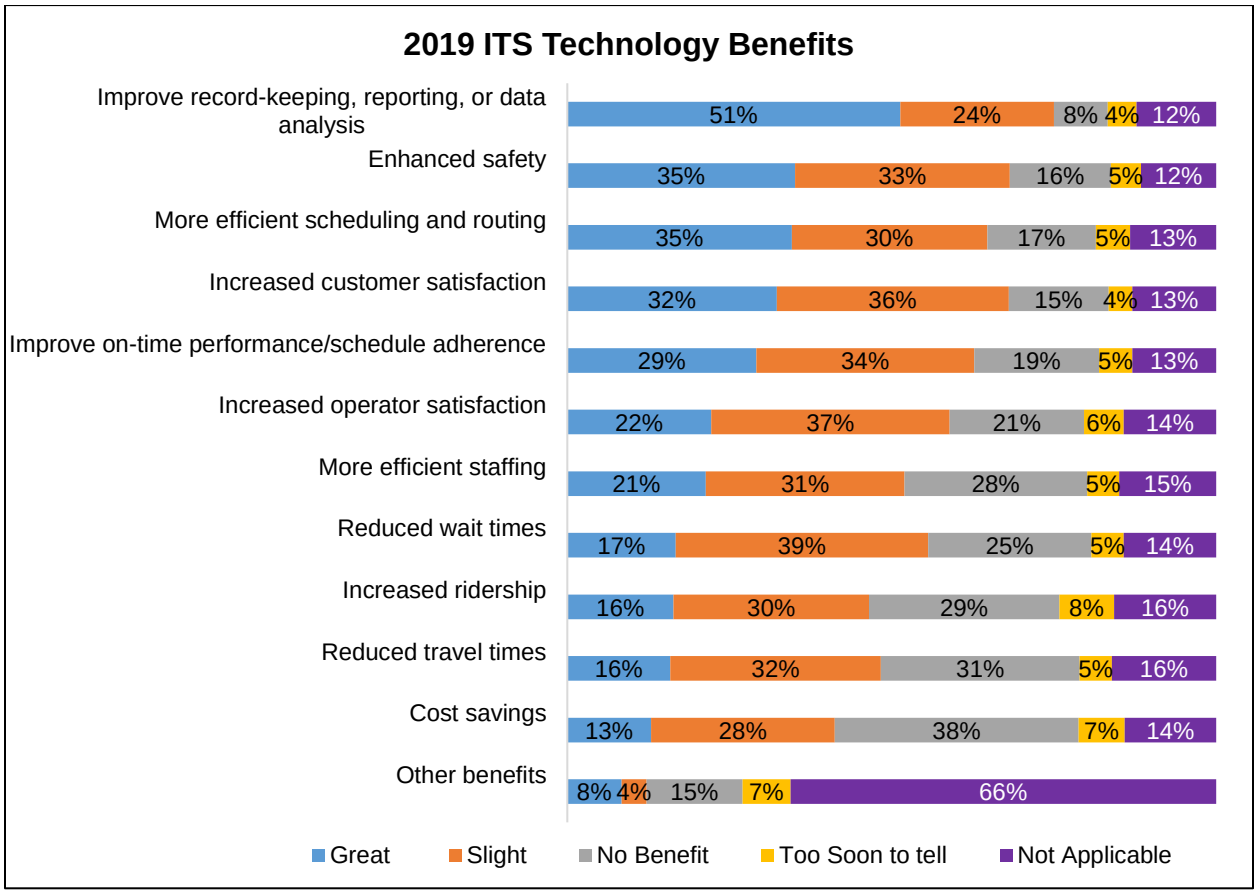
General ITS Technology Benefits

Example "Other" Benefits:

- ITS technologies allow those responsible for executing the service to "bring it to their desktops". This greatly enhances monitoring and accountability, which are two of the many important aspects of operating a safe, convenient, and affordable transit system…
- *ADA compliance (on-board stop announcement and sign display for visually and hearing impaired)*
- *Public perception that the agency is keeping up with technology.*

Survey responses indicate that small urban and rural transit providers are not yet recognizing many "great benefits" from the use of ITS technologies. Figure 19 shows that the benefit that stands out the most in the 2019 survey is ***improved record-keeping, reporting, or data analysis*** *(51 percent).* The next tier of benefits—***safety*** *(35 percent),* ***efficient scheduling and routing*** *(35 percent),* ***increased customer satisfaction*** *(32 percent),* and ***improved on time performance*** *(29 percent)*—are recognized by only about one-third of respondents as providing a great benefit, with roughly another third recognizing a slight benefit. Many other benefits that might be expected as a result of ITS deployment, such as ***increased operator satisfaction***, ***efficient staffing***, ***reduced wait times***, ***increased ridership***, ***reduced travel time***, and ***costs savings*** fall to the bottom of the list—with less than 25 percent saying they are a great benefit, and between 21 percent to 38 percent

indicating no benefit at all. Additional research might address the reasons why transit agencies are not experiencing greater benefits and should explore the types of benefits that small urban and rural transit providers are seeking when they deploy different ITS. For example, in rural areas, it may be that reduced travel time is not a priority for transit providers, as the less congested conditions mean that their service is already operating optimally with regard to travel time. Instead, rural transit providers may be seeking other benefits from ITS.



Source: USDOT

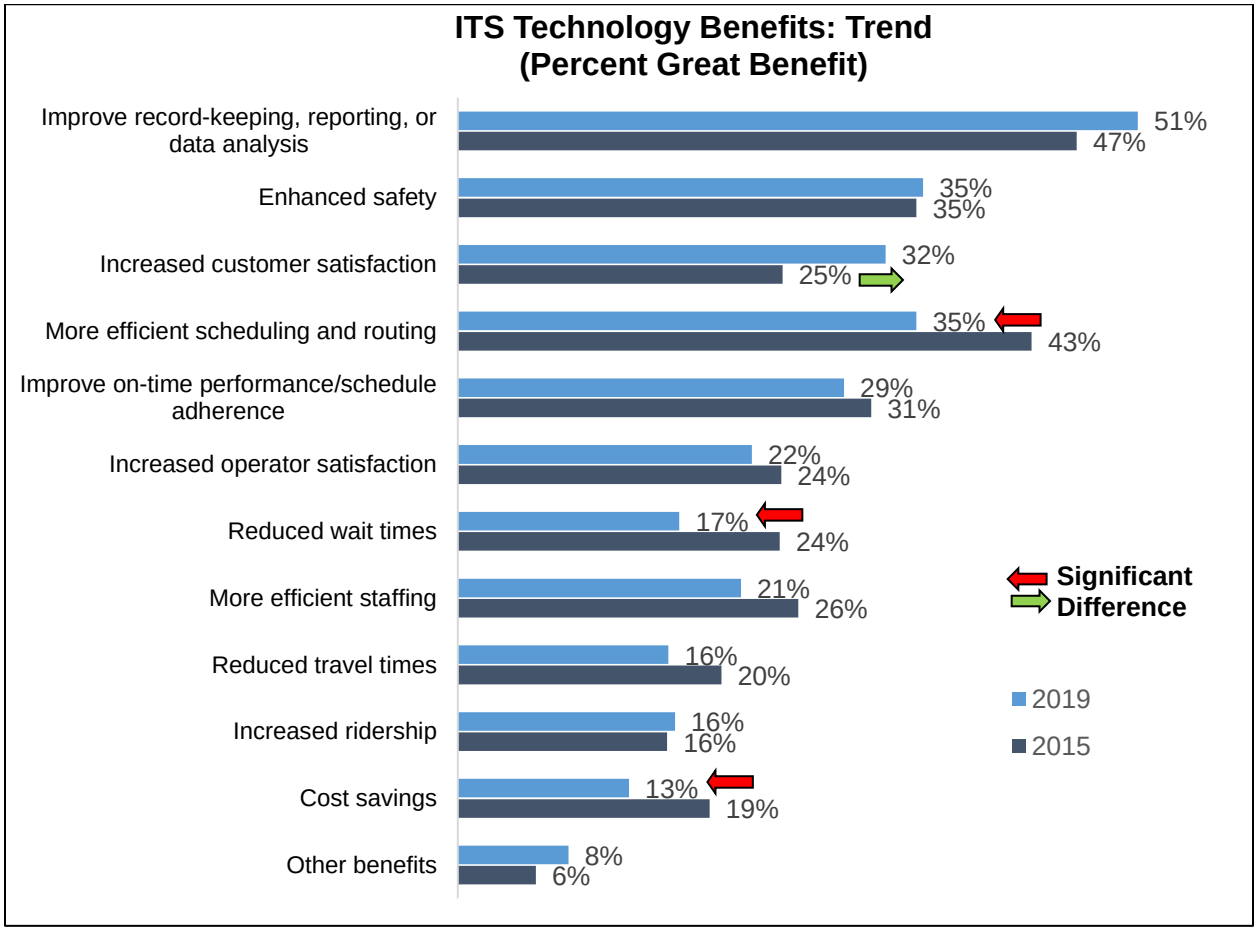
Q: In your opinion, to what extent has your organization realized the following benefits from deploying the ITS technologies listed in this survey

Figure 19. Benefits of ITS Technologies

The research team analyzed whether there are differences in benefits by agency type, but the findings indicate there were no significant differences between small urban and rural transit providers in the benefits perceived from their ITS deployments.

ITS Technology Benefits Trend

It may take time for transit agencies to realize the benefits of ITS technology, but there has not been a great shift in benefit ratings since 2015. Figure 20. Trend in "Great Benefit" in ITS Technology shows the proportion of transit agencies rating potential ITS benefits as great in 2015 and 2019. The differences in ratings range from only 2 to 8 percentage points. The number rating ***increased customer satisfaction as a*** great benefit increased significantly (+7 percentage points), while ***more efficient scheduling and routing*** (-8 points), ***reduced wait times*** (-7 points), and ***cost savings*** (-6 points) decreased significantly.



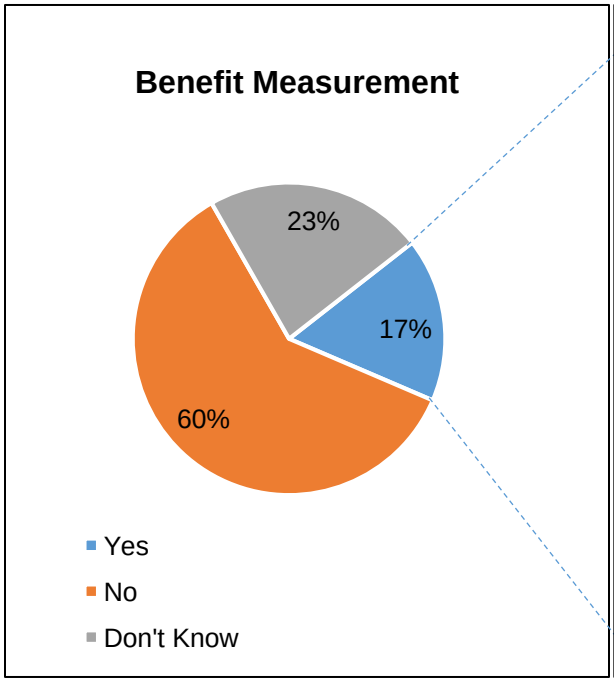
Source: USDOT

Q: In your opinion, to what extent has your organization realized any of the following benefits from deploying the ITS technologies listed in this survey?

Figure 20. Trend in "Great Benefit" in ITS Technology

Benefit Measurement

Only a small fraction (17 percent) of surveyed agencies report that they have been able to quantitatively measure ITS technology benefits (see Figure 21). This information could present an opportunity for FTA/ITS JPO to educate transit providers on how to measure the short and long-term impacts of ITS technology use. Small urban and rural transit agencies who have done quantitative benefit measurement could be interviewed for the purpose of developing case studies for the ITS JPO Benefits, Costs, and Lessons Learned database.



Please describe the steps your organization took to measure these benefits…

- "We compare miles driven and the cost/ride prior to deploying the routing software."
- "Deploying web-based bus locator information reduced number of customer phone calls to operations inquiring on bus status."
- "Used GIS in partnership with another agency and their planners to make route changes and add a new route; has led to an increase of over 30% in ridership."
- "Security cameras have aided us in pursing and defending insurance claims, complaints, lawsuits, and other matters."
- "By implementing our driver held wireless tablet passenger scheduling system, we have greatly reduced the number of pieces of paper used and stored to record transit data."

Source: USDOT

Q: Has your organization been able to quantitatively measure any benefits received from technologies listed in this survey?

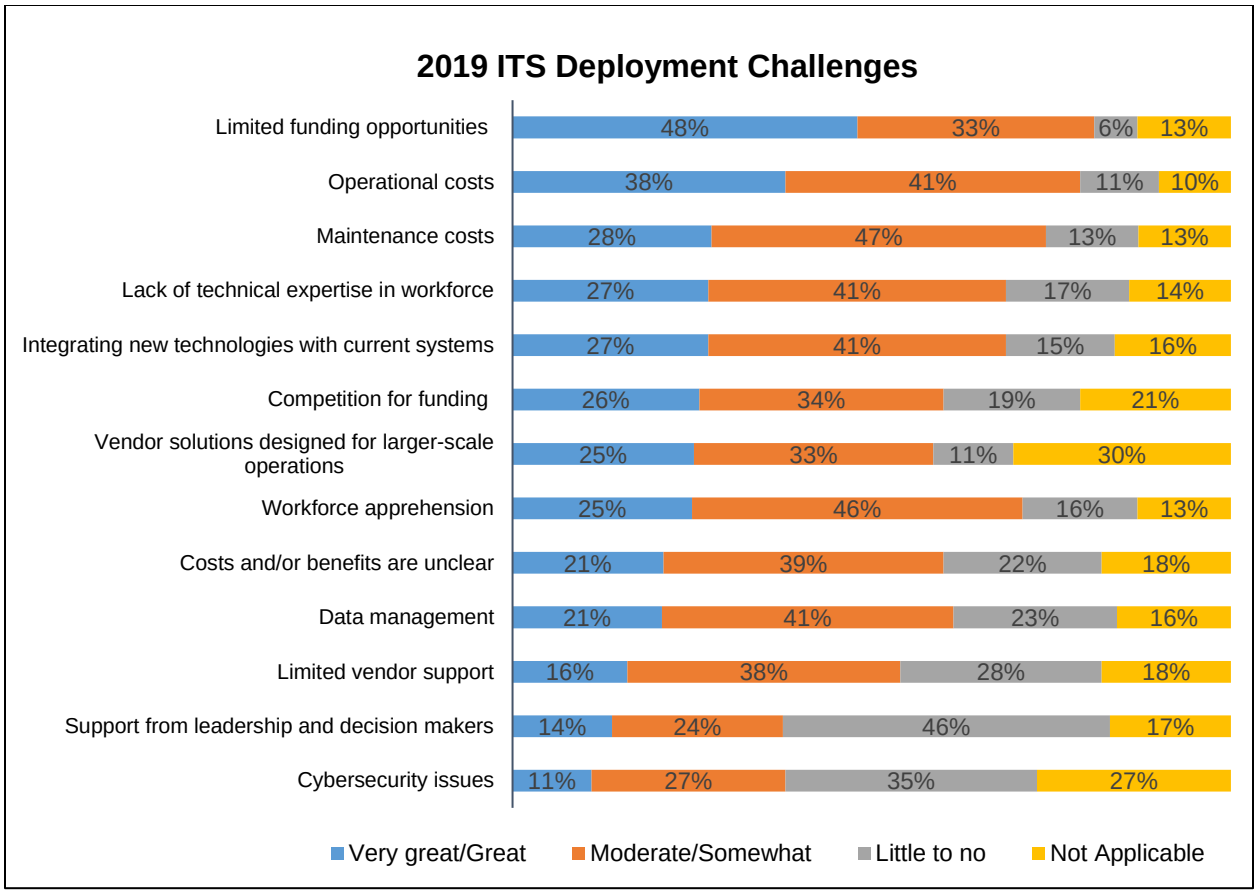
Figure 21. Benefit Measurement

Challenges to ITS Technology Deployment

Challenges

"I think technology changes so quickly that by the time all staff can grasp the concepts, new technology is employed. I think getting staff and the technology up to speed before embarking on the 'newest' thing should be considered more when looking for the 'next great IT' product."

Figure 22. ITS Deployment Challenges shows how issues were rated as challenges to ITS deployment. When looking at the proportion of respondents who rated issues as "very great or great challenges," funding issues—***limited funding opportunities*** (48 percent) and ***competition for funding*** (26 percent) and cost issues—***operational costs*** (38 percent) and ***maintenance costs*** (28 percent) rise to the top. Outside of funding and cost issues, agencies have to overcome technical issues including a ***lack of expertise in the workforce*** (27 percent), ***integrating new technologies with current systems*** (27 percent), and ***vendor solutions designed for larger-scale systems*** (25 percent). Other challenges cited as very great or great by at least 20 percent of agencies surveyed include ***workforce apprehension to introduction of technology*** (25 percent), ***unclear benefits and/or costs*** (21 percent), and ***data management*** (21 percent). ***Limited vendor support*** (16 percent), ***support from leadership*** (14 percent), and ***cybersecurity issues*** (11 percent) were seen as lesser challenges.



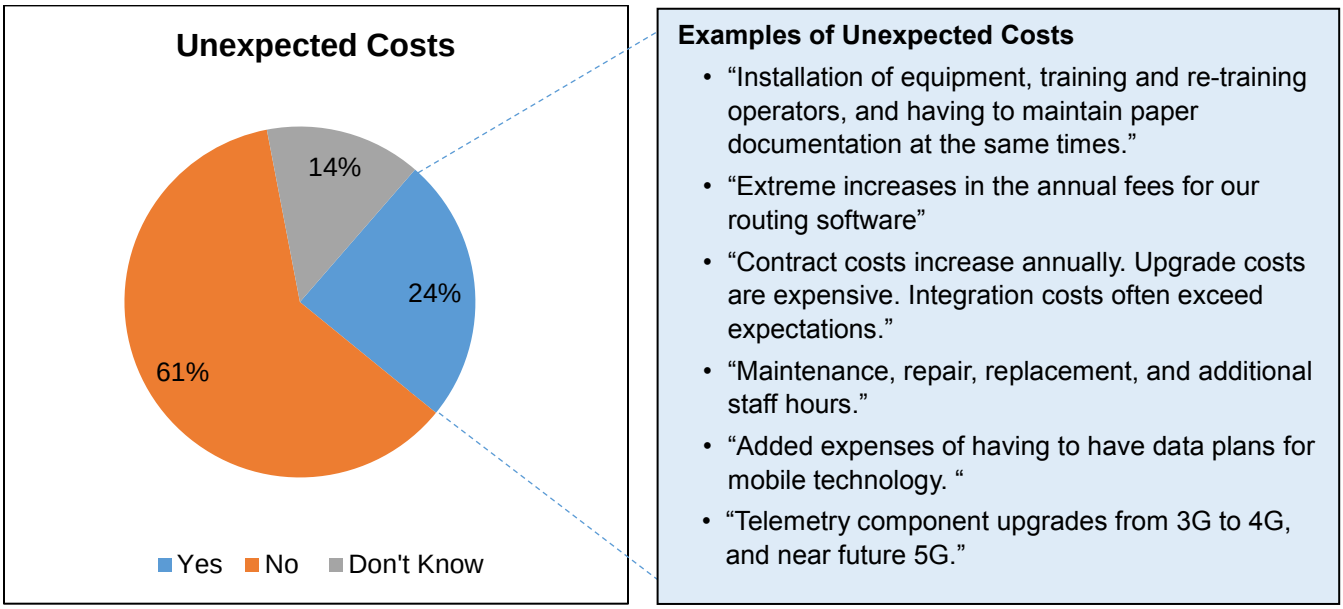
Source: USDOT

Q: How much of a challenge, if at all, were each of the following issues in your organization's deployment of the technologies listed in this survey?

Figure 22. ITS Deployment Challenges

Unexpected Costs

ITS technology costs as well as operational and maintenance costs are cited among the barriers and challenges to deploying ITS technologies. In addition to the known costs of deploying ITS technologies, about one-quarter of survey respondents described facing unexpected costs (see Figure 23. Unexpected Costs of ITS Deployments). The unexpected costs cited include employee training and staff hours; equipment maintenance, repair, and replacement; software fees and licenses; and mobile data plans and technology upgrades. This could be another opportunity for FTA/ITS JPO to educate small urban and rural transit providers on the life-cycle costs associated with ITS. Again, interviews with agencies deploying ITS, including those experiencing unexpected costs could provide information specific to the experiences of small urban and rural transit providers.



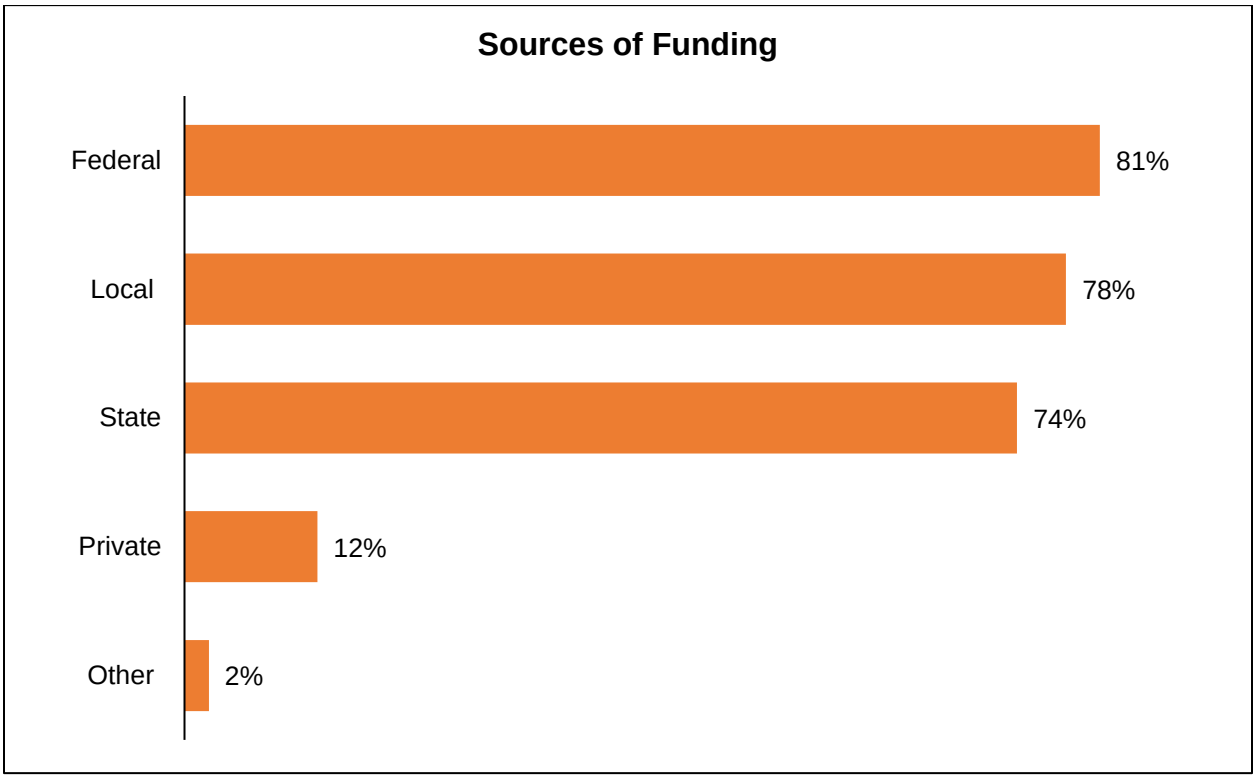
Source: USDOT

Q: Did your organization experience any unexpected costs when deploying, operating, or maintaining any of the technologies listed in this survey?

Figure 23. Unexpected Costs of ITS Deployments

Funding and Technical Support

Small urban and rural transit agencies tend to receive funding from the same sources. Overall, 81 percent of agencies receive Federal funding, 78 percent receive local funding, and 74 percent receive state funding. Only 12 percent receive funds from the private sector (see Figure 24).

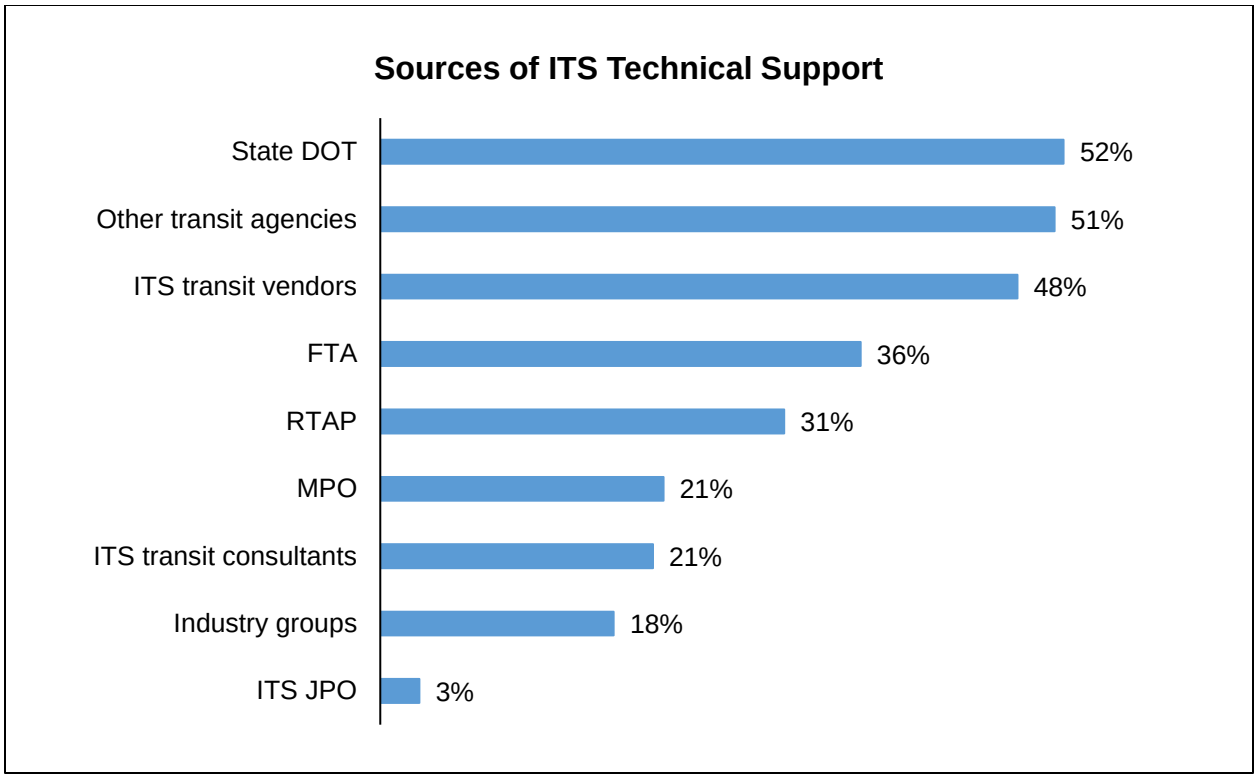


Source: USDOT

Q: Has your organization used any of the following funding sources for the deployment, operation, and/or maintenance the technologies listed in this survey?

Figure 24. Sources of Funding for ITS Technologies

Figure 25 displays that small urban and rural transit providers most often receive technical support for ITS planning, deployment, operations or maintenance from State DOTs (52 percent), other transit agencies (51 percent), and ITS transit vendors (48 percent). Just over one-third of agencies (36 percent) report receiving technical support from the Federal Transit Administration (FTA) and 31 percent from Rural Transit Assistance Program (RTAP).

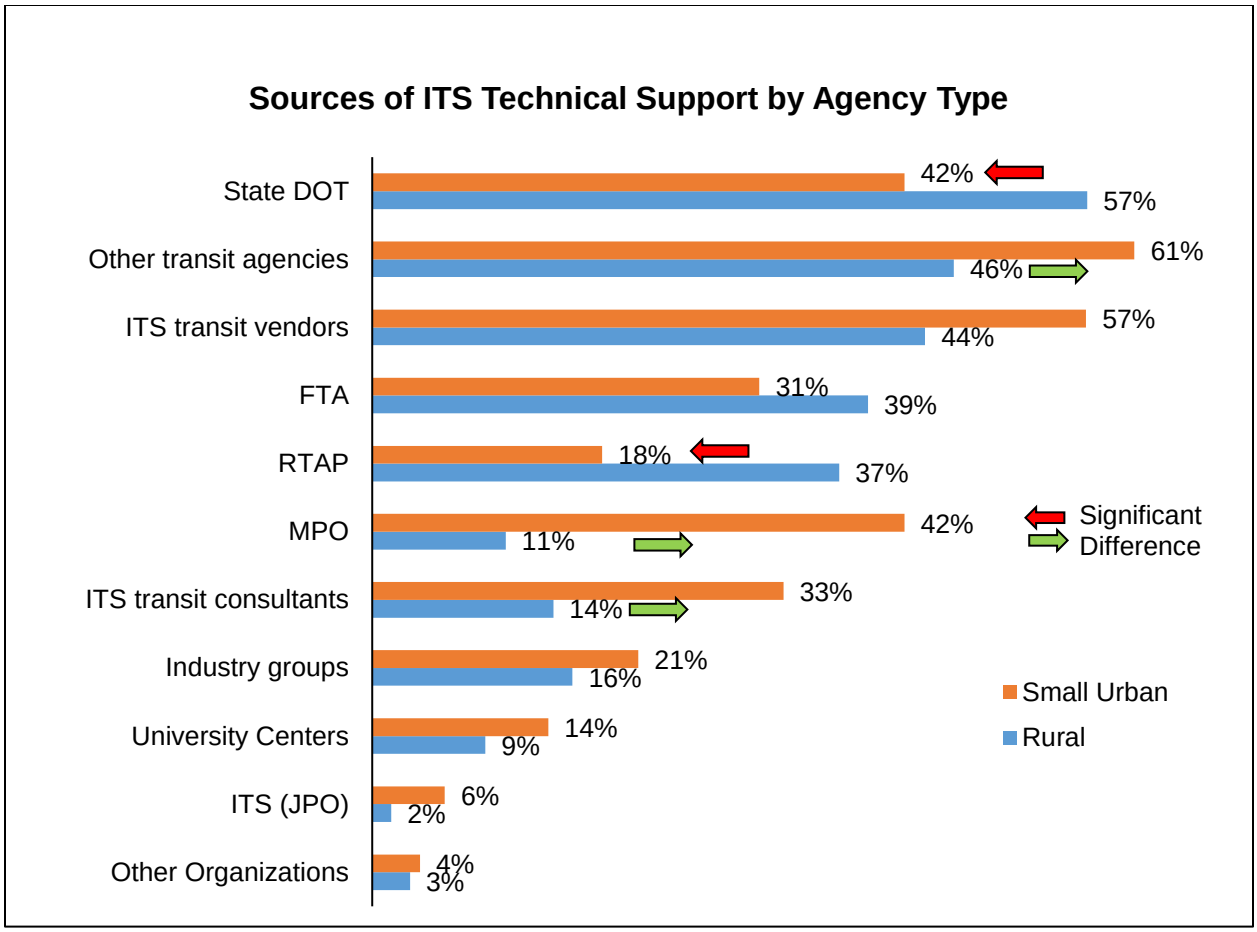


Source: USDOT

Q: Has your organization received technical support for the planning, deployment, operation, and/or maintenance of any of the technologies listed in this survey from any of the following entities?

Figure 25. Technical Support for ITS Technologies

There are some significant differences in sources of support by agency type. Figure 26. ITS Technical Support by Agency Type shows that rural agencies are more likely to get support from State DOTs (Rural–57 percent vs. Urban–42 percent) and RTAP (Rural–37 percent vs. Small Urban–18 percent). Small urban agencies more often work with other transit agencies (Small Urban–61 percent vs. Rural–46 percent), ITS consultants (Small Urban–33 percent vs. Rural–13 percent), and especially Metropolitan Planning Organizations (MPO) (Small Urban–42 percent vs. Rural–11 percent).



Source: USDOT

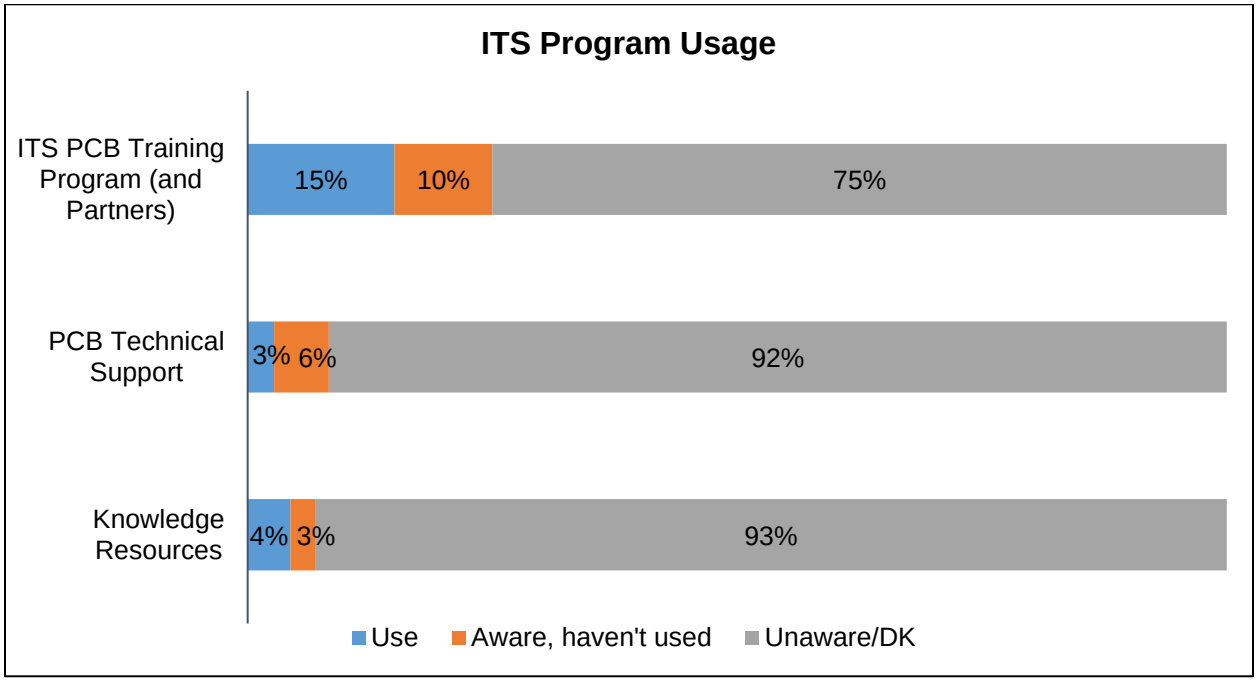
Q: Has your organization received technical support for the planning, deployment, operation, and/or maintenance of any of the technologies listed in this survey from any of the following entities

Figure 26. ITS Technical Support by Agency Type

Use of ITS JPO Resources

As seen in Figure 27, only a small number of small urban and rural transit providers are **aware** of ITS JPO resources. While 25 percent are aware of the ITS Professional Capacity Building (PCB) Training Program, only 9 percent are aware of ITS JPO PCB Technical Support and even fewer (7 percent) are aware of Knowledge Resources.

Only 15 percent of agencies have used the PCB Training Program, and a significantly smaller number have used the ITS JPO Knowledge Resources (4 percent) or PCB Technical Support (3 percent). These findings demonstrate that the ITS JPO needs to increase its outreach to small urban and rural transit agencies to make them better aware of the many ITS JPO resources. ITS JPO could also reach out to organizations and agencies that work with small urban and rural transit providers to encourage them to share ITS JPO resources.



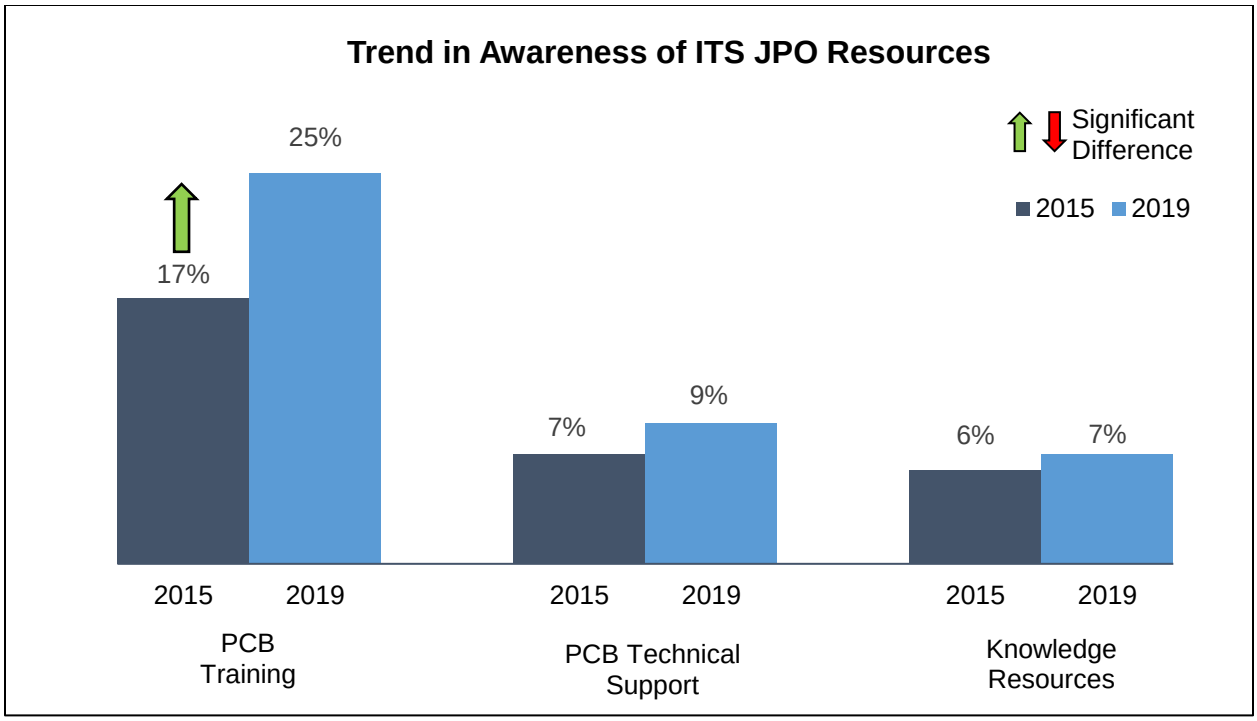
Source: USDOT

Q: Are you aware of [training, technical support, knowledge resources]? Has your organization used [training, technical support, knowledge resources]?

Figure 27. Use of ITS JPO Resources

Compared to the 2015 survey, there has been an increase in awareness of the PCB program (from 17 percent to 25 percent); however, awareness of PCB Technical Support and the Knowledge Resources has not changed (see Figure 28).[16]

[16] The GAO did not report usage of ITS JPO resources because the percentages were so small, so the research team can only compare awareness.



Source: USDOT

Q: Are you aware of [training, technical support, knowledge resources]?

Figure 28. Trend in Awareness of ITS JPO Resources

The survey also included questions assessing the helpfulness of the ITS JPO resources. Given the small numbers using the PCB Technical Support and the Knowledge Resources (fewer than 10 respondents), the findings are not reported. For the PCB Training Program, the number responding is also quite small (N=37), so results should be interpreted with caution. Among this small group of users, 60 percent indicated the PCB Training Program was very helpful, 33 percent said moderately helpful, and 8 percent said somewhat helpful.

Chapter 4. Conclusions and Next Steps

The 2019 ITS JPO Small Urban and Rural Transit Survey addresses the GAO recommendation to track ITS deployment in small urban and rural areas. The GAO also recommended that the ITS JPO "develop a strategy to raise awareness of ITS JPO's training, technical assistance, and knowledge resources for transit ITS deployment in the transit community." During the period 2016 to 2019, the ITS JPO has undertaken a number of efforts to address this recommendation, including:

- Participating in the ITS Rural Conference and Special Interest Group
- Offering courses with a rural focus (e.g., ITS for Safety Course)
- Sponsoring Rural ITS webinars (e.g. Connected Vehicles and Rural Road Weather Management)
- Disseminating an ITS Evaluation Executive Briefing on Rural Transportation Safety (2019)

This chapter summarizes the main conclusions from the survey, and presents possible next steps for the ITS JPO and FTA.

Conclusions

Small urban and rural transit providers are increasingly employing advanced communication systems and ITS technologies in transit operations. In 2019, most surveyed agencies report use of cellular telephone communications and internet service, which has enabled significant growth in the use of smartphones for transit communications, operations, and vehicle location. Four of the nine ITS technologies surveyed saw growth in use from 2015 to 2019, but the proportion of agencies using each ITS technology varies considerably. Most agencies are using Security Cameras and Systems (SCS) and Automatic Vehicle Location (AVL) technologies, but the remaining seven ITS technologies show moderate to low use.

The survey shows that use of ITS technologies differs by agency type. Small urban providers tend to use more ITS overall, and show higher use of ITS technologies more associated with bus service and less associated with demand response (e.g., Electronic Fare Payment (EFP) and Automatic Passenger Counters (APC)). Moving forward, FTA and USDOT should be conscious of differences in the transit needs and possibly resources between small urban and rural agencies.

Survey data on reasons for non-use can provide direction on how to increase ITS technology adoption. Difficulty getting funding for operational costs and high ITS technology costs are the most cited reasons. For ITS technologies such as Computer-Aided Dispatch (CAD) and Transit Information Systems, issues related to technical complexity could also be preventing use. Additionally, there are two low-use ITS technologies, Transit Signal Priority (TSP) and Automatic Passenger Counters (APC), where many non-users do not see a current need for the ITS technology.

Likewise, when asked about the challenges of deploying ITS technologies, limited funding opportunities and costs (e.g., operational, maintenance) were among the top challenges. In November of 2019, US Transportation Secretary Elaine L. Chao announced that FTA is awarding $423 million in transit infrastructure grants nationwide as part of its Grants for Buses and Bus Facilities Program (49 U.S.C.

5339). The grants—while infrastructure focused—may still encourage small urban and rural transit agencies to deploy ITS technologies so they can maximize the utility of their new assets.

Users of ITS technologies generally report that they find them useful, although some are deemed more useful than others. Mapping ITS technology use by usefulness shows that some ITS technologies are at the desired point of high use and usefulness, namely SCS and AVL. Others show middling use and usefulness, such a Traveler Information Systems, CAD, and Geographic Information Systems (GIS). One technology—EFP—shows a discrepancy between use and usefulness (e.g., low use but high usefulness). FTA/ITS JPO can use this information along with the reasons for non-use to develop support plans for priority ITS technologies.

The 2019 version of the Small Urban and Rural Transit Provider Survey included a new section on emerging technologies such as Connected Vehicles (CV) and Automated Vehicles (AV). While use of commercially available ITS technologies is increasing in smaller transit markets, CV and AV technologies are not yet making any headway.

ITS technologies are currently helping providers improve record keeping, enhance safety, improve efficiency, and increase customer satisfaction. Benefits that have not yet been realized include cost savings, reduced travel time, and increased ridership. In order to realize benefits it is important for agencies to measure short-term and long-term impacts of ITS technologies. Currently less than one-in-five agencies is able to quantitatively measure ITS benefits.

Use of USDOT resources for technical support and training continue to be low in 2019. Awareness is low for the ITS PCB Training and Technical Support, as well as for ITS JPO Knowledge Resources.

Next Steps

Based on the findings from the survey, the research team has developed a series of suggestions that the ITS JPO (and FTA) might consider when moving forward. Results of the survey demonstrate the need for continued support of small urban and rural transit providers in order to accelerate the deployment of ITS. With this goal in mind, a number of suggested next steps revolve around increased outreach to small urban and rural transit providers, and those organizations that work with them. In addition, follow-on research is also suggested in order to better understand agencies' needs and thus more effectively target support over time.

1. ***ITS JPO should consider revising the DTS sampling methodology to better account for small urban and rural areas.***

The 2019 ITS JPO Small Urban and Rural Transit Survey addresses the GAO recommendation to track ITS deployment in small urban and rural areas. Historically, the ITS JPO DTS have measured the deployment of ITS in large and medium sized metropolitan areas, and have not included small urban or rural areas. The ITS JPO is currently redesigning its DTS sampling methodology to address this gap, so that in the future, the survey population will include small urban and rural agencies. This will enable the ITS JPO to continue to track ITS deployment among small urban and rural transit providers.

2. ***ITS JPO could conduct more targeted outreach to small urban and rural transit agencies as part of its overall evaluation and technology transfer approach for emerging technologies (such as AV, CV, and new mobility services).***

The survey found that a relatively small number of small urban and rural agencies are aware of and using ITS JPO resources. By starting a line of communication with small urban and rural transit agencies, the ITS JPO can increase awareness of the many resources it has to offer transit providers. In addition, the survey found that small urban and rural transit providers have very specific needs and often operate in very different contexts. The ITS JPO should tailor its outreach to small urban and rural transit providers, acknowledging the different context(s) in which small urban and rural providers operate. The ITS JPO may want to establish a database of small urban and rural transit providers to facilitate information sharing specifically with this group, and/or it could create an "opt-in" mailing list for special outreach events like webinars and training opportunities. The ITS JPO should coordinate these efforts with FTA and the FTA regional offices.

In the near term, two specific and related activities could include (among other possible activities):

- **Develop a one to two page summary of findings from this survey and distribute it to small urban and rural transit provider contacts in the National Transit Database (NTD).**

- **Conduct a webinar that highlights survey findings, targeting small urban and rural transit providers, and State DOT and FTA staff who work with small urban and rural transit agencies**. The webinar would provide the opportunity to hear directly from small urban and rural transit agencies regarding the survey findings, and would offer insight on the type of support that they need. In addition, the webinar offers FTA regional offices the opportunity to learn about the survey findings, to better support small urban and rural transit agencies. The ITS JPO should work with FTA to coordinate a widely-advertised webinar, ideally reaching out to all small urban and rural transit agencies in the NTD.

Other targeted outreach activities that the ITS JPO or FTA could undertake include:

- Facilitate peer exchanges among small urban and rural transit agencies deploying ITS.
- Share evaluation best practices and performance measurement guidance.

3. ***ITS JPO should consider conducting additional qualitative research, such as case studies with small urban and rural transit agencies.***

Case studies with small urban and rural agencies would allow ITS JPO and FTA to better understand their needs with respect to certain ITS technologies, including GIS, Traveler Information Systems, CAD, EFP, and MMS. These ITS technologies had middling or lower use, although their usefulness ratings were positive (particularly EFP). For some ITS technologies, such as Traveler Information Systems and CAD, technological complexity appears to be a reason for non-use so case studies would provide the opportunity to explore these challenges, as well as others (such as cost) in more detail. In addition, for rural areas that tend to rely more heavily on demand response systems, it would be helpful to better understand whether and how ITS technologies such as GIS, Traveler Information Systems, and EFP can serve their needs. Finally, case studies could provide insight on the decline in use and usefulness of MMS. The case study explorations could then be fed into the ITS JPO outreach efforts (see #1 and #2 above).

References

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National Transit Database (NTD), *2017 Revenue Vehicle Inventory* https://www.transit.dot.gov/ntd/data-product/2017-annual-database-revenue-vehicle-inventory

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Appendix A. 2019 Questionnaire

Introduction

Welcome to the 2019 ITS Survey of Transit Providers Serving Small Urban and Rural Areas. The survey collects information on how transit providers are using electronics, communications, or information processing technologies — collectively known as Intelligent Transportation Systems (ITS) — in their operations.

The survey should take about 15 to 20 minutes to complete, depending on your responses to the questions. Thank you in advance for your support; your participation is a crucial part of the value of this survey.

ITS JPO will not attribute survey responses to individual respondents or otherwise disclose them to the public, and will generally present only aggregate survey results in our reports.

If you have any questions or difficulty accessing or completing the online survey, please contact Lora Chajka-Cadin at TransitProviderSurvey@dot.gov or 617-494-3675.

Communication Technologies

1. Do transit personnel at your organization use any of the following technologies or systems to assist in providing transit services? *(Select one response per row)*

		Yes	No	Not applicable
a.	Two-way radios	○	○	○
b.	Mobile data terminals (MDTs)	○	○	○
c.	Wireless local area networks (WLAN)	○	○	○
d.	Cellular telephone communications	○	○	○
e.	Land line telephone networks	○	○	○
f.	Internet	○	○	○
g.	Satellite phones	○	○	○
h.	Other communication technologies	○	○	○

		Yes	No	Not applicable
	You selected other communications technologies please provide a brief description.	No data	No data	No data

2. Do transit personnel at your organization use smart phones for any of the following functions? (Select one response per row)

		Yes	No	Not applicable
a.	Communications, for providing transit services	○	○	○
b.	Vehicle location	○	○	○
c.	Scheduling	○	○	○
d.	Operations management	○	○	○
e.	Other functions	○	○	○
	You selected other functions, please provide a brief description.	No data	No data	No data

ITS Technology Batteries

Computer-Aided Dispatch

Computer-Aided Dispatch (CAD) technology provides a number of functions, but the key component is automating the scheduling and dispatch function of a transit agency. CAD typically consists of software that incorporates transit routes, schedules, trip orders, and vehicle assignments. Some software packages can assign trips to vehicles and generate routes in real time. CAD is often used with Automatic Vehicle Location.

3. Is your organization currently using Computer-Aided Dispatch (CAD)? (Select one)
   - ○ Yes [ANSWER BATTERY 3_1]
   - ○ No [ANSWER BATTERY 3_2]
   - ○ I am not familiar with this technology [SKIP TO QUESTION 4]

Battery 3_1

3_1a. For which of the following services does your organization use CAD? ***(Select all that apply.)***

- □ **Bus** *(fixed-route and/or deviated-fixed-route)*
- □ **Commuter bus** *(fixed-route bus systems that are primarily connecting outlying areas)*
- □ **Demand-Response** *(scheduled in response to calls from passengers; includes paratransit, door-to-door, and curb-to-curb services)*
- □ **Vanpool** *(commuting service operating under pre-arranged schedules for previously formed groups of riders in vans)*
- □ Other

You selected other (services), please specify:_____

3_1b. Overall, how useful has CAD been for your organization? ***(Select one)***

- ○ Very useful
- ○ Moderately useful
- ○ Somewhat useful
- ○ Little to no use
- ○ Too soon to tell
- ○ Don't know

Battery 3_2

3_2a. Why is your organization not using CAD? ***(Select one response per row)***

	Reason	Not a Reason	Not Applicable
No perceived need	○	○	○
Cost of technology is too great	○	○	○
Lack of funding for operational costs	○	○	○
Lack of support from leadership and/or decision-makers	○	○	○
Lack of technical expertise in workforce	○	○	○
Difficult to integrate technology with current systems	○	○	○

	Reason	Not a Reason	Not Applicable
Costs of technology unclear	○	○	○
Benefits of technology unclear	○	○	○
Vendor issues	○	○	○
Other	○	○	○
You selected other (reason), please provide a brief description.	No data	No data	No data

3.2b. Does your organization currently plan to deploy CAD in the next five years? ***(Select one)***
- ○ Yes
- ○ No
- ○ Don't know

Automatic Vehicle Location

Automatic Vehicle Location is a computer-based vehicle tracking system that uses location technology (typically GPS satellites) and a wireless data communications system to transmit the real-time location from the vehicle to a transit operations center. Automatic Vehicle Location is often used with Computer-Aided Dispatch.

4. Is your organization currently using Automatic Vehicle Location? ***(Select one)***
- ○ Yes [ANSWER BATTERY 4_1]
- ○ No [ANSWER BATTERY 4_2]
- ○ I am not familiar with this technology [SKIP TO QUESTION 5]

BATTERY 4_1

4_1a. For which of the following services does your organization use Automatic Vehicle Location? ***(Select all that apply.)***

- □ **Bus** *(fixed-route and/or deviated-fixed-route)*
- □ **Commuter bus** *(fixed-route bus systems that are primarily connecting outlying areas)*
- □ **Demand-Response** *(scheduled in response to calls from passengers; includes paratransit, door-to-door, and curb-to-curb services)*
- □ **Vanpool** *(commuting service operating under pre-arranged schedules for previously formed groups of riders in vans)*

□ Other
- You selected other (services), please specify:_____

4_1b. Overall, how useful has Automatic Vehicle Location been for your organization? ***(Select one)***

- ○ Very useful
- ○ Moderately useful
- ○ Somewhat useful
- ○ Little to no use
- ○ Too soon to tell
- ○ Don't know

BATTERY 4_2

4_2a. Why is your organization not using Automatic Vehicle Location? ***(Select one response per row)***

	Reason	Not a Reason	Not Applicable
No perceived need	○	○	○
Cost of technology is too great	○	○	○
Lack of funding for operational costs	○	○	○
Lack of support from leadership and/or decision-makers	○	○	○
Lack of technical expertise in workforce	○	○	○
Difficult to integrate technology with current systems	○	○	○
Costs of technology unclear	○	○	○
Benefits of technology unclear	○	○	○
Vendor issues	○	○	○
Other	○	○	○
You selected other (reason), please provide a brief description.	No data	No data	No data

4.2b. Does your organization currently plan to deploy Automatic Vehicle Location in the next five years? ***(Select one)***

- ○ Yes
- ○ No
- ○ Don't know

Geographic Information Systems (GIS)

GIS is a computer mapping application that displays and analyzes the spatial relationship of different data such as vehicle routes, trip pick-up and drop-off points, transit stops, streets, landmarks, and terrain characteristics. GIS is often used to graphically display Automatic Vehicle Location data.

5. Is your organization currently using Geographic Information Systems (GIS)? ***(Select one)***
   - ○ Yes [ANSWER BATTERY 5_1]
   - ○ No [ANSWER BATTERY 5_2]
   - ○ I am not familiar with this technology [SKIP TO QUESTION 6]

BATTERY 5_1

5_1a. For which of the following services does your organization use GIS? ***(Select all that apply.)***

- □ **Bus** *(fixed-route and/or deviated-fixed-route)*
- □ **Commuter bus** *(fixed-route bus systems that are primarily connecting outlying areas)*
- □ **Demand-Response** *(scheduled in response to calls from passengers; includes paratransit, door-to-door, and curb-to-curb services)*
- □ **Vanpool** *(commuting service operating under pre-arranged schedules for previously formed groups of riders in vans)*
- □ Other
  - You selected other (services), please specify:_____

5_1b. Overall, how useful has GIS been for your organization? (***Select one)***

- ○ Very useful
- ○ Moderately useful
- ○ Somewhat useful
- ○ Little to no use
- ○ Too soon to tell
- ○ Don't know

BATTERY 5_2

5_2a. Why is your organization not using GIS? ***(Select one response per row)***

	Reason	Not a Reason	Not Applicable
No perceived need	○	○	○
Cost of technology is too great	○	○	○
Lack of funding for operational costs	○	○	○

	Reason	Not a Reason	Not Applicable
Lack of support from leadership and/or decision-makers	○	○	○
Lack of technical expertise in workforce	○	○	○
Difficult to integrate technology with current systems	○	○	○
Costs of technology unclear	○	○	○
Benefits of technology unclear	○	○	○
Vendor issues	○	○	○
Other	○	○	○
You selected other (reason), please provide a brief description.	No data	No data	No data

5_2b. Does your organization currently plan to deploy GIS in the next five years? ***(Select one)***

- ○ Yes
- ○ No
- ○ Don't know

Security Cameras and/or Security Systems

Security Cameras and Systems are used to enhance the security, and possibly the safety, of transit customers, personnel, and equipment, using technologies such as radio communications, audio surveillance, silent alarms, covert microphones, closed circuit television cameras, and other equipment.

6. Is your organization currently using Security Cameras and/or Security Systems? ***(Select one)***
   - ○ Yes [ANSWER BATTERY 6_1]
   - ○ No [ANSWER BATTERY 6_2]
   - ○ I am not familiar with this technology [SKIP TO QUESTION 7]

BATTERY 6_1

6_1a. Which of the following types of Security Cameras and/or Security Systems have you deployed? ***(Select all that apply.)***

- □ Closed circuit television cameras
- □ Silent alarms
- □ Audio surveillance

- □ Object detection sensors
- □ Covert microphones
- □ Other
  - You selected other (security cameras/systems), please specify

6_1b. For which of the following services does your organization use Security Cameras and/or Security Systems? ***(Select all that apply)***

- □ **Bus** *(fixed-route and/or deviated-fixed-route)*
- □ **Commuter bus** *(fixed-route bus systems that are primarily connecting outlying areas)*
- □ **Demand-Response** *(scheduled in response to calls from passengers; includes paratransit, door-to-door, and curb-to-curb services)*
- □ **Vanpool** *(commuting service operating under pre-arranged schedules for previously formed groups of riders in vans)*
- □ Other
  - You selected other (services), please specify:_____

6_1c. Overall, how useful have Security Cameras and/or Security Systems been for your organization? ***(Select one)***

- ○ Very useful
- ○ Moderately useful
- ○ Somewhat useful
- ○ Little to no use
- ○ Too soon to tell
- ○ Don't know

BATTERY 6_2

6_2a. Why is your organization not using Security Cameras and/or Security Systems? ***(Select one response for each row)***

	Reason	Not a Reason	Not Applicable
No perceived need	○	○	○
Cost of technology is too great	○	○	○
Lack of funding for operational costs	○	○	○
Lack of support from leadership and/or decision-makers	○	○	○
Lack of technical expertise in workforce	○	○	○
Difficult to integrate technology with current systems	○	○	○
Costs of technology unclear	○	○	○

	Reason	Not a Reason	Not Applicable
Benefits of technology unclear	○	○	○
Vendor issues	○	○	○
Other	○	○	○
You selected other (reason), please provide a brief description.	No data	No data	No data

6_2b. Does your organization currently plan to deploy Security Cameras and/or Security Systems in the next five years? ***(Select one)***

- ○ Yes
- ○ No
- ○ Don't know

Maintenance Management Systems

Maintenance Management Systems monitor everything from fuel and other fluid levels to engine temperature using information from other ITS systems, such as Automatic Vehicle Location and CAD. Systems may include engine and drivetrain systems monitoring.

7. Is your organization currently using Maintenance Management Systems? ***(Select one)***

- ○ Yes [ANSWER BATTERY 7_1]
- ○ No [ANSWER BATTERY 7_2]
- ○ I am not familiar with this technology [SKIP TO QUESTION 8]

BATTERY 7_1

7_1a. For which of the following services does your organization use Maintenance Management Systems? (Select all that apply.)

- □ **Bus** *(fixed-route and/or deviated-fixed-route)*
- □ **Commuter bus** *(fixed-route bus systems that are primarily connecting outlying areas)*
- □ **Demand-Response** *(scheduled in response to calls from passengers; includes paratransit, door-to-door, and curb-to-curb services)*
- □ **Vanpool** *(commuting service operating under pre-arranged schedules for previously formed groups of riders in vans)*
- □ Other
  - You selected other (services), please specify:_____

b. Overall, how useful have Maintenance Management Systems been for your organization? ***(Select one)***

- ○ Very useful
- ○ Moderately useful
- ○ Somewhat useful
- ○ Little to no use
- ○ Too soon to tell
- ○ Don't know

BATTERY 7_2

7_2a. Why is your organization not using Maintenance Management Systems? ***(Select one response per row)***

	Reason	Not a Reason	Not Applicable
No perceived need	○	○	○
Cost of technology is too great	○	○	○
Lack of funding for operational costs	○	○	○
Lack of support from leadership and/or decision-makers	○	○	○
Lack of technical expertise in workforce	○	○	○
Difficult to integrate technology with current systems	○	○	○
Costs of technology unclear	○	○	○
Benefits of technology unclear	○	○	○
Vendor issues	○	○	○
Other	○	○	○
You selected other (reason), please provide a brief description.	No data	No data	No data

7_2b. Does your organization currently plan to deploy Maintenance Management Systems in the next five years? ***(Select one)***

- ○ Yes
- ○ No
- ○ Don't know

Traveler Information Systems

Traveler Information Systems enable transit customers to receive travel information regarding various modes of transit or other types of transportation that the traveler may take. Systems may include any of the following:

- Onboard internet access,
- Text messaging/email,
- Variable message signs,
- Automated phone service (such as interactive voice response,511),
- Audible annunciators,
- In-vehicle displays,
- Trip planners
- Smartphone applications. (transit-agency owned, third party owned)
- Websites (transit agency owned, third party owned), or
- Social media (e.g., Facebook, Twitter, etc.)

8. Is your organization currently using Traveler Information Systems? ***(Select one)***
   - ○ Yes [ANSWER BATTERY 8_1]
   - ○ No [ANSWER BATTERY 8_2]
   - ○ I am not familiar with this technology [SKIP TO QUESTION 9]

BATTERY 8_1

8a. Which of the following types of Traveler Information Systems have you deployed? ***(Select all that apply.)***

- □ Onboard internet access
- □ Text messaging/email
- □ Variable message signs
- □ Automated phone service (such as interactive voice response, 511)
- □ Audible annunciators
- □ In-vehicle displays
- □ Trip planners
- □ Smartphone applications (transit-agency owned, third party owned)
- □ Websites (transit-agency owned, third party owned)
- □ Social medial (e.g, Facebook, Twitter, etc.)
- □ Other (please specify)
  - You selected other (traveler information systems), please specify

a. For which of the following services does your organization use Traveler Information Systems? ***(Select all that apply.)***

- □ **Bus** *(fixed-route and/or deviated-fixed-route)*
- □ **Commuter bus** *(fixed-route bus systems that are primarily connecting outlying areas)*
- □ **Demand-Response** *(scheduled in response to calls from passengers; includes paratransit, door-to-door, and curb-to-curb*

services)

- □ **Vanpool** *(commuting service operating under pre-arranged schedules for previously formed groups of riders in vans)*
- □ Other
  - You selected other (services), please specify:_____

c. Overall, how useful have Traveler Information Systems been for your organization? ***(Select one)***

- ○ Very useful
- ○ Moderately useful
- ○ Somewhat useful
- ○ Little to no use
- ○ Too soon to tell
- ○ Don't know

BATTERY 8_2

8_2a. Why is your organization not using Traveler Information Systems? ***(Select one response per row)***

	Reason	Not a Reason	Not Applicable
No perceived need	○	○	○
Cost of technology is too great	○	○	○
Lack of funding for operational costs	○	○	○
Lack of support from leadership and/or decision-makers	○	○	○
Lack of technical expertise in workforce	○	○	○
Difficult to integrate technology with current systems	○	○	○
Costs of technology unclear	○	○	○
Benefits of technology unclear	○	○	○
Vendor issues	○	○	○
Other	○	○	○
You selected other (reason), please provide a brief description.	No data	No data	No data

8_2b. Does your organization currently plan to deploy Traveler Information Systems in the next five years? **(*Select one)***

- ○ Yes
- ○ No
- ○ Don't know

Automatic Passenger Counters

Automatic Passenger Counters are electronic devices installed on transit vehicles that are used to count the number of passengers boarding and alighting.

9. Is your organization currently using Automatic Passenger Counters? ***(Select one)***
   - ○ Yes [ANSWER BATTERY 9_1]
   - ○ No [ANSWER BATTERY 9_2]
   - ○ I am not familiar with this technology [SKIP TO QUESTION 10]

BATTERY 9_1

9_1a. For which of the following services does your organization use Automatic Passenger Counters? ***(Select all that apply.)***

- □ **Bus** *(fixed-route and/or deviated-fixed-route)*
- □ **Commuter bus** *(fixed-route bus systems that are primarily connecting outlying areas)*
- □ **Demand-Response** *(scheduled in response to calls from passengers; includes paratransit, door-to-door, and curb-to-curb services)*
- □ **Vanpool** *(commuting service operating under pre-arranged schedules for previously formed groups of riders in vans)*
- □ Other
  - You selected other (services), please specify:_____

b. Overall, how useful have Automatic Passenger Counters been for your organization? ***(Select one)***
   - ○ Very useful
   - ○ Moderately useful
   - ○ Somewhat useful
   - ○ Little to no use
   - ○ Too soon to tell
   - ○ Don't know

BATTERY 9_2

*9_2*a. Why is your organization not using Automatic Passenger Counters? ***(Select one response per row)***

	Reason	Not a Reason	Not Applicable
No perceived need	○	○	○
Cost of technology is too great	○	○	○
Lack of funding for operational costs	○	○	○
Lack of support from leadership and/or decision-makers	○	○	○
Lack of technical expertise in workforce	○	○	○
Difficult to integrate technology with current systems	○	○	○
Costs of technology unclear	○	○	○
Benefits of technology unclear	○	○	○
Vendor issues	○	○	○
Other	○	○	○
You selected other (reason), please provide a brief description.	No data	No data	No data

9_2b. Does your organization currently plan to deploy Automatic Passenger Counters in the next five years? ***(Select one)***

- ○ Yes
- ○ No
- ○ Don't know

Electronic Fare Payment

Electronic Fare Payment provides an automated means of collecting and processing fares for public transportation services such as bus, rail, ferry and other modes. Systems may include magnetic stripe cards, smart cards, contactless credit card, mobile payment or mobile tickets, and automated fareboxes and faregates.

10. Is your organization currently using Electronic Fare Payment? **(*Select one)***
    - ○ Yes [ANSWER BATTERY 10_1]
    - ○ No [ANSWER BATTERY 10_2]
    - ○ I am not familiar with this technology [SKIP TO QUESTION 11]

BATTERY 10_1

10_1a. For which of the following services does your organization use Electronic Fare Payment? ***(Select all that apply.)***

- □ **Bus** *(fixed-route and/or deviated-fixed-route)*
- □ **Commuter bus** *(fixed-route bus systems that are primarily connecting outlying areas)*
- □ **Demand-Response** *(scheduled in response to calls from passengers; includes paratransit, door-to-door, and curb-to-curb services)*
- □ **Vanpool** *(commuting service operating under pre-arranged schedules for previously formed groups of riders in vans)*
- □ Other
  - You selected other (services), please specify:_____

b. Overall, how useful has Electronic Fare Payment been for your organization? ***(Select one)***
   - ○ Very useful
   - ○ Moderately useful
   - ○ Somewhat useful
   - ○ Little to no use
   - ○ Too soon to tell
   - ○ Don't know

BATTERY 10_2

10_2a. Why is your organization not using Electronic Fare Payment? ***(Select one response per row)***

	Reason	Not a Reason	Not Applicable
No perceived need	○	○	○
Cost of technology is too great	○	○	○
Lack of funding for operational costs	○	○	○
Lack of support from leadership and/or decision-makers	○	○	○
Lack of technical expertise in workforce	○	○	○
Difficult to integrate technology with current systems	○	○	○

	Reason	Not a Reason	Not Applicable
Costs of technology unclear	○	○	○
Benefits of technology unclear	○	○	○
Vendor issues	○	○	○
Other	○	○	○
You selected other (reason), please provide a brief description.	No data	No data	No data

10_2b. Does your organization currently plan to deploy Electronic Fare Payment in the next five years? ***(Select one)***

- ○ Yes
- ○ No
- ○ Don't know

Transit Signal Priority

Transit Signal Priority includes the use of sensors and/or traffic signal timing to detect approaching transit vehicles and grant them priority passage at an intersection.

11. Is your organization currently using Transit Signal Priority? ***(Select one)***
    - ○ Yes [ANSWER BATTERY 11_1]
    - ○ No [ANSWER BATTERY 11_2]
    - ○ I am not familiar with this technology [SKIP TO QUESTION 12]

BATTERY 11_1

11_1a. For which of the following services does your organization use Transit Signal Priority? ***(Select all that apply.)***

- □ **Bus** *(fixed-route and/or deviated-fixed-route)*
- □ **Commuter bus** *(fixed-route bus systems that are primarily connecting outlying areas)*
- □ **Demand-Response** *(scheduled in response to calls from passengers; includes paratransit, door-to-door, and curb-to-curb services)*
- □ **Vanpool** *(commuting service operating under pre-arranged schedules for previously formed groups of riders in vans)*
- □ Other
    - You selected other (services), please specify:_____

b. Overall, how useful has Transit Signal Priority been for your organization**?** ***(Select one)***

- ○ Very useful
- ○ Moderately useful
- ○ Somewhat useful
- ○ Little to no use
- ○ Too soon to tell
- ○ Don't know

BATTERY 11_2

11_2a. Why is your organization not using Transit Signal Priority**?** ***(Select one response per row)***

	Reason	Not a Reason	Not Applicable
No perceived need	○	○	○
Cost of technology is too great	○	○	○
Lack of funding for operational costs	○	○	○
Lack of support from leadership and/or decision-makers	○	○	○
Lack of technical expertise in workforce	○	○	○
Difficult to integrate technology with current systems	○	○	○
Costs of technology unclear	○	○	○
Benefits of technology unclear	○	○	○
Vendor issues	○	○	○
Other	○	○	○
You selected other (reason), please provide a brief description.	No data	No data	No data

11_2b. Does your organization currently plan to deploy Transit Signal Priority in the next five years? ***(Select one)***

- ○ Yes
- ○ No
- ○ Don't know

Emerging Technologies

In this next section, you will see questions about emerging technologies such as Connected Vehicles and Automated Vehicles.

Connected Vehicle

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.

12. Is your agency currently deploying connected vehicle (CV) technology? ***(Select one)***

- ○ Yes [SKIP TO Q12a]
- ○ No, but plan to deploy in the future
- ○ No plans to deploy [SKIP TO Q14]
- ○ Don't know [SKIP TO Q14]

a. [If Q12=OPTION1] **Please briefly describe your CV deployments.**

13. [Q12=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

Automated Vehicle/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** 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.

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

- ○ Yes (completed or in progress)
- ○ No [SKIP TO 16]
- ○ Don't know [SKIP TO 16]

15. **[IF Q14=OPTION 1]** What is your agency's primary role in the automated vehicle testing or deployment? ***(Select one)***

- ○ Agency is/was leading the automated vehicle testing/deployment
- ○ Agency is/was supporting the planning or execution of the automated vehicle testing/deployment
- ○ Agency is not involved in the automated vehicle testing/deployment
- ○ Other *(please specify)*

a. **[IF Q15=OPTION 1 OR 2]** Please describe your activities with respect to automated vehicle testing or deployment.

16. **[IF Q14 = 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 Q17]
- ○ Don't know [SKIP TO Q17]

a. [IF Q16 = 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

Mobility Service Provider Partnerships (Mobility on Demand)

17. Does your agency partner with private transportation service providers? **(Select all that apply)**
- □ Yes, for paratransit services
- □ Yes, for other services –
- □ No
- □ Don't know/Not sure

Q17a. [IF YES- PARATRANSIT] With which paratransit service(s) does your agency partner? *Select all that apply.*

- □ Human services providers
- □ Ridesourcing (Uber/Lyft)
- □ Microtransit
- □ Taxis
- □ Other (please specify:_____)

Q17b. [IF YES –OTHER] With which other service(s) does your agency partner? *Select all that apply.*

- □ Ridesourcing (Uber/Lyft)
- □ Bikesharing
- □ Microtransit
- □ Taxis
- □ Other (please specify:_____)

Costs

18. Did your organization experience any unexpected costs when deploying, operating, or maintaining any of the technologies listed in this survey?(***Select one)***
- ○ Yes
- ○ No (SKIP TO Q20]
- ○ Don't know (SKIP TO Q20]

19. If yes, what types of unexpected costs did your organization incur?
_____

Benefits

20. In your opinion, to what extent has your organization realized any of the following benefits from deploying any of the ITS technologies listed in this survey?

	Great benefit	Slight benefit	No benefit	Too soon to tell	Not applicable
Reduced travel times	○	○	○	○	○
Reduced wait times	○	○	○	○	○
Cost savings	○	○	○	○	○
Enhanced safety	○	○	○	○	○
Increased ridership	○	○	○	○	○
Improvement in on-time performance and schedule adherence	○	○	○	○	○
More efficient scheduling and routing	○	○	○	○	○
More efficient staffing	○	○	○	○	○
Improvements in record-keeping, reporting, or data analysis	○	○	○	○	○
Increased operator satisfaction	○	○	○	○	○
Increased customer satisfaction	○	○	○	○	○
Other benefits (*Please specify)*	○	○	○	○	○

21. Has your organization been able to quantitatively measure any benefits received from any of the technologies listed in this survey? ***(Select one)***
    - ○ Yes
    - ○ No (SKIP TO Q23]
    - ○ Don't know(SKIP TO Q23]

22. If yes, please describe the steps your organization took to measure these benefits. _____

23. How much of a challenge, if at all, were each of the following issues in your organization's deployment of any of the technologies listed in this survey? **(*Select one response per row)***

	Very great challenge	A great challenge	A moderate challenge	Somewhat of a challenge	Little or no challenge	Not applicable
Limited funding opportunities to pay for technology deployment	○	○	○	○	○	○
Operational costs	○	○	○	○	○	○
Maintenance costs	○	○	○	○	○	○
Competition for funding with other transportation projects outside your organization	○	○	○	○	○	○
Obtaining support for technologies from leadership and decision makers	○	○	○	○	○	○
Lack of technical expertise in workforce	○	○	○	○	○	○
Workforce apprehension to introduction of technology	○	○	○	○	○	○
Costs and/or benefits of technology are unclear	○	○	○	○	○	○
Integrating new technologies with current systems	○	○	○	○	○	○
Limited vendor support	○	○	○	○	○	○
Vendor technology solutions designed for larger-scale transit operations	○	○	○	○	○	○
Cybersecurity issues	○	○	○	○	○	○
Data management	○	○	○	○	○	○
Other *(please specify)*	○	○	○	○	○	○

Funding

24. Has your organization used any of the following funding sources for the deployment, operation, and/or maintenance of any of the technologies listed in this survey? ***((Select one response for each row)***

Please note: Federal funding sources may include MAP-21 formula programs (e.g., §5309, §5310, §5311, §5312, §5314, §5316, §5317, §5320, §5337, §5339), MAP-21 Discretionary Programs (e.g., Mobility Services for All Americans, Veterans Transportation and Community Living Initiative, and Tribal Transit Program), and funds from the American Recovery and Reinvestment Act (ARRA).

	Yes	**No**	**Don't Know**
Federal funding	○	○	○
State funding	○	○	○
Local funding	○	○	○
Private funding	○	○	○
Other (please specify)	○	○	○

Technical Support

25. Has your organization received technical support for the planning, deployment, operation, and/or maintenance of any of the technologies listed in this survey from any of the following entities? ***(Select one response for each row.)***

	Yes	No	Don't Know
Federal Transit Administration (FTA)	○	○	○
National Rural Transit Assistance Program (RTAP)	○	○	○
DOT ITS Joint Program Office (JPO)	○	○	○
State DOT	○	○	○

	Yes	No	Don't Know
Metropolitan planning organization (MPO)	○	○	○
ITS transit consultants	○	○	○
ITS transit vendors (such as RouteMatch, Trapeze, etc.)	○	○	○
Industry groups (such as CTAA, APTA, ITS America)	○	○	○
Other transit agencies	○	○	○
University centers (such as NTI-Rutgers, CUTR-USF)	○	○	○
Other organizations (Please specify)	○	○	○

ITS Joint Program Office

This section of the survey asks about your agency's use of training, technical assistance, or knowledge resources programs offered by the federal **ITS Joint Program Office (ITS JPO)**

The ITS JPO's Professional Capacity Building (PCB) Program provides the ITS workforce with ITS learning through training (offered by ITS PCB partners, such as National Transit Institute), technical assistance (Peer-to-Peer exchanges and webinars), and resource databases.

Training: ITS training offered by ITS PCB Program and its partners, including Center for ITS Training and Education (CITE), National Transit Institute (NTI), Institute of Transportation Engineers (ITE), and FHWA.

26. Are you aware of the training provided by the ITS PCB Program and/or its partners? **(*Select one)***
- ○ Yes
- ○ No [SKIP TO 27]
- ○ Don't know [SKIP TO 27]

26_1. Has your organization used training provided by the ITS PCB Program and/or its partners? **(*Select one)***

- ○ Yes

- ○ No [SKIP TO 27]
- ○ Don't know [SKIP TO 27]

26_2. How helpful was this training? **(*Select one)***

- ○ Very helpful
- ○ Moderately helpful
- ○ Somewhat helpful
- ○ A little or not at all helpful
- ○ Don't know

Technical assistance: The PCB Program provides technical assistance in the form of the ITS Peer-to-Peer Program and Talking Technology Transportation (T3) Webinars).

Q27. Are you aware of the technical assistance provided by the ITS PCB Program? **(*Select one)***

- ○ Yes
- ○ No [SKIP TO 28]
- ○ Don't know [SKIP TO 28]

Q27_1. Has your organization used the technical assistance program provided by the ITS PCB Program? **(*Select one)***

- ○ Yes
- ○ No [SKIP TO 28]
- ○ Don't know [SKIP TO 28]

Q27_2. How helpful was the technical assistance? **(*Select one)***

- ○ Very helpful
- ○ Moderately helpful
- ○ Somewhat helpful
- ○ A little or not at all helpful
- ○ Don't know

Knowledge Resources: ITS JPO Knowledge Resources include databases that offer a unique collection of reports, studies, technical documents, and instructional guides for planning, procuring, and deploying ITS. Four databases are available focused on ITS costs, benefits, lessons learned, and deployment statistics.

Q28. Are you aware of the knowledge resources provided by the ITSJPO? **(*Select one)***

- ○ Yes
- ○ No [SKIP TO END]
- ○ Don't know [SKIP TO END]

Q28_1. Has your organization used the knowledge resources provided by the ITS JPO? **(*Select one)***

- ○ Yes
- ○ No [SKIP TO END]
- ○ Don't know [SKIP TO END]

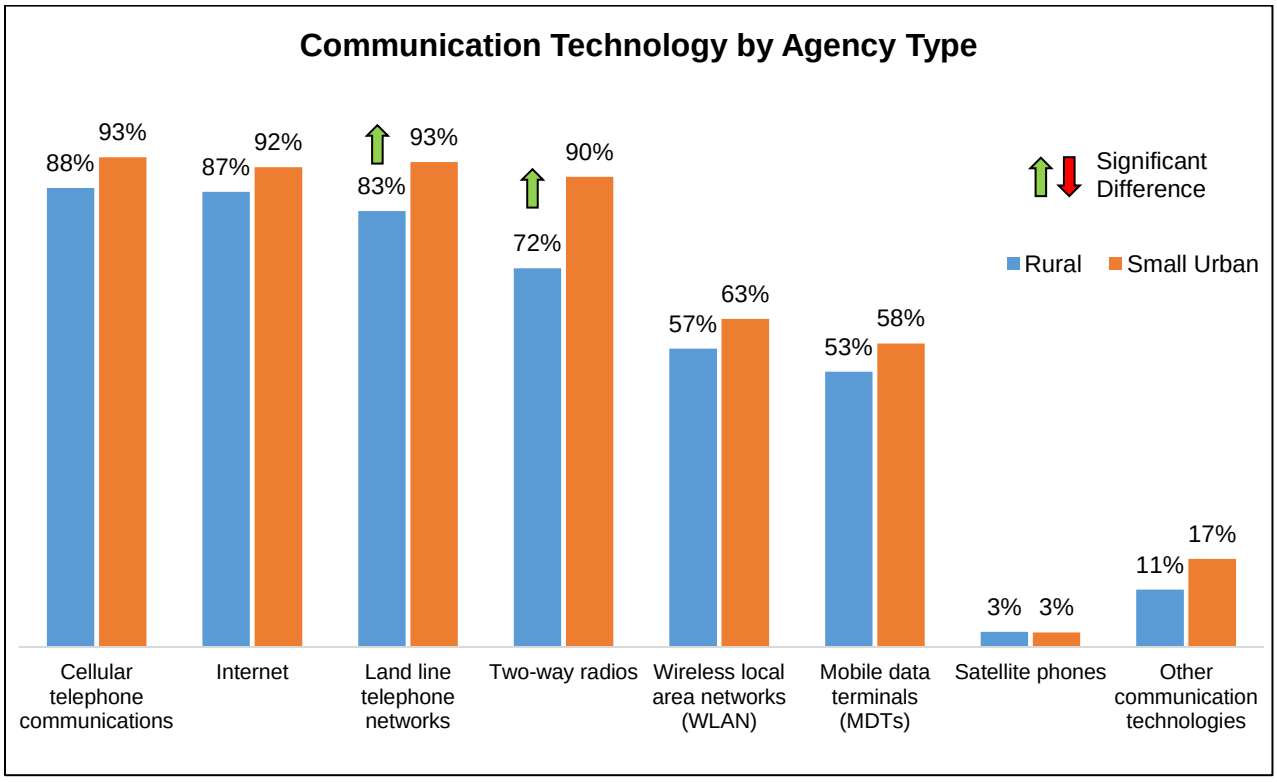
Q28_2. How helpful were these knowledge resources? **(*Select one)***

- ○ Very helpful
- ○ Moderately helpful
- ○ Somewhat helpful
- ○ A little or not at all helpful
- ○ Don't know

Q29. **Please enter any additional comments regarding this survey or your organization's experience with technology?**

Thank you for your participation!

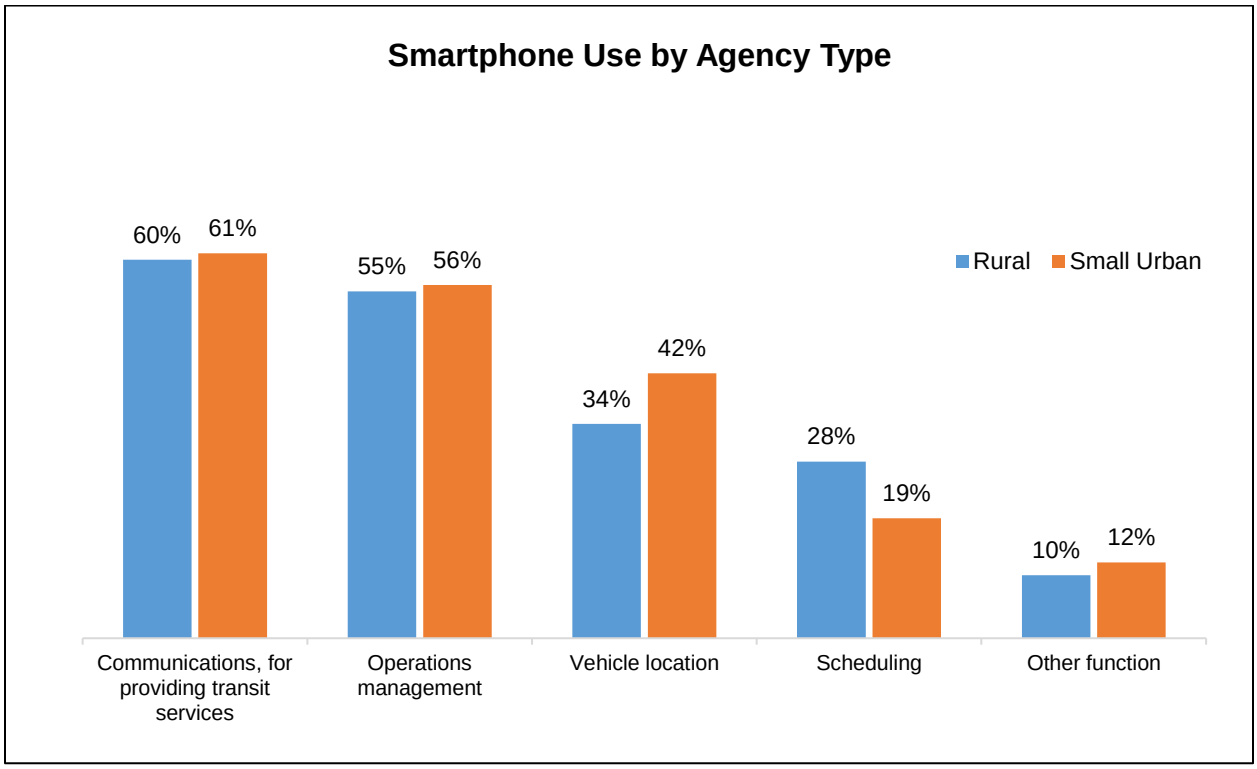
Appendix B. Additional Data Findings



Source: USDOT

Q. Do transit personnel at your organization use any of the following technologies or systems to assist in providing transit services? (% Yes)

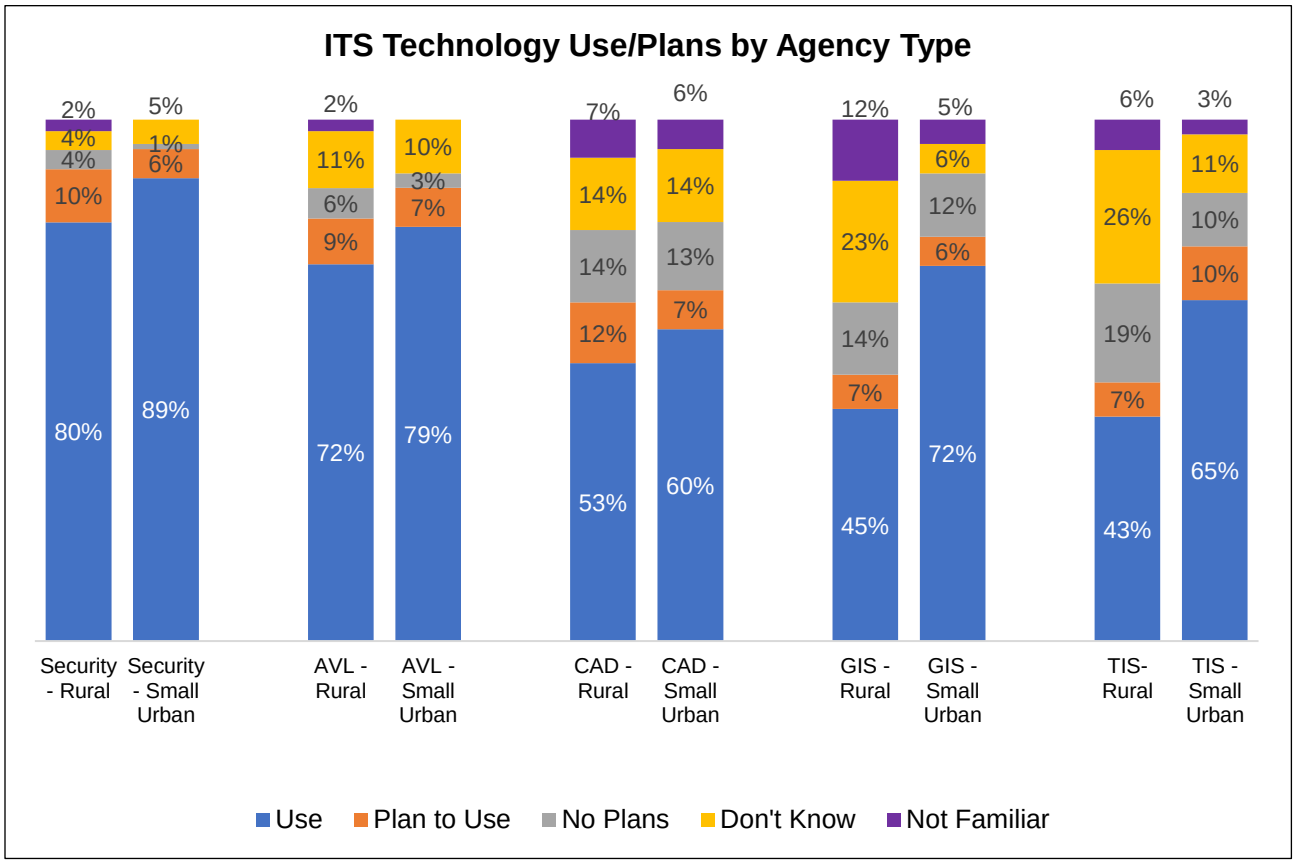
Appendix B. Communication Technology by Agency Type



Source: USDOT

Q; Do transit personnel at your organization use smartphones for any of the following functions? (% Yes)

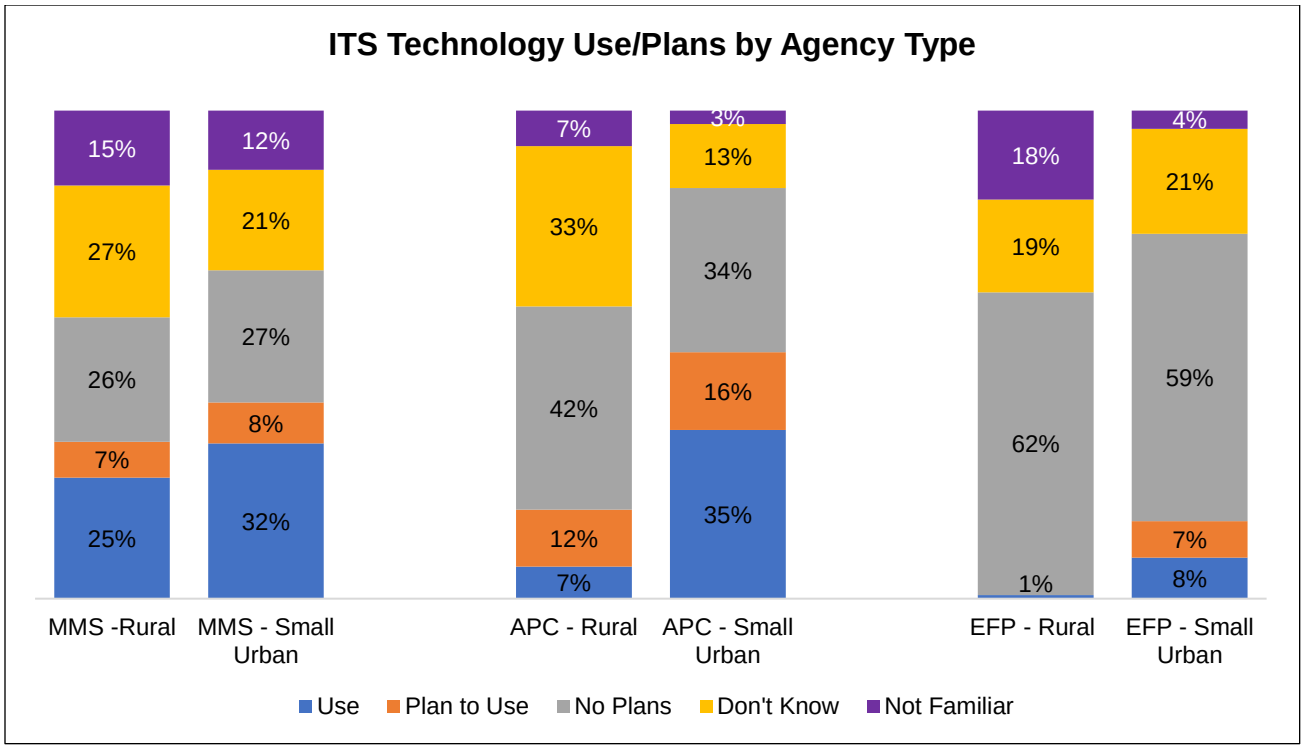
Appendix B. Use of Smartphone by Agency Type



Source: USDOT

Q. Is your organization currently using [TECHNOLOGY]? [If No] Does your agency currently plan to deploy [TECH.] in the next 5 years? TIS stands for Traveler Information Systems

Appendix B. High and Moderate Use ITS Technology by Agency Type



Source: USDOT

Q. Is your organization currently using [TECHNOLOGY]? [If No] Does your agency currently plan to deploy [TECH.] in the next 5 years?

Appendix B. Low Use ITS Technology by Agency Type

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