2025 Program Report

Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Program

May 2026

U.S. Department of Transportation

Federal Highway Administration

FOREWORD

The Fixing America's Surface Transportation Act, or FAST Act, Pub. L. No. 114-94 (2018) established the Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Program to make competitive grants for the deployment of advanced transportation technologies. This report fulfills the requirement of Section 503(c)(4)(G) of Title 23, United States Code, to make available to the public information that describes the effectiveness of grant recipients in meeting their ATCMTD projected deployment plans by posting an annual report on the U.S. Department of Transportation website. The report describes the effectiveness of grantees in meeting their projected deployment plans and presents findings on the safety, mobility, operational efficiency, and other effects of the technology deployments. It overviews fiscal year (FY) 2016, FY 2017, FY 2018, FY 2019, FY 2020, and FY 2021 ATCMTD projects with information as of March 31, 2025, including key technologies grantees are planning to deploy. The report also highlights performance measures grantees are using, as well as grantee insights and lessons learned regarding their technology deployments.

Cover photo: Alyson West, *A View of Wacker Drive at Dusk*, n.d. Available at PBIC Image Library (pedbikeimages.org), last accessed October 11, 2022.

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. FHWA-HOP-25-175	2. Government Accession No.	3. Recipient's Catalogue No.
4. Title and Subtitle 2025 Program Report: Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Program		5. Report Date May 2026 6. Performing Organization Code OST-R V-321
7. Author(s) Margaret Petrella, Anna Solow-Collins, Katya Garcia-Israel, Evelyn Aaron, Alison Cantor, and Mae Lewis-Workman		8. Performing Organization Report No. DOT-VNTSC-FHWA-25-08
9. Performing Organization Name and Address John A. Volpe National Transportation Systems Center 220 Binney Street Cambridge, MA 02142		10. Work Unit No. (TRAIS) 11. Contract or Grant No. See IAA
12. Sponsoring Agency Name and Address Office of Operations Federal Highway Administration 1200 New Jersey Avenue, SE Washington, DC 20590		13. Type of Report and Period Covered Final Report (April 2024–March 2025) 14. Sponsoring Agency Code HOTM-1
15. Supplementary Notes The ATCMTD program manager for this report was Jim Garling (jim.garling@dot.gov).		
16. Abstract The Fixing America's Surface Transportation (FAST) Act, Pub. L. No. 114-94 (2018) established the Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Program to make competitive grants for the deployment of advanced transportation technologies. The law directs that beginning 3 years after the first grant award and annually thereafter, the Secretary of Transportation shall post a report about the ATCMTD Program (23 United States Code § 503(c)(4)(G)) on the U.S. Department of Transportation website. The report should provide credible, useful information on the effectiveness of grantees in meeting their projected deployment plans, as well as findings on the safety, mobility, operational efficiency, and other effects of the technology deployments. This report represents the sixth report. It provides overviews of fiscal years 2016–2021 ATCMTD projects and describes the findings from one completed project. This report also highlights performance measures grantees are using, as well as grantee insights and lessons learned regarding their technology deployments.		
17. Key Words ATCMTD Program, FAST Act, ATCMTD grantees, performance measures	18. Distribution Statement No restrictions.	

19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 80	22. Price N/A

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1,000 L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2,000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2,000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	2.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Definition
ADOT	Arizona Department of Transportation
AI	artificial intelligence
AI-DSS	artificial intelligence-based decision support system
AI-ITMS	Artificial Intelligence-enhanced Integrated Transportation Management System
AI-TOMS	Artificial Intelligence-Based Transportation Operations Management System
ALDOT	Alabama Department of Transportation
app	application
ATCMTD	Advanced Transportation and Congestion Management Technologies Deployment
ATMS	advanced traffic management system
AV	automated vehicle
BCR	benefit-cost ratio
CAV	connected and automated vehicle
CCTV	closed-circuit television
CDOT	Colorado Department of Transportation
COG	Council of Governments
CSW	curve speed warning
CV	connected vehicle
C-V2X	cellular vehicle-to-everything
DAS	Distributed Acoustic Sensing
DelDOT	Delaware Department of Transportation

DMS	dynamic message sign
DOT	department of transportation
DSRC	dedicated short-range communication
DSS	decision support system
EV	electric vehicle
ER	emergency response
FAST Act	Fixing America's Surface Transportation Act
FCC	Federal Communications Commission
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
FRATIS	Freight Advanced Traveler Information System
FY	fiscal year
GDOT	Georgia Department of Transportation
HOV	high-occupancy vehicle
ICM	integrated corridor management
IMRCP	Integrated Modeling for Road Conditions Prediction
ITS	intelligent transportation system
IPv	Internet protocol version
LED	light-emitting diode
MaineDOT	Maine Department of Transportation
MDOT	Michigan Department of Transportation
ML	machine learning
MOD	mobility-on-demand

MoDOT	Missouri Department of Transportation
MWCOG	Metropolitan Washington Council of Governments
NCDOT	North Carolina Department of Transportation
NDDOT	North Dakota Department of Transportation
NDOT	Nebraska Department of Transportation
NFTA	Niagara Frontier Transportation Authority
NITTEC	Niagara International Transportation Technology Coalition
NW	Northwest
OBU	onboard unit
ODOT	Ohio Department of Transportation
PennDOT	Pennsylvania Department of Transportation
PLOI	Predictive Layered Operation Initiative
POV	Port of Virginia
PTI	planning time index
RDS	radar detection systems
RFID	radiofrequency identification
RSU	roadside unit
RTA	Regional Transit Authority
RWIS	road weather information system
SCMS	security credential management system
SDOT	Seattle Department of Transportation
SJTA	South Jersey Transportation Authority
SPaT	signal phase and timing

TDM	travel demand management
TDOT	Tennessee Department of Transportation
TIS	traveler information system
TMC	traffic management center
TRS	Truck Reservation System
TSMO	transportation systems management and operations
TSP	transit signal priority
TTI	travel time index
TxDOT	Texas Department of Transportation
UI	user interface
UDOT	Utah Department of Transportation
U.S.C.	U.S. Code
USDOT	U.S. Department of Transportation
V2I	vehicle-to-infrastructure
V2V	vehicle-to-vehicle
V2X	vehicle-to-everything
VCC	virtual coordination center
VDOT	Virginia Department of Transportation
VSL	variable speed limit
WSDOT	Washington State Department of Transportation

EXECUTIVE SUMMARY

BACKGROUND

This report is the sixth program report on the Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Program. The multiyear, comprehensive Fixing America's Surface Transportation Act (FAST Act), Pub. L. No. 114-94 (2018) established, among other programs, the ATCMTD Program, which funds grantees to deploy advanced technologies to improve safety, efficiency, system performance, and infrastructure return on investment.[1] The law sets aside $60 million each fiscal year (FY), from FY 2016 through FY 2020, for grant awards[2] and requires the U.S. Department of Transportation (USDOT) to award grants each year to at least 5, and no more than 10, eligible entities.[3] The Continuing Appropriations Act (2021), and Other Extensions Act (2020) extended this authority through FY 2021.[4]

The FAST Act outlines key reporting requirements for the grantees, including submitting annual reports to the Secretary of Transportation.[5] These reporting requirements enable an understanding of grantees' progress and the outcomes of their project deployments, providing insight into which technologies and types of projects have the most potential to advance FAST Act goals of improving transportation safety, efficiency, and system performance. In addition, the FAST Act prescribes that USDOT must make publicly available a program report beginning 3 years after the first grant award and annually thereafter.[6] The purpose of the program report is to provide information on the effectiveness of grantees in meeting their projected deployment plans. As specified in the FAST Act, the program report should include data on effects related to the following parameters:

- Traffic-related fatalities and injuries.
- Traffic congestion and improved travel time reliability.
- Transportation-related emissions.
- Multimodal system performance.
- Access to transportation alternatives.
- Public access to real-time integrated traffic, transit, and multimodal transportation information to make informed travel decisions.
- Cost savings to transportation agencies, businesses, and the traveling public.
- Other benefits to transportation users and the public.[7]

[1] FAST Act, § 6004 (codified at 23 United States Code (U.S.C.) 503(c)(4) (2018)).
[2] 23 U.S.C. § 503(c)(4)(I)(i) (2018).
[3] 23 U.S.C. § 503(c)(4)(D)(i) (2018).
[4] Pub. L. No. 116-159, div. B, title I, § 1101, 134 Stat. 709, 725 (2020).
[5] 23 U.S.C. § 503(c)(4)(F) (2018).
[6] 23 U.S.C. § 503(c)(4)(G) (2018).
[7] 23 U.S.C. § 503(c)(4)(G)(i)-(viii) (2018).

STATUS OF GRANT AWARDS

The ATCMTD Program has awarded 58 grants through FY 2021, including 8 in FY 2016, 10 in FY 2017, 10 in FY 2018, 10 in FY 2019, 10 in FY 2020, and 10 in FY 2021.[8] The grantees represent a diverse set of metropolitan and rural areas from across the United States. They are deploying a range of advanced technologies, including connected vehicle (CV) applications (apps), automated vehicles, adaptive signal systems, integrated corridor management (ICM) systems, real-time traveler information systems, green technologies (e.g., light-emitting diodes, electric vehicle shuttles), artificial intelligence and machine learning (ML), and infrastructure maintenance and monitoring systems, among other technologies.

All grantees in FYs 2016–2020 have executed their agreements. In addition, all grantees in FYs 2016–2021 received funding obligations. Chapter 2 lists the grant awards in each fiscal year.

SUPPORT TO GRANTEES

The Federal Highway Administration (FHWA) provides crosscutting project support to all grantees through a variety of mechanisms. The FHWA provides performance measurement support and has prepared a report, *Evaluation Methods and Techniques: Advanced Transportation and Congestion Management Technologies Deployment Program,* which is designed to assist grantees in evaluating their projects.[9] The FHWA also responds to any grantee requests for information and shares these responses with other grantees, if applicable.

The Accelerating Vehicle-to-Everything (V2X) Cohort sponsored by the Intelligent Transportation Systems Joint Program Office includes active, USDOT-funded deployers to provide targeted support across multiple grant programs, including ATCMTD. The V2X Cohort meets monthly via a webinar conference to provide status updates, share technical knowledge, and exchange information about grantees' challenges and lessons learned.

Status of Performance Measurement

As of March 31, 2025, nine grantees—the Cleveland (OH) Regional Transit Authority (RTA), Port of Virginia (POV), Delaware Department of Transportation, Northwest 33 Innovation Council of Governments, Washington Department of Transportation, Utah Department of Transportation, Missouri Department of Transportation, Niagara Frontier Transportation Authority, and Tennessee Department of Transportation—have completed their projects and submitted a final report that FHWA has approved or views as near final approval.[10] Five

[8]For four grantees—Ada County Highway District, Idaho (FY 2017); Greenville, SC (FY 2017); Dallas, TX (FY 2020); and South Jersey Transportation Authority (FY 2021)—FHWA and the grantees mutually agreed to terminate the grants. For these projects, FHWA deobligated the obligated funds (no ATCMTD funds were spent for any of these projects).

[9]*Evaluation Methods and Techniques: Advanced Transportation and Congestion Management Technologies Deployment Program*: https://ops.fhwa.dot.gov/publications/fhwahop19053/fhwahop19053.pdf.

[10]Five of the nine grantees are formally completed (i.e., closed), with final reports published as of March 31, 2025. Once published, final reports are posted on FHWA's Fixing America's Surface Transportation Act or "FAST Act" web page. As of March 31, 2025, final reports for Cleveland RTA, POV, DelDOT, WSDOT, and NW33 COG are published. See https://ops.fhwa.dot.gov/fastact/.

additional projects have completed their deployments and are either preparing or have recently submitted a draft final report.

Just over half of all projects (28 projects) have begun testing and deploying technology apps. A smaller number of projects (12 projects) are in the planning phase of their deployment processes, working on activities such as stakeholder engagement, system documentation (e.g., the concept of operations), and technology procurement.

Grantees are using a range of performance measures (as described in their annual reports and evaluation plans) to assess the benefits of their deployments. The performance measures tend to focus on improving safety and mobility as well as improving system performance and operational efficiencies. Grantees also provide performance measures for integrating real-time information, reducing costs, improving institutional efficiency, and enhancing access to transportation alternatives.

GRANTEE FINDINGS

The nine projects completed to date represent a range of technology deployments, including two integrated transportation management systems, two CV projects, two ICM projects, a port management system, an incident detection and prediction project, and a transit communications project. Grantees with completed projects reported the following findings to FHWA.

Seven projects measured the safety benefits of their project deployments, and in the majority of cases, the findings are positive; the projects resulted in reduced crashes, improved response time, and improved detection time. Seven projects reported evaluation findings related to reduced congestion or improved mobility. The projects indicate positive impacts on mobility, including improved transit ontime performance, reduced congestion, and eased traffic management. For the goal of improved system performance, most grantees reported positive results related to system reliability, system confidence, and data availability, with a few projects demonstrating mixed findings. In addition, five projects reported evaluation findings that addressed reduced costs. Projects indicated that the deployed technologies have improved operational efficiency through streamlined processes, improved awareness, and reduced burdens.

GRANTEE-REPORTED INSIGHTS

Grantees reported a broad range of challenges, lessons learned, and recommendations in their final reports. The research team reviewed this reported information and identified seven key themes: Data, Evaluation, National Events, Policy and Regulations, Project Scoping, Stakeholder and Project Management, Technology, and User Experience. The grantees commonly cited -data related topics and included data quality, insufficient data or data loss, data validation, data storage, and security standards, among other issues. Evaluation-related challenges referenced benefits estimation, as well as evaluation design and data issues. Several grantees also mentioned national events, whether it was in the context of reduced travel demand, supply shortages, or remote work requirements that affected projects. With respect to project policy and regulations,

the Federal Communications Commission's (FCC's) 5.9 GHz Rule[11] affected some projects. Several grantees cited project scoping issues, with several indicating that they overestimated the capabilities of immature technologies and had to rescope their projects. Other project scoping issues involved underestimating the costs of the project and staffing considerations. Stakeholder and project management issues tended to focus on the importance of engaging stakeholders and building community support, as well as project management processes. Grantees also mentioned a range of technology topics, including the importance of standardization, the need to adapt to rapidly changing technology, and the importance of technology testing and aligning the operational practices of new technologies within agencies' existing frameworks. Some grantees cited issues related to the functioning and accuracy of the deployed technology. Grantees also recommended being sensitive to user experience issues (e.g., related to user interface).

[11]The FCC's November 10, 2020, First Report and Order (86 FR 23281), approved on November 18, 2020, and published in the *Federal Register* on May 3, 2021, describes changes to the allocated 75 MHz of radio spectrum in the 5.9 GHz band used for vehicle and infrastructure communications, which is also known as the Safety Band.

About This Report

Section 6004 of the Fixing America's Surface Transportation Act (FAST Act), Pub. L. No. 114-94 (2018), codified at 23 United States Code (U.S.C.) § 503(c)(4), requires the development of this program report, which fulfills the requirement of Section 503(c)(4)(G) of Title 23, U.S.C., to make available to the public information that describes the effectiveness of grant recipients in meeting their ATCMTD projected deployment plans by posting an annual report on the U.S. Department of Transportation (USDOT) website. Per 23 U.S.C. § 503(c)(4)(G), the report shall include data on how the program has achieved the following activities:

- "Reduced traffic-related fatalities and injuries;
- Reduced traffic congestion and improved travel time reliability;
- Reduced transportation-related emissions;
- Optimized multimodal system performance;
- Improved access to transportation alternatives;
- Provided the public with access to real-time integrated traffic, transit, and multimodal transportation information to make informed travel decisions; and
- Provided cost savings to transportation agencies, businesses, and the traveling public."

CHAPTER 1. INTRODUCTION

This report is the sixth annual program -level report on the Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Program. The FAST Act, a Federal law providing long-term funding for surface transportation infrastructure planning and investment from fiscal year (FY) 2016 through FY 2021, established the ATCMTD Program, stating:

> … the Secretary [of Transportation] shall establish an advanced transportation and congestion management technologies deployment initiative to provide grants to eligible entities to develop model deployment sites for large-scale installation and operation of advanced transportation technologies to improve safety, efficiency, system performance, and infrastructure return on investment.[12]

The Continuing Appropriations Act (2021), and Other Extensions Act (2020) extended this authority through FY 2021.[13]

BACKGROUND

The ATCMTD Program funds grants to deploy advanced technologies in support of FAST Act goals, such as safety, mobility, and operational efficiency.[14] The law sets aside $60 million each fiscal year from FY 2016 through FY 2021 for the grant awards,[15] with the Federal share of funding not to exceed

[12] 23 U.S.C. § 503(c)(4) (2018).
[13] Pub. L. No. 116-159, div. B, title I, § 1101, 134 Stat. 709, 725 (2020).
[14] 23 U.S.C. § 503(c)(4)(A) (2018).
[15] 23 U.S.C. § 503(c)(4)(I)(i) (2018).

50 percent of the total cost of the project.[16] The law requires USDOT to award grants each year to at least 5, and no more than 10, eligible entities, with no more than 20 percent of the funds each year going to a single entity. The awards should be diverse with respect to the technologies being deployed and geographic location.[17] In addition, the law requires that candidates' applications include a technology deployment plan;[18] quantifiable system performance objectives;[19] quantifiable safety, mobility, and environmental benefit projections; a plan for partnering with other institutions, and an explanation of how applicants will leverage existing technology and infrastructure for the project.[20]

GRANTEE REPORTING REQUIREMENTS

The ATCMTD Program includes several key reporting requirements for grantees, including annual reports to the Secretary of Transportation.[21] The reporting requirements allow the Federal Highway Administration (FHWA) to monitor grantees' deployment progress and to understand the effects of grantees' projects, providing insight into which technologies and types of projects are most effective at advancing FAST Act goals of improving transportation safety, efficiency, and system performance. The grantees can also use the information to improve the operations of their deployments. The grantees' reporting feeds directly into this program report, allowing other State and local entities to learn from grantee successes and challenges when executing their advanced technology deployments.

The following sections summarize grantees' key reporting requirements.

Quarterly Reports

All grantees submit quarterly reports to FHWA, which include descriptions of current work completed and work planned for the upcoming quarter, status of procurements and key milestone dates, any significant problems encountered, tabulated costs, the work performed in support of USDOT goals, and any budget revisions.

[16] 23 U.S.C. § 503(c)(4)(J) (2018).
[17] 23 U.S.C. § 503(c)(4)(D) (2018).
[18] 23 U.S.C. § 503(c)(4)(C)(ii)(I) (2018).
[19] 23 U.S.C. § 503(c)(4)(C)(ii)(II) (2018).
[20] 23 U.S.C. § 503(c)(4)(C)(ii)(III) (2018).
[21] 23 U.S.C. § 503(c)(4)(F) (2018).

Annual Reports

One year after each grantee completes its executed grant agreement, and each year thereafter, the law requires that grantees submit a report to the Secretary of Transportation (referred to as the "annual report" in this document) that describes deployment effects, including the following feedback:[22]

- Information on project deployment and operational costs compared to the benefits and savings the project provides.
- Data on whether the project has helped reduce traffic crashes, congestion, and costs, and data on other benefits of the deployed systems.
- Data on the effectiveness of measuring and improving transportation system performance through the deployment of advanced technologies.
- Data on the efficacy of providing real-time integrated traffic, transit, and multimodal transportation information to the public to make informed travel decisions.
- Information on lessons learned and recommendations for future deployment strategies to optimize transportation efficiency and multimodal system performance.

Evaluation Plans

As part of their applications, many grantees proposed to develop evaluation plans, which they incorporated into their cooperative agreements after execution. Beginning in FY 2018, the FHWA made creating evaluation plans mandatory for grantees. These plans outline project goals, evaluation methods and design, performance measures, data collection procedures, and evaluation risks.[23]

SUPPORT TO GRANTEES

The FHWA provides performance measurement support to the grantees to assist them in meeting their reporting requirements. In addition, through the cohort program outlined later in this section, FHWA provides technical assistance to help grantees overcome any challenges or issues they may be facing in their deployments. The FHWA also responds to any grantee requests for direction. If the FHWA learns information from one grantee that applies to other grantees, the Agency shares the information.

[22] 23 U.S.C. § 503(c)(4)(F) (2018).

[23] Beginning with FY 2018 awards, all grantees are required to prepare evaluation plans. See section A.5 of the 2018 FHWA Notice of Funding Opportunity No. 693JJ318NF00010: https://grants.gov/search-results-detail/303763.

Performance Measurement Support

The FHWA provides grantees with an annual report template that they are encouraged to use to fulfill this reporting requirement. The annual report template contains four sections. The Introduction and Overview section asks grantees to provide a project description and indicate the technologies they are deploying and the project's goals. The Evaluation and Research Activities section asks grantees to list their performance measures and research activities by goal area. The Findings section requests information on grantees' findings (tied to performance measures). The Wrap-Up section presents grantees with the following series of questions:

- How is the project doing with respect to meeting original expectations (i.e., as stated in the project proposal)? Note here any *major* deviations or changes in scope from the original proposal due to either project-driven outcomes or other unforeseen challenges.

- Are there any aspects of your project that you consider cutting edge, noteworthy, or innovative?

- How do the project's deployment and operational costs compare to the benefits and savings the project provides (i.e., can you provide an objective benefit-cost analysis or alternate subjective comparison)?

- What lessons have been learned to date from your deployment, specifically regarding future deployment strategies to optimize transportation efficiency and multimodal system performance? Please note lessons learned regarding challenges in technology deployment (e.g., technical, institutional), research (e.g., performance measurement), or other lessons learned.

- What recommendations can you provide regarding future deployment strategies in this or these area(s)?

To assist grantees in preparing their evaluation plans and conducting their evaluations, FHWA provided grantees with an "Evaluation Checklist"—a high-level list of issues and topics that grantees should consider when preparing their evaluation plans. In addition, FHWA has produced the report *Evaluation Methods and Techniques: Advanced Transportation and Congestion Management Technologies Deployment Program* to assist grantees in developing credible evaluations that measure the effects of their technology deployments.[24] The document provides an overview of evaluation design and performance measurement and includes chapters related to specific methods (benefit-cost analysis and survey design), as well as a limited set of technologies that are either being commonly deployed among grantees or where additional technical assistance would be particularly useful (connected vehicles (CVs), automated vehicles (AVs), and adaptive signal control). The FHWA has also developed a final evaluation report template that the Agency has shared with grantees.

[24] *Evaluation Methods and Techniques: Advanced Transportation and Congestion Management Technologies Deployment Program*: https://ops.fhwa.dot.gov/publications/fhwahop19053/fhwahop19053.pdf.

Cohort Program

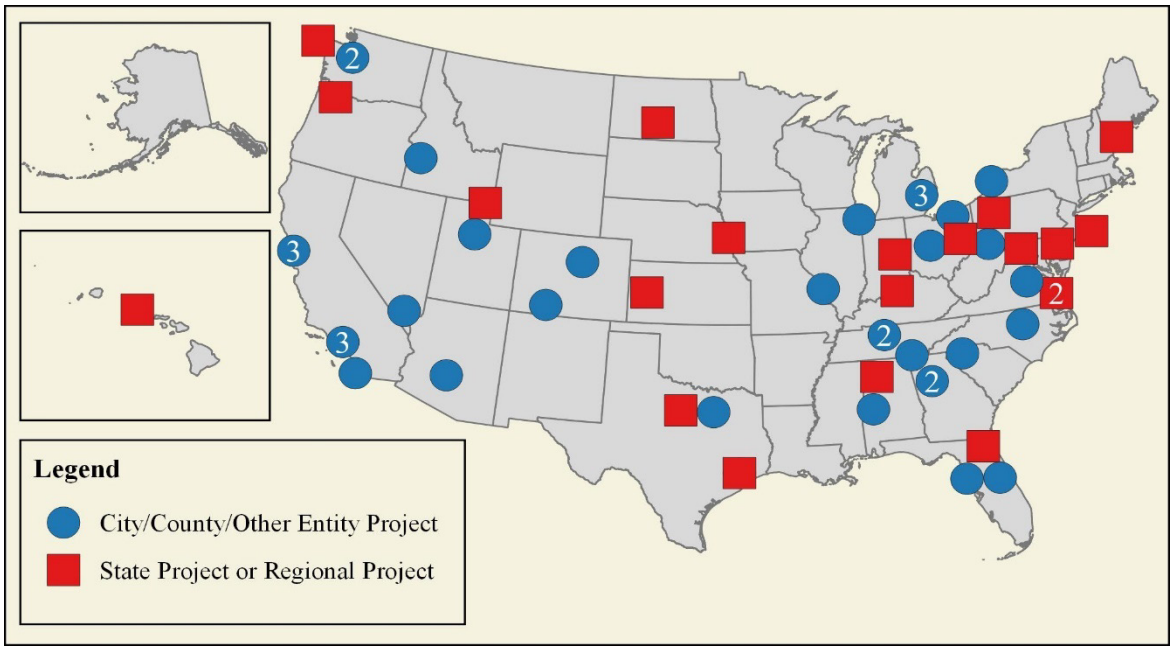
The Accelerating Vehicle-to-Everything (V2X) Cohort comprises active, USDOT-funded deployers and provides targeted support across multiple grant programs, including ATCMTD. The purpose of the cohort is to facilitate and support peer-led discussions that help advance V2X deployments. The cohort provides opportunities for engagement on a variety of topics, encouraging members to share their experiences, challenges, best practices, and documentation. Emphasis will be on advancing interoperable deployments of V2X. The Accelerating V2X Cohort meets monthly.

CHAPTER 2. OVERVIEW OF GRANTEE PROJECTS

This chapter provides a general overview of the grantee projects. Across the 6 fiscal years of this program, FHWA received 298 applications and awarded 58 grants, including 8 in FY 2016, 10 in FY 2017, 10 in FY 2018, 10 in FY 2019, 10 in FY 2020, and 10 in FY 2021.[25]

The grantees represent a diverse array of agencies, including city, county, and other local agencies and State departments of transportation (DOTs), as shown in figure 1. In addition, the ATCMTD Program has awarded grants equally to rural and nonrural projects.

All grantees in FYs 2016–2021 have executed their agreements. In addition, all grantees in FYs 2016–2021 received funding obligations.



Note: Locations with more than one project are marked with the number of projects.

Source: FHWA.

Figure 1. Map. Advanced Transportation and Congestion Management Technologies Deployment Program grantees.[26]

[25]For four grantees—Ada County Highway District, Idaho (FY 2017); Greenville, SC (FY 2017); Dallas, TX (FY 2020); and South Jersey Transportation Authority (FY 2021)—FHWA and the grantees mutually agreed to terminate the grant. For these projects, FHWA deobligated the obligated funds (no ATCMTD funds were expended for any of these projects).

[26]See the Projects by Fiscal Year section for a complete list of projects.

PROJECTS BY FISCAL YEAR

Each project grantee is identified by fiscal year in the following lists. Each bullet point contains the project name at the time of award, followed by the lead entity grantee in italics. For brief descriptions of each project, please see appendix A.

Fiscal Year 2021 Awards

The ATCMTD Program awarded the following 10 grants in FY 2021:

- Proactive Route Operations to Avert Congestion in Traffic (PROACT) Alabama, *Alabama DOT (ALDOT)*.
- An End-to-End Decision Support System for Integrated Smart Electric Grid and Transportation System Management, *City of Chattanooga, TN*.
- Chicago Centralized Transit Signal Priority Project (CCTSP), *City of Chicago, IL*.
- Great Plains Rural Freight Technology Corridor Project, *Kansas DOT (KDOT)*.
- Kentucky's Wrong Way Driving and Integrated Safety Technology, *Kentucky Transportation Cabinet*.
- Port of Los Angeles Gateway, *Port of Los Angeles, CA*.
- EZConnect℠: An Open and Cloud-Based Mobility Center Providing One-Stop Access for Travel Needs of Underserved Customers, *NEORide℠*.
- Electric Vehicle User Range Anxiety Solution for Rural North Dakota, *North Dakota DOT (NDDOT)*.
- Smart and Connected Atlantic City Expressway, *South Jersey Transportation Authority (SJTA)*.
- Washington State Ferries Terminal Wait Times Traveler Information System, *Washington State DOT (WSDOT)*.

Fiscal Year 2020 Awards

The ATCMTD Program awarded the following 10 grants in FY 2020:

- Advancing Connectivity and the Economy Through Technology in the San Diego Region, *San Diego Association of Governments, California*.
- Pinellas Connected Community, *Pinellas County Public Works Department, Florida*.
- Emergency Vehicle Preemption Using Connected Vehicle Technology, *Georgia DOT (GDOT)*.
- Maine Advanced Signal Control and Connected Vehicle System for Safe, Efficient, and Equitable Rural Transportation (MAST) Project, *MaineDOT*.
- Smart Intersections: Paving the Way for a National Connected and Automated Vehicle (CAV) Deployment, *University of Michigan*.
- Integrated Safety Technology Corridor, *Regional Transportation Commission of Southern Nevada*.
- Charlotte Avenue/Dr. Martin L King, Jr. Boulevard Transit Headways and Congestion Management, *Metropolitan Government of Nashville and Davidson County (Public Works Department)*.

- S.M. Wright Smart Corridor, *City of Dallas, TX*.
- Utah Broadly Connected, *Utah DOT (UDOT)*.
- Autonomous Truck Ready, *Port of Virginia (POV)*.

Fiscal Year 2019 Awards

The ATCMTD Program awarded the following 10 grants in FY 2019:

- MWCOG: Deployment of Personalized and Dynamic Travel Demand Management (TDM) Technology in the Washington, DC—Baltimore, MD—Richmond, VA megaregion, *Metropolitan Washington Council of Governments (MWCOG)*.
- I–4 Florida's Regional Advanced Mobility Elements (FRAME), *Florida DOT (FDOT)*.
- Implementing Cellular V2X Technology to Improve Safety and Intelligent Transportation Systems (ITS) Management in Hawaii, *Hawaii DOT (HDOT)*.
- Intelligent Woodward Corridor Project, *Michigan DOT (MDOT)*.
- I–270 Predictive Layered Operation Initiative (PLOI), *Missouri DOT (MoDOT)*.
- Multimodal Connected Vehicle Pilot, *North Carolina DOT (NCDOT)*.
- DriveOhio I–70 Truck Automation Corridor, *Ohio DOT (ODOT)*.
- Artificial Intelligence-Powered Decision Support Tools for Integrated Corridor Management, *Tennessee DOT (TDOT)*.
- Artificial Intelligence Meets Integrated Corridor Management: Realizing the Next Generation of Regional Mobility, *Virginia DOT (VDOT)*.
- Deployment of the Washington State Virtual Coordination Center (VCC) for Multimodal Integrated Corridor Management, *WSDOT*.

Fiscal Year 2018 Awards

The ATCMTD Program awarded the following 10 grants in FY 2018:

- Bay Area Mobility-On-Demand Project, *Contra Costa Transportation Authority, California*.
- Advanced Connected Transportation Infrastructure and Operations Network (ACTION), *University of Alabama*.
- Wolf Creek Pass Advanced Technology Deployment, *Colorado DOT (CDOT)*.
- Artificial Intelligence-enhanced Integrated Transportation Management System (AI-ITMS) Deployment Program, *Delaware DOT (DelDOT)*.
- Georgia DOT Connected Vehicles, *GDOT*.
- Multi-State Rural Integrated Corridor Management, *Nebraska DOT (NDOT)*.
- Oregon Smart Mobility Network, *Oregon DOT*.
- Work Zone Reservation and Traveler Information System, *Pennsylvania DOT (PennDOT)*.
- I–10 Corridor Coalition Truck Parking Availability System (I–10 Corridor Coalition TPAS), *Texas DOT (TxDOT)*.
- Utah Connected, *UDOT*.

Fiscal Year 2017 Awards

The ATCMTD Program awarded the following 10 grants in FY 2017:

- Loop 101 Mobility Project, *Arizona DOT (ADOT)*.
- Global Opportunities at the Port of Oakland Freight Intelligent Transportation System, *Alameda County Transportation Commission, California*.
- Connecting the East Orlando Communities, *FDOT*.
- SMART Arterial Management, *Ada County Highway District, Idaho*.
- Improving Safety and Connectivity in Four Detroit Neighborhoods, *City of Detroit, MI*.
- Connecting Cleveland Project, *Greater Cleveland RTA, Ohio*.
- Greenville Automated (A-Taxi) Shuttle, *County of Greenville, SC*.
- The Texas Connected Freight Corridors Project, *TxDOT*.
- Truck Reservation System (TRS) and Automated Workflow Data Model, *POV*.
- Multimodal Integrated Corridor Mobility for All, *Seattle DOT (SDOT), Washington.*

Fiscal Year 2016 Awards

The ATCMTD Program awarded the following eight grants in FY 2016:

- Freight Advanced Traveler Information System (FRATIS), *Los Angeles County Metropolitan Transportation Authority, California*.
- City of San Francisco Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Initiative, *San Francisco Municipal Transportation Agency, California*.
- Los Angeles DOT Implementation of Advanced Technologies to Improve Safety and Mobility within the Promise Zone, *Los Angeles DOT (LADOT), California*.
- Denver Smart City Program, *City and County of Denver, CO*.
- A Connected Region: Moving Technological Innovations Forward in the NITTEC[27] Region, *Niagara Frontier Transportation Authority (NFTA)*.
- NW 33 Smart Mobility Corridor, *Northwest (NW) 33 Innovation Council of Governments (COG)*.
- SmartPGH, *City of Pittsburgh, PA*.
- ConnectSmart™: Connecting TSMO[28] and Active Demand Management, *TxDOT*.

[27]Niagara International Transportation Technology Coalition.
[28]Transportation systems management and operations plan.

SUMMARY OF TECHNOLOGY DEPLOYMENTS

The ATCMTD grants awarded from FY 2016 through FY 2021 support the deployment of a range of advanced transportation technologies as shown in table 1.[29] Many projects deploy more than one technology. For a more detailed list of the technologies deployed in the projects, please see appendix A.[30]

Table 1. Advanced Transportation and Congestion Management Technologies Deployment grantees' key technology deployments as of March 31, 2025.

Technology	Number of Projects (54 Projects Total)
Advanced TISs	37
CVs or CV infrastructure (e.g., freight or snowplow priority, pedestrian priority)	36
Cameras or sensors for detection (including for infrastructure)	31
Apps (e.g., for ticketing, trip planning, freight reservation)	23
Transportation system performance (monitoring) data collection, analysis, and dissemination: AI/ML	23
C-V2X	20
Transportation system performance (monitoring) data collection, analysis, and dissemination: advanced analytics	19
DSRC	17
Adaptive signals	17
Other telecommunications (e.g., fiber optic cable, Wi-Fi™)	16
Advanced transportation management (e.g., ICM and DSS)	16
Weather sensors	9
Tolling or managed lanes	7
AVs	6
ITSs using a smart grid (or similar energy distribution) or charging systems	6
Electronic pricing and payment systems	6
Infrastructure maintenance, monitoring, and condition assessment	5
Advanced mobility and access technologies (e.g., dynamic ridesharing and information systems)	2

AI = artificial intelligence; Apps = applications; AVs = automated vehicles; CV = connected vehicles; C-V2X = cellular vehicle-to-everything; DSRC = dedicated short-range communications; DSS = decision support system; ICM = integrated corridor management; ITS = intelligent transportation system; ML = machine learning; TISs = traveler information systems.

[29]For four grantees—Ada County Highway District, Idaho (FY 2017); Greenville, SC (FY 2017); Dallas, TX (FY 2020); and South Jersey Transportation Authority (FY 2021)—FHWA and the grantees mutually agreed to terminate the grant. These four projects are not included in this section or any following sections of this report.

[30]Table 1 is not an exhaustive list; it represents target and other prevalent technologies being deployed.

The grantee projects also span a range of modes and service models. In addition to passenger vehicles, many of the projects either focus on or have a component that includes freight, transit, pedestrian/bicyclist, or mobility-on-demand (MOD), as shown in table 2. Many projects address more than one mode or service model.

Table 2. Advanced Transportation and Congestion Management Technologies Deployment grantees' project modes or services as of March 31, 2025.

Mode or Service Model	Number of Projects (54 Projects Total)
Passenger vehicle	36
Transit	27
Pedestrian/bicyclist	19
Freight	19
MOD	6

MOD = mobility-on-demand.

GRANTEE DEPLOYMENT STATUS

As of March 31, 2025, the grantees have completed nine projects; that is, they have submitted their final reports, which are either FHWA approved or approaching final FHWA approval. These grantees include the Cleveland RTA, POV, DelDOT, NW 33 COG, WSDOT, UDOT, MoDOT, NFTA, and TDOT. Five additional projects have completed their deployments and are either preparing or have recently submitted a draft final report. The largest share (28 projects) has begun testing and deploying technology applications (apps), and 12 grantees are in the planning phase of their deployment process, working on activities including stakeholder engagement, system documentation (e.g., the concept of operations), and technology procurement. Table 3 illustrates the overall deployment status of FY 2016–FY 2021 grantees by showing the number of projects at different stages of deployment.[31]

Table 3. Advanced Transportation and Congestion Management Technologies Deployment fiscal years 2016–2021 grantees' project status as of March 31, 2025.

Deployment Status	Number of Projects (54 Projects Total)
Planning stages	12
Piloting, testing, or partial deployment	28
Completed deployment	14

[31]The table excludes four grantees who mutually agreed with FHWA to terminate their grants.

OVERALL STATUS OF PERFORMANCE MEASUREMENT

As part of the ATCMTD Program application process, applicants are required to include the following information:

> Quantifiable safety, mobility, and environmental benefit projections, such as data-driven estimates of how the project will improve the region's transportation system efficiency and reduce traffic congestion.[32]

As a result, all grantees from FY 2016 through FY 2021 included proposed performance measures or targets in their applications. In addition, as noted in chapter 1, executed agreements require many grantees to develop evaluation plans that outline project goals, evaluation methods and design, performance measures, and data collection procedures. As of March 31, 2025, 43 grantees had submitted evaluation plans: 5 FY 2016 grantees, 5 FY 2017 grantees,[33] 10 FY 2018 grantees, 9 FY 2019 grantees, 9 FY 2020 grantees, and 5 FY 2021 grantees.

SUMMARY OF GRANTEE PERFORMANCE MEASURES

In their annual reports and evaluation plans, grantees identify the performance measures they will use to evaluate the benefits of their projects. Grantees tailor performance measures to their specific projects; however, for many projects, the core metric is similar. For example, a grantee with a transit project may use "improved transit vehicle travel time," whereas a grantee with a freight project may use "reduction in travel times along key port access corridors." While these performance measures vary by mode and geographic location, depending on the scope of their respective projects, the core of both metrics is travel time. Table 4 lists the most common core performance measures the 45 active grantees use across reported goal areas. If multiple grantees use a performance measure, the number of grantees is noted in parentheses, such as (n = 3). The goals shown in table 4 align with requirements in the FAST Act and the effects the Secretary identified in the notices of funding opportunity (e.g., improved safety, reduced traffic congestion).

Grantees are not reporting on all the goal areas that align with the requirements in the FAST Act. Grantees focus on the goals and performance measures relevant to their deployments. As table 4 illustrates, safety and mobility are the two most common grantee goals.

[32] 23 U.S.C. § 503(c)(4)(C)(ii)(III) (2018).

[33] Three of the FY 2016 grantees and five of the FY 2017 grantees were not required to complete an evaluation plan per their grant agreements.

Table 4. Common performance measures by goal area reported by active grantees (*n* = 45), 2025.

Goal Area	Common Performance Measures
Improved safety	• Number of crashes (including by severity and mode) (*n* = 24) • Perceived safety (*n* = 10) • Number of incidents (*n* = 8) • Speed (*n* = 7) • Number of safety notifications or activations (*n* = 6) • Incident response or detection time (*n* = 6)
Reduced congestion or improved mobility	• Travel time (*n* = 13) • Delay (*n* = 13) • Travel time reliability (*n* = 11) • Speed (*n* = 8) • User satisfaction or perceived improvement (*n* = 7) • Number of riders, users, or vehicles (*n* = 5)
Reduced environmental impacts	• Emissions (*n* = 9) • Fuel consumption (*n* = 7) • Delay (*n* = 2) • Occupancy (*n* = 2) • Travel time (*n* = 2)
Improved system performance (including optimized multimodal system performance)	• Perceived system effectiveness (*n* = 5) • Accuracy (*n* = 4) • Ontime performance (*n* = 7) • Number of riders, users, or vehicles (*n* = 5)
Enhanced access to transportation alternatives	• Number of passengers or ridership (*n* = 4) • User satisfaction (*n* = 3) • Access to local businesses (*n* = 1) • Number of app developers using the data (*n* = 1) • Number of trips or rides (*n* = 1) • Occupancy (alternatives access)

Table 4. Common performance measures by goal area reported by active grantees (*n* = 45), 2025 (continuation).

Goal Area	Common Performance Measures
Effectiveness of providing integrated real-time transportation information to the public to make informed decisions	• User feedback or perception (*n* = 10) • Number aware of or using information (*n*=7) • Number of messages (*n* = 3) • Number of vehicles (*n* = 3) • Number of detections (*n* = 2) • Change in speed (*n* = 2) • Information accuracy (*n* = 2)
Reduced costs	• Benefit-cost analysis (*n* = 6) • Mobility costs (*n* = 4) • Operating and maintenance costs (*n* = 4) • Safety costs (*n* = 4) • Administrative costs (*n* = 3) • Reduced fuel costs or emissions savings (*n* = 3)
Institutional or administrative benefits	• Information sharing between agencies or stakeholders (*n* = 7) • Improved understanding or awareness of technologies (*n* = 3) • Perceived institutional or administrative benefits (*n* = 3) • Improved efficiency or access to data (*n* = 2) • Transferability of system (*n* = 2)
Other benefits	• Improved user experience (*n* = 2) • Parking (*n* = 2) • Strengthen decisionmaking (*n* = 2) • Accelerating technology deployment (*n* = 1) • Community engagement (*n* = 1) • Improve situational awareness (*n* = 1) • Positive attitude toward new technologies (*n* = 1) • Promote economic opportunity (*n* = 1) • User input (*n* = 1)

app = application.

CHAPTER 3. GRANTEE-REPORTED FINDINGS AND INSIGHTS

This chapter provides the details of nine completed projects as of March 31, 2025. These details include findings, challenges, lessons learned, and recommendations.

FINAL REPORTS

Of the nine projects completed by March 31, 2025, FHWA highlighted six projects in past program reports. Table 5 provides information on these grantees, including the fiscal year in which they were awarded and the report year in which they are summarized. Past program reports can be found online by visiting https://ops.fhwa.dot.gov/fastact/index.htm.

Table 5. Projects with final reports summarized in past program reports.

Project Grantee	Fiscal Year	Report Year
Greater Cleveland Regional Transit Authority	2017	2021
Port of Virginia	2017	2024
Delaware Department of Transportation	2018	2024
Northwest 33 Innovation Council of Governments	2016	2024
Washington State Department of Transportation	2019	2024
Utah Department of Transportation	2018	2024

The following sections summarize the key findings of the three projects completed between April 1, 2024, and March 31, 2025. These projects represent a range of technology deployments, including incident identification and prediction tools, a regional, integrated transportation management system, and an integrated corridor management (ICM) deployment involving artificial intelligence-based decision support system (AI-DSS). Any questions about the projects highlighted in this section can be sent to the ATCMTD program managers at ATCMTD@dot.gov.

I–270 Predictive Layered Operation Initiative (PLOI), Missouri Department of Transportation (Fiscal Year 2019)

Through the I–270 PLOI, MoDOT implemented crash risk location prediction and incident identification, advanced video analytics, and Integrated Modeling for Road Conditions Prediction (IMRCP) to improve traffic management and enhance roadway safety along an I–270 corridor, the most traveled road in northern St. Louis County. This ATCMTD-funded initiative is part of the I–270 North Design-Build Project, which is focused on rebuilding a major portion of I–270, as shown in figure 2.

Source: MoDOT.

Figure 2. Map. I–270 design-build location.

The crash risk location prediction and incident identification tool is a prediction analytics engine that processes and reacts to new data to spot trends and identify circumstances where crashes occur. This tool comprises two components: predictive analytics and incident detection. Predictive analytics uses historical and current data to create crash risk areas that indicate the direction, start point, end point, and time range of high-risk crash areas. The incident identification tool combines multiple CV data sources with deep learning, machine learning (ML), and artificial intelligence (AI) to create and confirm incident alerts. Over the 2-year verification period, the percentage of crash areas visible to operators correctly predicting a crash in the right direction increased from 1.4 percent in February 2022, to 10.9 percent in October 2023.

The advanced video analytics system analyzes data from closed-circuit television (CCTV) cameras to identify events, dangerous conditions, and traffic data in realtime to send alerts to traffic management center (TMC) staff. Advanced video analytics were highly efficient and accurate; system alerts consistently achieved an accuracy of 80 percent or higher and reached 95-percent accuracy in April 2023. The combined efforts of the incident identification tool and advanced video analytics achieved earlier incident notifications in 45 percent of the recorded cases, with a median emergency response (ER) time savings of 10 minutes per incident.

The IMRCP integrates historical traffic and road weather event data with real-time data to forecast road conditions. Although the IMRCP was fully operational by the 2021–2022 winter season, the available data were insufficient due to limited weather incidents during the verification period.

Overall, the PLOI generally succeeded in its goals to improve safety, mobility, response times, real-time information, and cost savings for the I–270 corridor. Following the success of the project, MoDOT plans to expand these technologies elsewhere in the State in an effort to improve roadway conditions for all users.

A Connected Region: Moving Technological Innovations Forward in the NITTEC[34] Region, Niagara Frontier Transportation Authority (Fiscal Year 2016)

NITTEC[35] led the ATCMTD project to create AllRoads—a multiagency, technology-enabled, integrated regional mobility management system—comprising the following three parts:

- A data hub to allow electronic collection and exchange of information among the various stakeholder traffic management systems; field, central, and third-party data sources; and field traffic management devices (e.g., CCTV and road weather information systems (RWISs)).

- A decision support system (DSS) to automate and streamline coordinated responses across stakeholders to regional events.

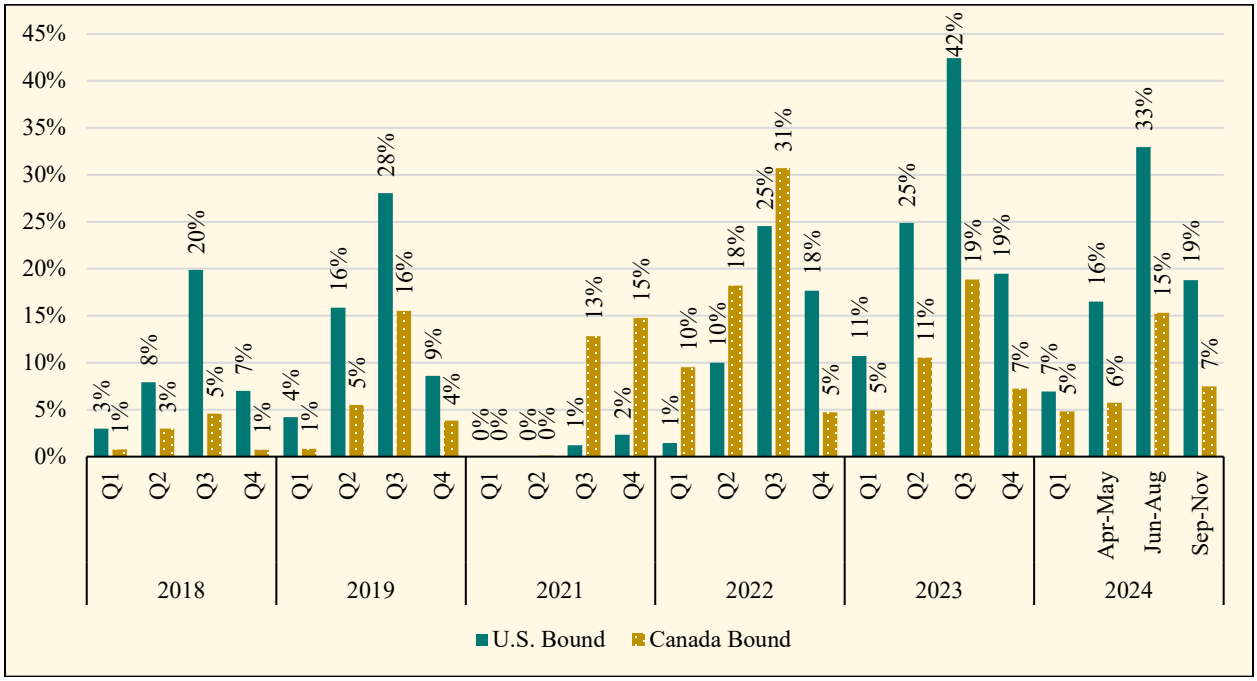
[34]Niagara International Transportation Technology Coalition.

[35]The grantee, NFTA, is a member of NITTEC, whose mission is to improve mobility, reliability, and safety on the regional binational multimodal transportation network.

- A performance measures module to monitor the performance of the various systems and provide reports and dashboards that stakeholder decisionmakers can use to determine the extent to which the various systems are meeting their objectives.

NITTEC collected baseline data and then compared them to postdeployment data to measure the impacts of these deployments.

NITTEC measured successes reducing congestion and improving mobility. The coalition calculated the percentage of 5-minute intervals where simultaneous delay occurred at two or more border crossings between the Peace Bridge, Lewiston-Queenston Bridge, and Rainbow Bridge for each quarter. For cars (shown in figure 3) in two quarters (June through August 2024, and September through November 2024) compared with corresponding periods in 2023, postdeployment simultaneous delay decreased by 15 to 30 percent for both U.S.- and Canada-bound cars.



Q = quarter.

Source: Niagara Frontier Transportation Authority.
Figure 3. Simultaneous car delays.

For trucks, U.S.-bound traffic experienced a decreased postdeployment simultaneous delay of 46 percent and 20 percent, respectively. Trucks traveling to Canada experienced a 37 -percent delay in the quarter covering June through August 2024, compared with the corresponding period in 2023. While the postdeployment simultaneous delays increased by 75 percent for Canada--bound truck traffic in the quarter covering September through November 2024, (compared with 2023), this increase likely resulted from the already very low rate of simultaneous delay for Canada-bound trucks, as the actual numerical increase remained low.

NITTEC also calculated the average delays in minutes at each border crossing quarterly for cars and trucks, and the results were mixed. For both U.S.- and Canada-bound cars, the average delays were shorter during the postdeployment period than during the corresponding time periods in 2023 for the Peace Bridge and Lewiston-Queenston Bridge, while the Rainbow Bridge had slightly longer delays. For U.S.-bound trucks, the average delays were shorter in the postdeployment period than during the corresponding time periods in 2023 for the Peace Bridge and Lewiston-Queenston Bridge. For trucks bound for Canada, the delays were roughly equivalent on both the Peace Bridge and Lewiston-Queenston Bridge. NITTEC did not report truck data for Rainbow Bridge.

Before implementing this project, NITTEC and its member agencies collected and used data independently of one another, limiting data exchanges to requests and manual sharing. AllRoads improved interagency coordination. The number of datasets collected by the end of 2024 was 39, an increase of 44 percent compared with the 27 datasets collected in 2022. With respect to dataset usage, the number of instances NITTEC and its member agencies used the data increased by 28 percent, from 43 instances in 2022 to 55 in 2024. However, significantly more users accessed the data in 2024, because a total of 84 users across 17 agencies had been trained to use the AllRoads system by the end of 2024.

NITTEC calculated the travel time index (TTI) and the planning time index (PTI) during peak periods quarterly for 12 links across 4 expressways: I–90, I–190, I–290, and New York State Route 33. Both TTI and PTI remained the same.

In its evaluation of safety metrics, NITTEC reported similar incident response times and clearance times in both the baseline and postdeployment periods, noting that NITTEC's members are not yet using the AllRoads system to its full capacity.

NITTEC will continue to use AllRoads, integrating ITSs and training stakeholder staff.

Artificial Intelligence-Powered Decision Support Tools for Integrated Corridor Management, Tennessee Department of Transportation (Fiscal Year 2019)

TDOT enhanced the operational performance of the I–24 corridor between Nashville and Murfreesboro by deploying a range of ITSs, as well as by developing, deploying, and integrating an AI-DSS. TDOT implemented overhead dynamic message signs (DMSs) with dynamic lane control, variable speed limit (VSLs), video detection for emergency pulloffs, new CCTV cameras, and radar detection systems (RDS), as well as upgraded and connected traffic signals. The AI-DSS gathers incident data as well as data from these monitoring and control devices deployed in the I–24 ICM system, analyzes the information in realtime, and incorporates inputs from TMC technicians to make real-time decisions about posting VSLs, pushing information to the traveling public, and recommending traffic signal timing plan changes.

For the evaluation, TDOT collected baseline data for a period of 2.5 years (January 1, 2021, through June 19, 2023) and compared those data with postdeployment data, which generally covered a 1.5-year period from June 20, 2023, to December 31, 2024.

Safety metrics indicated a 7-percent decrease in primary crashes, a 10-percent decrease in rear-end collisions, and an 11-percent decrease in fatal collisions (decrease of one crash). The AI-DSS did not significantly affect travel time and travel time reliability, with both performance metrics recording relatively no change; however, an 8-percent increase in traffic volumes along the corridor between the before and after evaluation periods suggests a positive outcome for the AI-DSS itself. Incident management improved greatly, showing a 20-percent decrease in incident clearance time.

TMC operations, TMC processes, and incident management improved postdeployment with reduced incident clearance times and positive TMC technician feedback, indicating AI-DSS made detecting incidents quicker and technicians' jobs more efficient. The AI-DSS recommended responses in a matter of seconds as opposed to the minutes it takes a traditional DSS. Additional results include increasing the event detection rate by 7 percent and decreasing detection time by 7 percent.

Source: Stantec.
Figure 4. Variable speed limits above Tennessee I–24.

In a separate assessment of the VSL (shown in figure 4), TDOT observed a 14-percent reduction in crashes when the VSL was active (i.e., when the system posted a speed limit lower than the maximum speed limit), and conversely, the crash rate increased by 12 percent when the VSL was inactive. Secondary crashes were reduced by 50 percent when the VSL was active. Notably, traffic volumes increased 6.6 percent following the deployment of the VSL, so these findings suggest that without the deployment of VSL, the total crash rate on I–24 likely would have increased. Additionally, the VSL response time is 9 minutes before the crash is reported in the TMC, indicating that the VSL is 90 percent faster than the TMC.

The researchers also found that the benefits of this project outweighed the costs. A benefit-cost analysis quantified project benefits against costs, identifying a total project cost of approximately $72.39 million and an equivalent annual cost of $7.11 million. A $40.33-million reduction in user delay costs and crash costs primarily drove project benefits. The analysis indicated a breakeven point of approximately 2.18 years and a benefit-cost ratio (BCR) of 5.67. For reference, TDOT estimated that a typical roadway widening project generally has a 1.0–2.0 BCR.

The AI-DSS can be easily reconfigured and adapted to different locations and corridors with the required level of existing ITS infrastructure. In addition to expanding its use beyond Region 3, TDOT also expressed the goal to expand on the functionalities of the AI-DSS.

SYNTHESIS OF GRANTEE FINDINGS

This section provides key findings from nine completed projects as of March 31, 2025.[36] The findings are organized by FAST Act goal area; however, each project is unique in ways that make direct comparison difficult. While the evaluation results often demonstrate positive impacts, a common limitation on the benefits of these technologies appears to be the scale of deployment. Whether the limitation is the number of users, density of deployments, or availability of staff training, grantees often conclude that benefits would be larger if the technology were deployed on a greater scale.

Improved Safety

Seven grantees evaluated the safety benefits of their project deployments, including performance measures related to incident outcomes, incident response times, incident detection, and safety-related perceptions. In the majority of cases, the findings were positive; the projects resulted in reduced crashes, improved response times, and improved detection times.

One grantee measured the incident-related outcomes of its project deployment, including crash severity, crash rates, and rear-end collisions, whereas another grantee measured the probability of an incident:

- **AI-Powered Decision Support Tools for ICM:** TDOT used a phased approach to improve I–24 corridor operations, implementing ICM in the first phase, followed by an initial phase of an AI-based DSS, and then the final phase of the AI-DSS. While crash severity rates showed improvements after the implementation of ICM, the results were mixed after the final AI-DSS deployment. Serious injury crashes increased by 6 percent (one crash), and fatal injury crashes decreased by 11 percent (one crash). Given the relatively small number of crashes, the findings should be interpreted with caution. With respect to rear-end collisions, the safety of the corridor improved. After TDOT implemented the I–24 ICM, rear-end collisions decreased by 17 percent (34 crashes), and after the final AI-DSS phase, rear-end collisions decreased by 23 percent (152 crashes). TDOT also evaluated its VSL deployment, observing a 14 -percent reduction in the primary crash rate when the VSL was active, and conversely a 12-percent increase in the crash rate when the VSL was inactive. Moreover, the VSL evaluation found that the secondary crash rate decreased by 50 percent per month.

[36]Approximately two-thirds of reported results are presented in this chapter. Reported results had sufficient context to interpret the findings, and more than one project assessed the same type of performance measure associated with the reported results. “Lessons learned” was a common performance measure, and they are excluded in this section because they are described in more detail in the next section of this report.

- **TRS and Automated Workflow Data Model**: POV's TRS made the port safer by reducing the need for drivers to exit their trucks to coordinate, an act that is considered the highest risk to drivers' safety at the port. While waiting to back into a lane, brief coordination with other motor carriers is acceptable for up to 2 minutes, then drivers must be in their cabs according to the Port of Virginia Health and Safety Rules for Motor Carriers.[37] The threshold for categorizing quarterly compliance as satisfactory versus unsatisfactory is a 95-percent compliance rate with this rule. Before the TRS-2 project, most of the compliance scores were in the "unsatisfactory" range, and after the implementation of TRS-2, compliance scores rose above the 95-percent threshold. Moreover, the risk score went from 1,000 (a risk level classification of severe) in 2018 to a risk score of 140 in 2021.

Several grantees focused on safety benefits related to incident response times, with positive results in most cases:

- **AI-Powered Decision Support Tools for ICM:** TDOT experienced significant improvements in incident clearance time. The I–24 ICM evaluation phase saw a 20 -percent (74 minutes) reduction in clearance time for both eastbound and westbound directions. Clearance times also were reduced in the final AI-DSS evaluation phase, including a 26 -percent (93 minutes) reduction in clearance time eastbound and a 22 -percent (73 minutes) reduction westbound.

- **A Connected Region: Moving Technological Innovations Forward in the NITTEC Region:** NITTEC, which deployed a data hub and a DSS to enable an integrated regional mobility management system, evaluated both incident clearance times and incident response times. The findings were mixed. While the incident clearance time for all crashes was approximately 7 minutes longer on average during the evaluation period compared with the baseline, the incident response time for all events was approximately 3 minutes faster on average. The grantee reports that the changes in incident clearance and response times are likely due to normal year-to-year fluctuations in these values.

- **I–270 PLOI:** MoDOT implemented a crash risk location prediction and incident identification tool, advanced video analytics, and IMRCP to improve traffic management and enhance roadway safety along an I–270 corridor. Its incident identification tool achieved earlier incident notifications in 45 percent of the cases, with a median time saved of 10 minutes.

[37] See: https://wp.portofvirginia.com/wp-content/uploads/2022/06/Port-of-Virginia-Health-and-Safety-Rules-Motor-Carriers-20220505.pdf.

Five grantees evaluated incident detection. While three grantees had generally positive results, two had mixed or negative results:

- **AI-Powered Decision Support Tools for ICM:** TDOT found that during the I–24 ICM evaluation phase, incident detections increased by 5 percent (62 incidents) in the eastbound direction and by 9 percent (85 incidents) westbound. But during the final AI-DSS evaluation phase, incident detections decreased by 5 percent (191 incidents) eastbound and by 2 percent (76 incidents) westbound.

- **AI-ITMS:** DelDOT enhanced its integrated transportation management system with AI and ML algorithms. Its evaluation found that the detection algorithms did not currently meet DelDOT's accuracy standards. On average, the detection algorithms detected incidents 14 minutes and 33 seconds after they occurred. However, DelDOT indicated that performance may be tied to monitoring device density, and latencies within existing systems may be notable sources of delay (i.e., rather than the new system).

- **Utah Connected:** UDOT's project deployment included the deployment of fiber sensing, also known as DAS (Distributed Acoustic Sensing), along 26 miles of two heavily used recreational corridors. DAS detected all four crashes that occurred during the evaluation period. At American Fork Canyon, where UDOT deployed both cameras and DAS, UDOT found that the DAS detected 96 percent of the 91 vehicles a camera detected. UDOT also assessed the potential value of its CV deployment by comparing the RWIS records and weather events CV-equipped vehicles generated during 2023. This analysis found that in cases when the vehicle was slipping on the road due to icy conditions, the CV-equipped vehicle issued spot weather warnings that the RWIS records had not generated. According to UDOT, these findings underscore the value the CV warnings added.

- **NW 33 Smart Mobility Corridor**: NW 33 COG, which developed a CV test corridor, measured the number of onboard warnings that were issued to drivers. During the evaluation period, NW 33 COG recorded 13,930 application events for the 5 CV safety apps across 189 unique onboard units (OBUs). The red-light violation warning accounted for 58 percent of all events evaluated. Curve speed warning (CSW) accounted for 40 percent.

Two grantees collected data on perceptions related to the deployed safety technology. One project found positive results, while the other found an overall negative view of the technology, which the grantee indicates may be due, at least in part, to the fact that no formal training was provided to potential users:

- **Utah Connected:** UDOT found that passenger perception regarding the safe operation of the AV shuttle was positive, with 98 percent of surveyed participants indicating that they felt safe on board. Additionally, on a scale of 1 to 10, where 1 is extremely poor and 10 is extremely well, the average response to the question "How successful was the shuttle in making you feel safe and comfortable?" was 9.65 when the shuttle host was visible and 9.52 when the host was disguised as a fellow passenger.

- **NW 33 Smart Mobility Corridor**: NW 33 COG surveyed drivers of equipped vehicles to obtain feedback on their in-vehicle experience with the CV apps. The grantee collected 75 responses for a 37.5-percent response rate. A majority (71 percent) expressed low satisfaction with the CV technology. While some respondents reported experiencing safety enhancements through increased driver awareness (28 percent), fewer crashes (8 percent), and fewer "near misses" (5 percent), two-thirds (66 percent) indicated they were somewhat unlikely (11 percent) or very unlikely (55 percent) to retain or recommend the demonstrated CV technology. In addition, the respondents tended to give the CV apps low effectiveness ratings.

Reduced Congestion or Improved Mobility

Seven projects reported evaluation findings related to reduced congestion or improved mobility. The projects indicate positive impacts on mobility, including improved transit ontime performance, reduced congestion, and streamlined traffic management.

Three projects reported evaluation findings related to travel time and were able to demonstrate benefits to mobility:

- **Utah Connected**: UDOT found that the average speed for general traffic was 32.35 mph during winter weather events on equipped corridors that granted snowplow preemption compared with a slightly slower speed of 32.26 mph during normal, nonwinter weather conditions. Additionally, buses equipped with transit signal priority (TSP) completed their routes 2.3 minutes faster on average than nonequipped buses.

- **A Connected Region: Moving Technological Innovations Forward in the NITTEC Region**: NITTEC, which deployed a data hub and a DSS to enable an integrated regional mobility management system, found that average delays for passenger vehicles were shorter for two of the three bridges during the postdeployment period as compared with the corresponding time periods in the baseline year. For trucks, the average delays were shorter or approximately equivalent for both of the two relevant bridges. Additionally, simultaneous delay[38] for passenger vehicles decreased between 15 percent and 46 percent in the postdeployment period as compared with the corresponding time periods in the baseline year.

- **TRS and Automated Workflow Data Model**: Before POV deployed the mandatory reservation system at each of the terminals, the agency was unable to anticipate and organize cargo efficiently to facilitate import pickups. Port workers often had to move containers multiple times based on the order truckers arrived at the gate and at the stacks, contributing to longer queues and longer wait times. Before POV implemented the first iteration of the TRS, truck visits at Virginia International Gateway and average turn times were increasing as follows:

[38]Simultaneous delay is defined as a 5-minute interval where the current delay for vehicles is 30 minutes or longer at two or more border crossings.

- In 2013, the port had 203,221 visits, with an average turn time of 60.2 minutes per visit.

- In 2016, the port had 399,444 visits, and turn times averaged 77.4 minutes. In 2018, the year before deployment, the number of truck visits reached 420,820, with turn times of 90.4 minutes on average for the year.

- In 2019, as POV began to implement the mandatory truck reservations and the first elements of TRS 2.0 technology, POV began to see average turn times fall (39.5 minutes) while overall average monthly truck visits increased further (443,300 truck visits in 2018).

- In 2020, with the deployment of additional TRS 2.0 enhancements, and focus on operational efficiencies, POV was able to handle an increase in truck visits beyond the designed terminal limits, averaging 38,069 visits per month, with a reduced turn time of 37.7 minutes per visit. TRS 2.0 enhancements allowed POV to operate at levels 25 percent above the design capacity for an extended period with a nominal increase in truck turn times.

In 2021, POV was able to move record gate volumes (1.63 million gate transactions) as a result of 530,482 truck visits at the Virginia International Gateway, with a turn time of 52.5 minutes.

- **AI-Powered Decision Support Tools for ICM**: TDOT found that, despite an 8 -percent increase in traffic volumes, the average travel times on the interstate did not show significant variation during the deployment phases of the I–24 ICM and the initial AI -based DSS. Additionally, an analysis revealed that recurring congestion traffic flow smoothed or harmonized over the evaluation phases when compared with the respective baseline.

Two projects reported evaluation findings related to travel time reliability, but neither project was able to demonstrate a clear benefit to mobility through the selected evaluation method:

- **AI-Powered Decision Support Tools for ICM**: TDOT deployed ICM followed by an AI-based DSS on its I–24 corridor to improve transportation operations. The average TTI, a measure of reliability from the Regional Integrated Transportation Information System, increased in each phase when compared with the baseline data. After TDOT implemented the I–24 ICM, the average TTI remained unchanged in the eastbound direction, while it increased by 5 percent westbound. After the agency deployed the initial AI-DSS, the average TTI increased by 3 percent eastbound and 4 percent westbound. After the final AI-DSS deployment, the TTI increased by 6 percent eastbound and 10 percent westbound.

- **Connected Region: Moving Technological Innovations Forward in the NITTEC Region**: NITTEC found that the TTI on expressways and arterials during peak periods during the baseline ranged from 1.00 to 1.56. During the evaluation period, the TTI remained similar to the baseline period, with an average change of 0.02.

Three projects reported evaluation findings that demonstrate improved transit ontime performance:

- **Utah Connected**: UDOT found that ontime performance for buses equipped with TSP increased by 1.3 percentage points to 88.1 percent during a time when TSP was only functioning at half of the intersections along the route. Ontime performance also worsened for nonequipped buses. The estimated net improvement in ontime performance was 2.7 percentage points as a result of the project deployment.

- **Connecting Cleveland Project**: RTA found that the upgraded communication equipment increased the availability of usable ontime performance data and that as a result, ontime performance has significantly increased. RTA's ontime performance goal was 80 percent, which, due to the improvements, increased to 85 percent. Ontime performance for the Hayden garage was 90 percent.

- **Connected Region: Moving Technological Innovations Forward in the NITTEC Region**: NITTEC found that ontime performance during the evaluation period was 81.9 percent, an improvement of 0.9 percent from the previous period.

Two projects reported evaluation findings showing perceptions of improved mobility:

- **I–270 PLOI**: MoDOT found that TMC operators rely heavily on the deployed congestion management technologies for monitoring traffic incidents. Respondents to a survey of TMC operators noted that the crash risk area tool was often the first to report alerts for certain events compared with the advanced traffic management system (ATMS). The advanced video analytics deployment also received praise, achieving an average score of 4.25 out of 5. Survey respondents consistently rated the advanced video analytics favorably for its accuracy and comprehensive overview. MoDOT concluded that survey respondents were in consensus regarding the value of both the crash risk location prediction and incident identification tool and the advanced video analytics tool in enhancing traffic management and ER practices.

- **Deployment of the Washington State VCC for Multimodal ICM**: WSDOT, which deployed a VCC for integrated multimodal corridor management, conducted surveys for baseline data collection (completed in 2023) and for each of the three postdeployment phases (also completed in 2023):

    - WSDOT asked VCC users how likely they were to make alterations to their congestion management strategies in future incidents after seeing the information from partner agencies in the VCC. Ratings increased from a mean of 44.57 in Phase 1 to a mean of 55.36 in Phase 3 of the project. This difference, which is not statistically significant, is likely due to the small number of participants responding to this question. Seven survey respondents provided higher ratings and indicated that they were likely to make changes in mobility strategies in future incidents given the information in the VCC. Four respondents cited insufficient or no experience with the VCC for it to have had an impact.

- VCC users also rated their level of agreement with the statements, "The VCC Incident Model has improved my ability to monitor and manage I–5 corridor operations during a major incident." and "I feel I have more information about an incident now that I have access to the VCC." The number of respondents in agreement with the 2 statements was approximately 50 out of 100 for both questions and increased to approximately 54 and 58, respectively; however, this increase was not statistically significant.

Improved System Performance

Projects that addressed the improved system performance goal used performance measures covering three general areas: system reliability, system confidence, and data availability. While most grantees reported positive results, a couple of projects demonstrated mixed findings.

The following three grantees measured system performance by evaluating system reliability:

- **Connecting Cleveland:** RTA gauged system reliability using two performance measures: frequency of no audio defects and real-time information accuracy. After the upgrade of its communication system, RTA experienced an 86-percent reduction in "no audio" defects, which are caused by "dead zones" where operators are unable to talk with dispatchers. In addition, RTA found that the real-time information is more than 90 percent accurate and provides reliable real-time information and trip planning.

- **AI-ITMS:** DelDOT, which enhanced its transportation management system with AI and ML, found that each of the 13 data inputs to, and 5 algorithms run by, the system are ingested and run a maximum of every 5 minutes, which is faster than the 7-minute threshold that was set for the system.

- **NW 33 Smart Mobility Corridor**: NW 33 COG developed a CV test corridor and evaluated roadside unit (RSU) uptime, which is essential for monitoring the performance and reliability of the deployed RSUs, identifying potential issues, and ensuring the project's operational efficiency. NW 33 COG monitored 65 RSUs. The average uptime for all RSUs was 93 percent, while 72 percent of RSUs operated at an uptime of 99 percent or higher, indicating reliable and consistent operation. However, two instances of lower uptimes (26.73 percent and 57.04 percent) suggest potential issues or areas requiring improvement. In addition, NW 33 COG surveyed technology users to measure perceptions about reliability:

  - A majority of respondents indicated the CV technology is unreliable (59 percent), including 16 percent who rated the technology as somewhat unreliable and 43 percent who rated it as extremely unreliable.

  - By contrast, about one-fifth felt the technology is reliable (15 percent somewhat reliable and 4 percent very reliable). As noted previously, the grantee reported that a lack of user training likely contributed to the low ratings.

The following two grantees assessed system performance by measuring system confidence:

- **AI-Powered Decision Support Tools for ICM**: TDOT deployed ICM followed by an AI-based DSS on its I–24 corridor to improve transportation operations. TDOT surveyed system operators to understand the perceived usefulness of the AI-DSS information to decisionmaking; operators' level of confidence in accepting the AI-DSS recommendations, and the level of operator intervention in changing the recommended responses:

    - Overall, the operators indicated that they found the information provided by the system useful, as it increased awareness of what was happening in the corridor and made their jobs more efficient.

    - Operators reported no issues with having to wait for a suggested response, and the AI-DSS recommendations generally aligned with their expectations.

- **Deployment of the Washington State VCC for Multimodal ICM:** WSDOT deployed a VCC for integrated multimodal corridor management and assessed several different measures related to system confidence. Surveys and interviews of VCC staff, as well as an evaluation of the system, provided insight on the following performance measures:

    - *Survey of VCC Satisfaction*: The average satisfaction with the accuracy of the information from other agencies increased across the three survey phases from an average score of 55 to 70 (the scale ranged from 0 to 100), indicating that VCC users were more satisfied over time. The average satisfaction rating for increased collaboration did not increase significantly (from 55 in Phase 1 to 60 in Phase 3).

    - *Survey of Accuracy of Incident Clearance Times*: Of the 302 VCC closed incident models, only 18 (6 percent) included an estimated clearance time. The baseline interviews and surveys indicated that VCC users preferred not to give estimates as they believed them to be unreliable.

    - *Survey of Trust in VCC Information:* Trust was high in all three postdeployment surveys. The average rating for trust in the information that is available in an active VCC incident model was 81 in Phase 1, 76 in Phase 2, and 81 in Phase 3. The average ratings for trust in the information in the VCC agency dispatches were similarly high: 82 in Phase 1, 75 in Phase 2, and 83 in Phase 3.

    - *Interviews Regarding Changes in Staff Interactions With Legacy Systems:* WSDOT also anticipated that the VCC would result in changes in staff interactions with legacy systems, but the findings for this measure were mixed. Of the 18 staff members the agency interviewed, the majority (10) reported that their interactions with the legacy systems remained the same, while 8 staff members indicated a change.

- *System Evaluation:* In addition, WSDOT assessed system confidence by evaluating whether the rules engine in the VCC is making good decisions about when to autogenerate incident models. The evaluation found that the rules engine generated several false positives, which required additional labor on the part of users. However, these system-generated false positives were not increasing in number over time as the number of total incidents has increased, indicating that the relative burden of managing them is decreasing.

The following five grantees assessed system performance using performance measures related to data availability and use, and their findings are generally positive:

- **Connecting Cleveland:** Following its deployment of new transit communication systems, RTA measured the number of Transit® app users and found a steady increase in the number downloading and using the app. The evaluation found that 15 percent of all RTA riders use the app for more than 500,000 trips per month.

- **A Connected Region: Moving Technological Innovations Forward in the NITTEC Region:** NITTEC, which deployed a data hub and a DSS to enable an integrated regional mobility management system, evaluated the number of agencies populating and receiving each type of data in the system. From 2022 to 2024, the number of datasets increased by 44 percent, from 27 to 39. The number of instances in which the datasets were used increased by 28 percent, from 43 to 55 (the number of agencies using the system also increased from 9 to 17).

- **Utah Connected:** In evaluating its new Data Ecosystem®, which was developed as part of its CV deployment, UDOT measured the number of data sources, the percentage of available data sources being ingested, and the frequency of data ingestion. In total, 199 RWIS sensors, 186 OBUs, 296 RSUs, 296 network switches, 236 security credential management systems (SCMSs), and 236 traffic signal controllers are integrated into the system. UDOT found that 100 percent of all available data elements from these data sources are being ingested into the Data Ecosystem, and no data are excluded or removed. Despite its ingestion, however, not all data are being used, and efforts to use the data more fully are underway in subsequent projects.

- **Deployment of the Washington State VCC for Multimodal ICM:** Based on its survey of VCC operators, WSDOT found that 5 of 11 VCC users felt that the VCC had helped them leverage other agency resources, suggesting mixed results on this performance measure.

- **AI-ITMS:** DelDOT set a target that the AI-ITMS should simultaneously monitor 50 percent of DelDOT's ITS and internal networks. DelDOT determined that devices that currently feed data into Artificial Intelligence-Based Transportation Operations Management System (AI-TOMS) algorithms can be considered as actively monitored. Using this definition, DelDOT found that 89 percent of devices are concurrently being monitored, far exceeding the 50-percent target.

Reduced Costs

Five projects reported evaluation findings that addressed reduced costs. Projects indicated that the deployed technologies have improved operational efficiency through streamlined processes, improved awareness, and reduced burdens.

Each project that reported evaluation findings related to reduced costs was able to demonstrate a benefit:

- **Connecting Cleveland Project**: For this project, RTA installed software that provides real-time health monitoring for vehicles' onboard ITS equipment. With device management, RTA is able to monitor vehicles in realtime and troubleshoot issues remotely and can push software fixes to the vehicles while in operation to increase efficiency. RTA also installed 10-inch color tablets to onboard vehicles. These devices provide various benefits, including easy navigating options, brightness or dimming features, turn-by-turn navigation, and pretrip inspections. RTA replaced its paper-based pretrip inspection system with a paperless system, so operators record any issues with their vehicles using their tablets. The information is now recorded in an RTA database, so it can be more easily tracked, and a daily report is provided to the maintenance staff. The new system is more efficient and saves more than 240,000 pieces of paper each year.

- **TRS and Automated Workflow Data Model**: POV achieved a reduction in operational gate hours while handling more cargo through its gates. In 2018 and 2019, POV gates were open for 22 hours each day to keep up with the cargo demand. After fully implementing mandatory reservations, POV was able to decrease gate operational hours by 40.9 percent, down to 13 operational gate hours, while handling a 76.4-percent increase of ingate container volume (2019–2021). Notably, all labor hours outside of the standard operating day are paid at a premium rate, so a reduction in these hours also reduces operating costs. The process of handling containers (from the ship to the stack, within the stack, and to the truck) takes time and coordination from different port systems.

    - The AI housekeeping enhancement for stack optimization will also directly reduce the costs of operating POV by reducing turn times and reducing the need for additional operating hours to accommodate greater capacity.

    - The housekeeping proof of concept focused on measuring key performance differences between AI-based housekeeping container stacks versus non-AI-based housekeeping container stacks.

    - For the period beginning September 1, 2022, through November 14, 2022, the AI-managed stacks outperformed the baseline stacks. The AI housekeeping proof of concept produced a measurable reduction in the number of rehandles (i.e., how many containers would be required to shift out of the way to lift a target container) and a reduction in gantry distances for truck deliveries, and it enabled a net increase in deliveries per hour.

  - On an average day, the stacks that used AI-based housekeeping saw a reduction in rehandles of domestic imports by 28.6 percent.

  - Based on the results from the proof of concept, POV could potentially eliminate 218 unnecessary moves per day, or 5,154 wasteful container repositioning moves per year.

- **AI-Powered Decision Support Tools for ICM**: Through a survey of TMC operators, TDOT found that information provided by the system has been useful in making the TMC technicians' job more efficient and making them more aware of what is happening on the entire corridor.

- **Deployment of the Washington State VCC for Multimodal ICM**: In the Phase 1 postdeployment survey, 12 of 28 respondents indicated that they were responsible for report creation, and when asked if it was less work to create these reports, the mean rating was 33.42 (on a scale of 0 to 100, where 0 is completely disagree and 100 is completely agree). Twenty of 41 respondents in Phase 2 reported having responsibility for report creation, and they had a slightly higher agreement that it was less work to create reports (mean = 39.50); however, this increase is not statistically significant. In Phase 3, the average agreement level increased to a mean rating of 76.60, which was a statistically significant increase from the Phase 1 average rating.

- **I–270 PLOI**: Through implementing a crash risk area and incident identification tool, advanced video analytics, and IMRCP, MoDOT sought to improve the return on investment and realize cost savings from rapid ER deployment. Based on interviews with ER operators, MoDOT found that that all participating ER operators consistently log into the crash risk area and incident identification tool at the beginning of their shifts. ER respondents rated the technology with an average score of 3.67 out of 5. Their feedback highlighted several benefits of the platform, such as reduced radio chatter and improved incident mapping, while also pointing out challenges like platform instability, accuracy issues, and the process of logging information. The effectiveness ratings varied, reflecting an appreciation for the advanced information provided by the tools, but also emphasizing the need for improvements. The respondents also expressed mixed feelings about continuing to use the crash risk location prediction and incident identification tool, citing its potential benefits against operational challenges.

GRANTEE-REPORTED INSIGHTS

In their final reports, grantees are required to share challenges, lessons learned, and recommendations from their project deployments. The research team performed a review of the challenges, lessons learned, and recommendations from the nine grantees who have submitted final reports. The team identified the key categories based on the grantees' reported information. Grantees' challenges, lessons learned, and recommendations fell into the following eight categories:

- Data.
- Technology.
- Stakeholder or Project Management.
- Project Scoping.
- National Events.
- Evaluation.
- User Experience.
- Policy or Regulatory.

Each of the following sections provide a brief description of the category. The research team further classified the grantees' challenges, lessons learned, and recommendations within each category into more specific subtopics. The following sections highlight both the shared and unique experiences of the nine grantees and are listed in order of the number of grantees who shared each takeaway. Grouping these challenges, lessons learned, and recommendations into categories and subcategories was a subjective exercise designed to identify commonalities among grantees. In addition, the findings presented in the following sections are general summaries of the challenges, lessons learned, and recommendations. For more detailed information, please reference the grantees' published final reports.[39]

[39]Five of the nine grantees are formally completed (i.e., closed), with final reports published as of March 31, 2025. Once published, final reports are posted on FHWA's Fixing America's Surface Transportation Act or "FAST Act" web page. As of March 31, 2025, final reports for Cleveland RTA, POV, DelDOT, WSDOT, and NW33 COG are published. See https://ops.fhwa.dot.gov/fastact/.

Data

These challenges, lessons learned, and recommendations focus on issues with data collection, storage, and use:

- **Data Quality:** MoDOT reported data quality issues due to the compression of video data from agency cameras through third-party software negatively impacting the quality of the footage. UDOT reported several data integrity issues, including Global Positioning System errors and incorrect observations for vehicle speed. UDOT also noted that fiber optic data quality is dependent on the installation method used. TDOT reported that integrating data from multiple sources presented data quality challenges related to completeness, accuracy, and reliability. TDOT recommended checking data streams for consistency before collecting baseline data. The grantee also noted that higher quality data inputs for weather information and real-time arterial traffic conditions would have improved the AI-DSS for VSL and diversion routing.

- **Insufficient Data or Data Loss:** UDOT reported challenges gathering enough data to train its fiber optic sensors. TDOT faced challenges with the timeliness of data and historical data gaps and, as a result, struggled to successfully capture current conditions in its analysis. DelDOT reported an inability to successfully model vulnerable road users due to insufficient data. Finally, the NW 33 Innovation Corridor COG lost a lot of data because of issues with its over-the-air download function not working properly between its RSUs and its OBUs.

- **Data Validation:** A common theme among applicants collecting a large amount of data was the need to either manually or systematically validate the data collected. WSDOT and DelDOT both had issues with incident timelines being inaccurate and requiring validation. MoDOT found that the existence of duplicate events meant that operators lost time validating alerts, while UDOT recommended validating MAP messages[40] against real field conditions.

- **Data Storage:** UDOT, DelDOT, and the NW 33 Innovation Corridor COG shared lessons learned about the high cost of data storage. Given the massive amounts of data generated by these advanced technologies, deployers may need to balance what data need to be stored versus the cost of storage.

- **Security Standards:** DelDOT had issues with firewall updates significantly slowing the deployment of new capabilities, and the NW 33 Innovation Corridor COG shared that it could not detect which OBUs were installed on its project vehicles due to anonymity security measures. In contrast, WSDOT reported that users were concerned about its data being leaked if shared with the grantee, so WSDOT had to build trust with its stakeholders.

[40]USDOT. n.d. *MAP Tool* (software). https://webapp.connectedvcs.com/, last accessed May 1, 2025.

- **Using Existing Data:** Both MoDOT and TDOT recommend considering the use of existing organizational data, or data from other existing systems or deployed devices, before investing in new data.

- **TDOT's Other Data Takeaways:** TDOT also made recommendations relating to data dashboard and visualization tools; it noted the helpfulness of these tools for performance monitoring and measurement and emphasized the benefits of developing tools early. The project team cautioned, however, that some tools may have limitations that could affect the presentation of results.

Technology

These challenges, lessons learned, and recommendations relate to technology-specific issues:

- **Test Bed Effect:** Both the NW 33 Innovation Corridor COG and DelDOT mentioned the positive effects of their test beds. Since completing their projects, they have had a "test bed" effect, attracting other advanced transportation technology deployers to their regions for testing. Similarly, TDOT reported that the knowledge gained from its test bed could be leveraged to support the deployment of advanced transportation technology in other regions of the State.

- **Technology Verification:** MoDOT struggled with obtaining sufficient data for technology validation. Specifically, the grantee was unable to accurately verify the success of the IMRCP tool, which is used to refine weather and traffic forecasts, due to limited events of adverse weather conditions during the analysis period. TDOT reported that construction, seasonal changes, and driver compliance present challenges for technology verification and evaluation. UDOT recommended testing technology after installation to make sure that it works properly.

- **Importance of Standardization:** The NW 33 Innovation Corridor COG and WSDOT emphasized the importance of creating consistency across technology. The NW 33 Innovation Corridor COG coordinated with DriveOhio to create SAE International® J2945 standards,[41] whereas WSDOT collaborated with SDOT to standardize operating procedures for VCC usage.

- **Rapid Changes of Technology:** The NW 33 Innovation Corridor COG and DelDOT had rapid changes to technology that interrupted their original plans and schedules. In NW 33 Innovation Corridor COG's case, the grantees needed to upgrade from Internet protocol version (IPv)4 to IPv6 (the IPv4 standard was insufficient for conducting over-the-air updates for OBU firmware and certificate top offs for the SCMS). In DelDOT's case, the agency needed to upgrade the firmware on many traffic signals.

[41] See https://www.sae.org/standards/content/j2945_201712/.

- **Technology Function and Accuracy:** MoDOT struggled with the accuracy of its Advances Video Analytics tools. Additionally, both MoDOT and DelDOT reported inclement weather interfering with their traffic cameras, which limited the tool's ability to accurately detect and categorize traffic conditions.

- **UDOT's Other Technology-Specific Takeaways:** UDOT had several takeaways regarding its SCMS. First, the agency highlighted the importance of managing security certificates, as expired or missing certificates can cause devices to ignore critical messages. The grantee also recommended replacing certificates on older OBUs, instead of attempting to "re-enroll" the devices. Additionally, the agency emphasized careful planning of RSU configurations as vital to accommodate future message types and avoid unnecessary costs or security risks. Finally, UDOT noted that ongoing Internet connectivity and resources are essential for regular certificate replenishment and monitoring.

- **DelDOT's Other Technology-Specific Takeaways:** DelDOT reported uncertainty about whether its AI-TOMS could be scaled to all statewide traffic lights.

- **WSDOT's Other Technology-Specific Takeaways:** WSDOT recommended that operational changes due to new technologies should align with current operational practices and agency roles. In addition, the grantee recommended that deployers should not add too much complexity because busy users will likely skip over complicated features.

- **NW 33 Innovation Corridor COG's Other Technology-Specific Takeaways:** The NW 33 Innovation Corridor COG assumed J2945/4 would have been published in time for the project, but since it was not, the grantee had to shift to a less desirable alternative. The grantee also recommended that future CV projects should start small and develop the performance measures accordingly, rather than assuming a huge deployment of CVs when drafting performance measures. Finally, this grantee also mentioned that in the initial version of its project, pedestrian alerts relied on button presses, which did not always happen or did not always mean someone would be walking. The agency recommended making it more reliant on actually detecting pedestrians, as users need to trust the technology is accurate (i.e., if it says a pedestrian is walking, there should be one).

- **TDOT's Other Technology Specific Takeaways:** For future deployment, TDOT recommended additional vehicle detection to serve as a queue flush function on some of the offramps along the corridor.

- **MoDOT's Other Technology Specific Takeaways:** MoDOT reported challenges related to the integration of multiple technologies under a cohesive platform. The grantee highlighted that the integration process required extensive and time-consuming customization and, in some instances, redevelopment of certain components to ensure compatibility across the different technologies.

Stakeholder or Project Management

These challenges, lessons learned, and recommendations relate to stakeholder involvement and project management strategies:

- **Stakeholder Communication and Coordination:** Several projects reported challenges and recommendations regarding communicating and coordinating with stakeholders:
    - Both WSDOT and the NW 33 Innovation Corridor COG recommend forming a committee of stakeholders and technology users who have a role in decisionmaking to provide feedback throughout the deployment process.
    - POV highlighted the importance of creating a communication plan with all related stakeholders.
    - MoDOT emphasized the importance of transparent and continuous communication with all parties involved in the project to ensure alignment of goals and expectations. MoDOT also reported that coordination with police is helpful in achieving the most impactful results in terms of crash reductions and safety improvements.
    - WSDOT recommended building stakeholder feedback frameworks around existing stakeholder coordination mechanisms.
    - Finally, TDOT reported that TMC operators found limited cooperation from other local agencies to be a leading factor in managing incidents, and NITTEC simply reported that stakeholder cooperation was a leading project challenge.
- **Program Management Processes:** Several projects had takeaways regarding methods and processes to improve project management:
    - DelDOT and WSDOT used an "agile development" process that relies on stakeholder iteration in the development of software. This process enabled the grantees to continuously adjust and improve the design based on stakeholder input.
    - TDOT recommended using alternative delivery methods, such as integrated project delivery, which can promote collaboration from all stakeholders and facilitate an efficient working structure.
    - NITTEC faced roadblocks in the early stages of the project due to an initial underestimation of the required project management tasks and reported that challenges were ultimately overcome by breaking the project into two phases—a planning phase and an implementation phase—and soliciting consultant services to assist in project management tasks. The grantee also emphasized the importance of developing well-thought-out system requirements and management strategies.

- **Community Support:** MoDOT struggled with some agencies and municipalities being unwilling or unable to incorporate technology due to low staff or budget constraints. Both the NW 33 Innovation Corridor COG and WSDOT recommended building community buy-in to ensure the new technology has a user base and that the community will support continued investment in technology.

- **Installation:** UDOT recommended creating a guidebook when installing something new to make it easier to install next time. Cleveland RTA recommended having internal staff members do installations, so that they have a better understanding of the system as a whole.

- **Emerging Technologies:** Both MoDOT and the POV recommended building extra time into project scheduling when working with cutting-edge technology.

- **UDOT's Other Stakeholders or Project Management Takeaways:** UDOT emphasized the importance of defining internal roles and responsibilities within a project.

Project Scoping

These challenges, lessons learned, and recommendations relate to problems with project scoping:

- **Immature Technology:** NW 33 Innovation Corridor COG, WSDOT, and UDOT overestimated the ability of current technology and had to reduce their scopes.

- **Underestimation of Funding Needs:** NW 33 Innovation Corridor COG underestimated the amount of funds required to power its RSUs and recommended further coordination with power companies. NITTEC recommended identifying ongoing maintenance costs before entering deployment to avoid underestimation of required funds.

- **Staffing Considerations:** Cleveland RTA underestimated the number of staff members needed for the project, requiring staff to work overtime to complete the project on time. MoDOT emphasized the importance of securing adequate technical support for the project, including expertise from professionals such as data scientists.

- **NW 33 Innovation Corridor COG's Other Stakeholder or Project Management Takeaways:** The NW 33 Innovation Corridor COG recommended developing a set of use cases first, then evaluating each by its technology viability, BCR, and stakeholder feedback.

- **NITTEC's Other Scoping Takeaways:** NITTEC recommended carefully considering the amount of upfront planning needed before entering deployment to avoid project delays or other scoping challenges.

National Events

These challenges, lessons learned, and recommendations stem from national events that disrupted the projects in some capacity:

- **Reduced Travel Demand:** DelDOT had difficulties establishing a baseline between 2020 and 2021 to evaluate system performance due to lower travel demand. NITTEC removed the year 2020 from its analyses to account for irregular travel behavior during that year, but the grantee noted that it could not completely account for the effects on transportation that extended beyond 2020. UDOT could not test its autonomous bus operations due to a reduced demand for the system resulting from business closures.

- **Remote Work Requirement:** DelDOT, Cleveland RTA, and MoDOT mentioned the inability to come into the office led to logistical challenges for the project, while the POV listed the need for remote work as a recommendation.

- **Supply Shortages:** DelDOT and the NW 33 Innovation Corridor COG both had difficulty acquiring all the required equipment for their projects due to limitations in supply.

- **MoDOT's Other National Events Takeaways:** MoDOT noted that the shift in priorities to ER and public health-related projects meant that other projects were deprioritized, resulting in unforeseen budgetary and resource allocation constraints. This grantee emphasized the importance of agile staff allocation strategies during national events to ensure the continued prioritization of project goals amid unforeseen constraints.

Evaluation

These challenges, lessons learned, and recommendations focus on issues relating to project evaluation:

- **Benefits Estimation:** Both TDOT and NITTEC highlighted the difficulty of estimating and monetizing benefits when evaluating impacts. TDOT struggled to attribute any benefits or disbenefits observed to specific ITS subsystems, given that the project deployed multiple subsystems across the project areas and that external influences such as driver behavior could not be controlled. NITTEC reported that the benefits associated with its system were largely centered around the provision of real-time data and improved situational awareness—both of which cannot be easily monetized.

- **Evaluation Data:** TDOT struggled to access data for the full baseline period due to data source availability and reliability, which ultimately resulted in the removal of performances measures from the project evaluation.

- **Evaluation Design**: TDOT noted that once the system went live, the grantee was reluctant to turn it off to collect "before" data or to isolate the effects of individual subsystems, as it believed this interruption would deny the public the potential benefits. Lastly, the grantee struggled to assess the safety impact of VSL due to the infrequency of vehicle-to-vehicle collisions and the existence of confounding factors such as weather. UDOT faced several experiment design and data challenges that caused inconsistencies in its results when comparing equipped and nonequipped snowplow performance. As a result, an adequate pre-post evaluation was not possible.

User Experience

These challenges, lessons learned, and recommendations focus on the users' experience with the deployed technologies:

- **User Confusion:** MoDOT, WSDOT, UDOT, and the NW 33 Innovation Corridor COG had recommendations centered around addressing user confusion with their technology. MoDOT noted difficulties adapting staff routines to accommodate new technologies and emphasized the importance of ensuring all operators fully understand new technologies and their benefits. WSDOT and UDOT's recommendations focused on user interface (UI); WSDOT suggested mobile compatibility, as its initial app was not well designed for mobile technology, and UDOT suggested collecting UI feedback from multiple users. NW 33 Innovation Corridor COG recommended user training for its use case.

- **WSDOT's Other User Experience Takeaways:** WSDOT shared that technology users often like the simpler option when given a choice and mentioned this preference is important to keep in mind when designing a system.

- **MoDOT's Other Use Experience Takeaways:** MoDOT highlighted that positive feedback from the operators verifying and using new technologies is crucial for them to build a sense of ownership over the tools being used.

Policy or Regulatory

These challenges, lessons learned, and recommendations relate to new regulations and policies that interrupted projects or caused delays:

- **FCC 5.9 GHz Rule:**[42] This rule affected both UDOT and the NW 33 Innovation Corridor COG's projects, causing delays and reshaping their scope.

- **UDOT's Other Policy or Regulatory Takeaways:** UDOT experienced challenges resulting from the National Highway Traffic Safety Administration's suspension of EasyMile®, a France-based autonomous shuttle company, in 2020, due to a passenger being injured. Ultimately, UDOT experienced schedule delays and budget issues.

[42]The FCC's November 10, 2020, First Report and Order (86 FR 23281), approved on November 18, 2020, and published in the *Federal Register* on May 3, 2021, describes changes to the allocated 75 MHz of radio spectrum in the 5.9 GHz band used for vehicle and infrastructure communications, which is also known as the Safety Band.

CHAPTER 4. GRANTEES' CONCLUSIONS

The FAST Act established the ATCMTD Program to develop model deployments to improve safety, efficiency, system performance, and infrastructure return on investment. USDOT has awarded 58 projects from FY 2016 through FY 2021, including city and county projects, as well as statewide and regional projects. The projects represent a diverse set of advanced technology deployments across the United States. Some of the key technology deployments include CVs, advanced traveler information systems (TISs), ICM, AI-enhanced maintenance and monitoring technologies, adaptive traffic signal control, and AVs. The projects span a range of modes and service models: vehicle, freight, transit, pedestrian and bicyclist, and MOD.

This 2025 ATCMTD Program report summarizes key findings from the following nine completed projects:

- Connecting Cleveland Project, *Greater Cleveland RTA*.
- TRS and Automated Workflow Data Model, *POV*.
- AI-ITMS Deployment Program, *DelDOT*.
- NW 33 Smart Mobility Corridor, *NW 33 COG*.
- Utah Connected, *UDOT*.
- Deployment of the Washington State VCC for Multimodal ICM, *WSDOT*.
- I–270 PLOI, *MoDOT*.
- A Connected Region: Moving Technological Innovations Forward in the NITTEC[43] Region, *NFTA*.
- AI-Powered Decision Support Tools for ICM, *TDOT.*

These projects include two ICM deployments, two integrated transportation management systems, two CV deployments, a port management system, an incident detection and prediction tools project, and a transit communications and vehicle monitoring project. Five of the projects use AI or ML.

Seven projects measured the safety benefits of their project deployments, and in the majority of cases, the findings are positive; the projects resulted in reduced crashes, improved response times, and improved detection times. Seven projects reported evaluation findings related to reduced congestion or improved mobility. The projects indicate positive impacts on mobility, including improved transit ontime performance, reduced congestion, and eased traffic management. For the goal of improved system performance, most grantees reported positive results related to system reliability, system confidence, and data availability, with a couple of projects demonstrating mixed findings. In addition, five projects reported evaluation findings that addressed reduced costs. Projects indicated that the deployed technologies have improved operational efficiency through streamlined processes, improved awareness, and reduced burdens.

This report also summarizes the grantees' challenges, lessons learned, and recommendations, as described in the final reports of the nine completed projects. Key themes include data, technology, stakeholder and project management, project scoping, national events, evaluation, user experience, and policy and regulations. The grantees commonly cited data-related topics,

[43]Niagara International Transportation Technology Coalition.

including data quality, insufficient data or data loss, data validation, data storage, and security standards, among other issues. Grantees mentioned a range of technology topics, including the importance of standardization and technology verification, the need to adapt to rapidly changing technology, as well as the importance of technology testing and aligning the operational practices of new technologies within agencies' existing frameworks. Some grantees cited issues related to the functioning and accuracy of the deployed technology. Stakeholder and project management issues tended to focus on the importance of engaging stakeholders, building community support, and project management processes. A number of grantees cited project scoping issues, with several indicating that they overestimated the capabilities of immature technologies and had to rescope their projects. Other project scoping issues involved underestimating the costs of the project and staffing considerations. Other lessons learned related to national events, whether it was in the context of reduced travel demand, supply shortages, or remote work requirements that affected projects. Evaluation-related challenges, such as benefits estimation and evaluation design also surfaced, as did user experience issues. With respect to policy and regulations, the FCC's 5.9 GHz Rule affected some projects. Appendix B summarizes the challenges and lessons learned reported by the 45 ongoing (i.e., not completed) projects.

In addition to the 9 completed projects, 5 grantees have completed deployment and are collecting evaluation data; an additional 28 grantees are piloting, testing, or beginning to deploy technologies; and 12 grantees are still in the planning phases.

APPENDIX A. ADVANCED TRANSPORTATION AND CONGESTION MANAGEMENT TECHNOLOGIES DEPLOYMENT PROJECT DESCRIPTIONS

This section summarizes each ATCMTD project selected for an award, including grant amount, project goals, and technologies being deployed.

FISCAL YEAR 2021 PROJECTS

Proactive Route Operations to Avert Congestion in Traffic (PROACT) Alabama *(ALDOT)*:

- Grant Amount: $5 million.
- Project Goals: This project improves highway management and operations to connect residents to jobs, healthcare, education, and service through reduced congestion, improved measurement of operational performance, a reduced number of and severity of crashes, and improved real-time information to improve mobility.
- Technologies Being Deployed: Advanced traffic technologies and decision support tools, including dedicated short-range communication (DSRC), cellular vehicle-to-everything (C-V2X), cellular, 900-MHz radios, an advanced road weather monitoring and forecasting tool and technologies, CV probe data, a central traffic management system and machine vision for signalized intersection operations and safety, CV hardware for a freight priority app, and TIS apps.

An End-to-End Decision Support System for Integrated Smart Electric Grid and Transportation System Management *(City of Chattanooga, TN)*:

- Grant Amount: $4,577,721.
- Project Goals: This project improves access to electric vehicle (EV) charging stations, accelerates deployment of clean transportation, reduces transportation-related emissions, reduces traffic incidents, improves travel time reliability, optimizes multimodal system performance and access, and provides cost savings to transportation agencies, businesses, and users.
- Technologies Being Deployed: A centralized citywide traffic management system, smart electric grid monitoring and management system, EV charging infrastructure online monitoring system, system-of-systems analytics and end-to-end DSS, a DSS for EV charging, personalized EV charging information system, cellular and DSRC, roadside cameras, intersection light detection and ranging, and wireless communication technologies.

Chicago Centralized Transit Signal Priority Project (CCTSP) *(City of Chicago, IL)*:

- Grant Amount: $3,990,000.
- Project Goals: This project enhances the use of existing transportation capacity to reduce costs and improve return on investment, advance public transportation systems, implement advanced safety systems, and reduce environmental impacts.
- Technologies Being Deployed: Centralized TSP system utilizing existing infrastructure, high-frequency bus automatic vehicle location reporting, an interface between central bus system and ATMS, video analytics and AI technology at intersections with DSRC or C-V2X communication, and remote TSP requests placed on the signal controller by ATMS.

Great Plains Rural Freight Technology Corridor Project *(KDOT)*:

- Grant Amount: $6,679,072.
- Project Goals: This project uses advanced technologies to deliver traffic, weather, and other operational information to commercial truckers to optimize freight routing, improve safety, reduce congestion, and improve economic opportunities.
- Technologies Being Deployed: Fiber optic communication cables to enable V2I, RWISs, microwave vehicle detection systems, signal phase and timing (SPaT), CV integrations for freight vehicles, DMSs, and an expansion of online real-time traveler information.

Kentucky's Wrong-Way Driving and Integrated Safety Technology *(Kentucky Transportation Cabinet)*:

- Grant Amount: $5,147,300.
- Project Goals: This project detects and deters wrong-way incidents by alerting other drivers and emergency responders and improves an existing ITS to monitor and detect other safety concerns related to pedestrians, debris, and halted vehicles on the roadway.
- Technologies Being Deployed: Computing and video processing with thermal cameras, automatically activated flashing light-emitting diodes (LEDs) on wrong-way signs, DMSs, machine readable QR codes® on wrong-way signage, and DSRC (5.9 GHz spectrum).

Port of Los Angeles Gateway *(Port of Los Angeles, CA)*:

- Grant Amount: $3 million.
- Project Goals: This project improves trucking, drayage, and terminal operator activities by streamlining cargo staging and empty returns, which will decrease congestion at the port.
- Technologies Being Deployed: Web-based user portal, digital twin, ML, AI, microservice architecture, Internet of Things, radiofrequency identification (RFID), Wi-Fi™, Bluetooth™, and an app program interface.

EZConnect: An Open and Cloud-Based Mobility Center Providing One-Stop Access for Travel Needs of Underserved Customers *(NEORide, Ohio)*:

- Grant Amount: $1,493,313.
- Project Goals: This project improves the availability of real-time information to connect underserved riders to multiple transit agencies providing service through a central system, which reduces congestion and increases customer access and satisfaction.
- Technologies Being Deployed: A cloud-based real-time mobility coordination center with an open data exchange, V2X technologies, a trip planner with integration with the EZfare® payment system, and a centralized reservation and coordination system.

Electric Vehicle User Range Anxiety Solution for Rural North Dakota *(NDDOT)*:

- Grant Amount: $1,449,000.
- Project Goals: This project accelerates the deployment of EV charging stations, creates jobs, and advances access to clean transportation in rural areas.
- Technologies Being Deployed: Wi-Fi, electronic pricing and payment systems at charging stations, and smart grid technologies.

Smart and Connected Atlantic City Expressway *(SJTA)*

- Note: FHWA and the grantee mutually agreed to terminate the grant, and the grantee returned the obligated funds. Grant Amount: $8,748,763.
- Project Goals: This project transforms the Atlantic City Expressway into a smart and connected corridor to serve transportation users safely and efficiently while supporting the deployment of CAVs in the future.
- Technologies Being Deployed: DSRC and C-V2X for cashless tolling, RSUs, OBUs, and congestion pricing algorithms.

Washington State Ferries Terminal Wait Times TIS *(WSDOT)*:

- Grant Amount: $5,122,345.
- Project Goals: This project improves service reliability and efficiency, increases ridership, improves customer experience, and supplements existing city and highway congestion information to provide more comprehensive travel information.
- Technologies Being Deployed: Cellular (4G and 5G) communications, Bluetooth and Wi-Fi readers, microwave detection sensors, license plate recognition systems, LiDAR (light detection and ranging), location-based services data, RFID, and a systemwide terminal wait-time TIS.

FISCAL YEAR 2020 PROJECTS

Advancing Connectivity and the Economy Through Technology in the San Diego Region *(San Diego Association of Governments, California)*:

- Grant Amount: $9,298,300.
- Project Goals: This project improves safety, expands transportation services and choices, provides the tools for actively managing all transportation systems, enhances access and services to transportation information, and adapts to transportation trends and services for all modes.
- Technologies Being Deployed: Mobility hub technologies, smart intersection system, CV roadside and onboard equipment, border wait time monitoring system, next-generation traveler information, CV border tolling, and commercial vehicle inspection technology.

Pinellas Connected Community *(Pinellas County Public Works Department, Florida)*:

- Grant Amount: $9,298,300.
- Project Goals: This project improves the safety of pedestrians and intersections within the region; improves mobility within the region; accelerates deployment of V2X technologies; reduces the number and severity of traffic crashes; and increases driver, passenger, and pedestrian safety.
- Technologies Being Deployed: CV technologies, including emergency vehicle preemption, TSP, speed warnings, intersection warnings, vehicle hazard warnings, and emergency vehicle warnings; demand management; decision support; work zone monitoring; a mobile phone-based OBU app; and video analytics technologies.

Emergency Vehicle Preemption Using Connected Vehicle Technology (*GDOT)*:

- Grant Amount: $3,206,809.
- Project Goals: This project reduces incident response time, reduces ambulance transport time, decreases pedestrian crashes, facilitates arterial traffic flow, reduces delay, measures and reports quantifiable system performance measures, and enables system reproducibility and transferability to other regions within metropolitan Atlanta and national locations.
- Technologies Being Deployed: Fifteen dual-mode (DSRC and C-V2X) RSUs, 170 dual-mode OBUs installed in incident management vehicles and ambulances, a real-time information smartphone app, and an SCMS.

Maine Advanced Signal Control and Connected Vehicle System for Safe, Efficient, and Equitable Rural Transportation (MAST) Project *(MaineDOT)*:

- Grant Amount: $3,471,615.
- Project Goals: This project maximizes investments, lessens environmental impacts by monitoring and rapidly correcting operating deficiencies, measures operational performance, reduces crash severity, increases traveling public awareness, responds rapidly to changing operational status, improves economic benefits, increases operational CV footprints and the integration of advanced technologies, and enhances the understanding of traffic flow.
- Technologies Being Deployed: Advanced traffic controllers, traffic detection system, DSRC and cellular V2I infrastructure and units, cellular modem and hardwire communication infrastructure, automated traffic signal performance measures, and traffic signal control data analytics based on AI.

Smart Intersections: Paving the Way for a National Connected and Automated Vehicle (CAV) Deployment *(University of Michigan)*:

- Grant Amount: $9,950,098.
- Project Goals: This project reduces crashes and fatalities; improves safety for drivers, passengers, vulnerable road users, and first responders; reduces transportation-related emissions; improves operational performance; reduces infrastructure costs; improves return on investment; and paves the way for a national CAV deployment.
- Technologies Being Deployed: C-V2X and DSRC dual-mode RSUs; DSRC and V2V fleets; smart sensors with edge computing, authentication, authorization, and accounting servers; data analytics; and an advanced V2X technology living lab.

Integrated Safety Technology Corridor *(Regional Transportation Commission of Southern Nevada)*:

- Grant Amount: $6 million.
- Project Goals: This project streamlines traffic flow, enhances the use of real-time data and analytics, reduces the number and severity of crashes, and enhances the monitoring of infrastructure to identify and prioritize repairs.
- Technologies Being Deployed: Active traffic management, wrong-way driver notifications, strategic traffic management sites, high-occupancy vehicle (HOV) detection, and an integrated data platform and interface.

Charlotte Avenue/Dr. Martin L King, Jr. Boulevard Transit Headways and Congestion Management *(Metropolitan Government of Nashville and Davidson County, TN, Public Works Department)*:

- Grant Amount: $1,500,000.
- Project Goals: This project uses technology to enhance connectivity to employment, institutional, and cultural destinations, transforming the operation of a key transit corridor and setting the stage for future technology investments throughout the region. It also improves safety, mobility, choice, and the overall quality of life for city residents.
- Technologies Being Deployed: Connected transit vehicle technology, connected V2I intersection upgrades, TSP, congestion management technology, fleet headway management software, and real-time bus occupancy data.

S.M. Wright Smart Corridor *(City of Dallas, TX)*:

- Note: FHWA and the grantee mutually agreed to terminate the grant, and the grantee returned the obligated funds.
- Grant Amount: $4 million.
- Project Goals: The grantee designed this project to improve the system performance of the S.M. Wright corridor, provide advanced performance measures for evaluating operations, reconnect and revitalize areas to improve mobility, connect high-density residential areas with small-scale neighborhood commercial uses, and provide information to other entities for deploying the project's technologies.
- Technologies Being Deployed: Smart traffic signal packages, smart bus shelters, autonomous vehicles, advanced transportation-related emissions monitoring, RSUs, OBUs, roadside control units, a connected mobility control center, a connected mobility platform, a deep learning versatile platform, a data analytics platform, integrated mobility interface, a CV transit pedestrian alert system, and traffic management system improvements.

Utah Broadly Connected *(UDOT)*:

- Grant Amount: $5,450,000.
- Project Goals: This project leverages real-time information to improve safety, mobility, and system efficiency; enhance the quality of life; and prepare Utah's transportation network for future deployments.
- Technologies Being Deployed: CV apps using V2X technology, including DSRC and C-V2X for CSW, the Spot Weather Impact Warning system, intersection safety, roadway departure warnings, VSL, infrastructure monitoring, and TSP apps; data analytics, including ML, deep reinforcement learning, AI, and vehicle image reidentification and cellular telematics technology; automated traffic signal performance metrics; third-party probe data (e.g., Bluetooth); and data-sharing tools.

Autonomous Truck Ready *(POV)*:

- Grant Amount: $2,102,500.
- Project Goals: This project improves safety, reduces freight turnaround times, prepares Virginia's ports for increased shipping activity in the future, and develops and shares findings with other ports.
- Technologies Being Deployed: Autonomous truck movement, DSRC and C-V2X communications infrastructure, mobile communications infrastructure, and traffic map integration.

FISCAL YEAR 2019 PROJECTS

MWCOG: Deployment of Personalized and Dynamic Travel Demand Management (TDM) Technology in the Washington, DC—Baltimore, MD—Richmond, VA Megaregion *(MWCOG)*:

- Grant Amount: $2,970,000.
- Project Goals: This project leverages the best available technology to maximize the cost effectiveness of a megaregion TDM program; integrates and expands existing TDM programs with a shared technology platform among all public- and private-sector partners; provides personalized, timely, and accurate travel information to all residents and visitors; and enhances multimodal transportation access and system performance for all user groups with rewards and gamification.
- Technologies Being Deployed: Advanced TISs; TDM; advanced transportation management technologies; advanced public and shared transportation systems; advanced mobility and access technologies; multimodal trip planner and TDM programs for rural, low-income, and elderly or disabled persons; personalized and dynamic traveler incentives; and multimodal payment and reward integration.

I–4 Florida's Regional Advanced Mobility Elements (FRAME) *(FDOT)*:

- Grant Amount: $10,071,600.
- Project Goals: This project is working toward FDOT's strategic plan vision of increasing the delivery rate of fatality-free and congestion-free transportation systems by implementing CVs and other emerging technology solutions, bringing safety and mobility benefits to the I–4 corridor.
- Technologies Being Deployed: 689 CV RSUs and 670 OBUs included with roadside-to-vehicle messages for lane closures, work zones, delays, congestion, end of the queue, incidents, SPaT, speeds, and pedestrian-bicyclist safety; advanced traffic signal controllers with automated traffic signal performance measures, blank-out signs for route diversion, transit and freight signal priority, advance railroad crossing warnings, and wrong-way driving alerts.

Implementing Cellular V2X Technology to Improve Safety and Intelligent Transportation Systems (ITS) Management in Hawaii *(HDOT)*:

- Grant Amount: $6,855,000.
- Project Goals: This project reduces costs and improves return on investment through the enhanced use of existing transportation capacity; delivers environmental benefits that alleviate congestion and streamline traffic flow; reduces the number and severity of traffic crashes and increases safety; collects, disseminates, and uses real-time transportation-related information; monitors transportation assets to improve infrastructure management; delivers economic benefits by reducing delays; and accelerates deployment of V2V, V2I, and AV apps.
- Technologies Being Deployed: A cellular-based V2X system for all traffic devices and infield devices in Hawaii, C-V2X and DSRC equipment for motor vehicles, a remote browser-based platform for traffic operations personnel, a smartphone app for travelers, and preemption for emergency vehicles.

Intelligent Woodward Corridor Project *(MDOT)*:

- Grant Amount: $5,500,000.
- Project Goals: This project provides increased safety for pedestrians, cyclists, and vehicle traffic; reduced congestion; more efficient public transportation; integrated multimodal transportation; transportation resiliency; operational effectiveness; and reduced maintenance and operating costs.
- Technologies Being Deployed: Pedestrian detection, prioritization, and alerts; traffic intersection preemption and signal priority for authorized vehicles; V2V and V2I communications; transportation system optimization through data analytics and edge computing; and wrong-way driver detection and alerts.

I–270 Predictive Layered Operation Initiative (PLOI) *(MoDOT: St. Louis Metropolitan Area, MO)*:

- Grant Amount: $1 million.
- Project Goals: This project predicts crashes and properly equips patrol officers to forestall crashes, thus lowering the number of incidents along I–270 North, improving incident detection time, and reducing arrival time for ER vehicles.
- Technologies Being Deployed: Predictive analytics and AI for incident detection and management, advanced video analytics for improving pedestrian safety and wrong-way driving, and integrated modeling for road condition predictions.

Multimodal Connected Vehicle Pilot *(NCDOT)*:

- Grant Amount: $2,117,750.
- Project Goals: This project improves mobility, reduces safety incidents, reduces environmental impacts, improves agency efficiency, and allows NCDOT to deploy CV technology and apps more effectively within North Carolina for further safety, mobility, and environmental benefits.
- Technologies Being Deployed: V2V and V2I CV apps, including TSP, multimodal apps (e.g., pedestrian, driver, bicyclist); intelligent traffic signal timing; red light violation warning; speed warning; as well as traveler information, high-resolution data, automated traffic signal performance measures, and accessible pedestrian signal system with pedestrian presence detection.

DriveOhio I–70 Truck Automation Corridor *(ODOT: I–70 Corridor)*:

- Grant Amount: $4,400,000.
- Project Goals: This project facilitates and provides host fleets and truck automation vendors with an opportunity to deploy technology in revenue service, accelerates truck automation technology adoption, prepares standards and regulations for use by other deploying entities, and shares data and field experiences with the logistics industry.
- Technologies Being Deployed: Truck automation, including truck platooning, partial automation (Level 2), and high automation (Level 4) in revenue service by host fleets, as well as roadway automation readiness audit and related roadway repairs.

Artificial Intelligence-Powered Decision Support Tools for Integrated Corridor Management *(TDOT)*:

- Grant Amount: $2,617,653.
- Project Goals: This project develops DSS and subsequent strategies by using AI; reduces the cost to deploy, operate, and maintain ICM systems; builds a more scalable system to support traffic operations on corridors statewide; and improves the efficiency of ICM. This system creates a balanced, responsive, and equitable arrangement that monitors and controls traffic; shares traveler information with the public; improves system and travel time reliability; encourages mode shift; and improves the safety, efficiency, maintenance, operations, and mobility of all users (motorists, transit riders, transit operators, and freight haulers) along the corridor.
- Technologies Being Deployed: AI-based ICM DSS, Web interface for ICM partners, and TMC ICM software integration; V2V and V2I communications with connected traffic signals; VSL; RDS and video analytics for real-time traffic data collection and monitoring; and environmental sensor systems.

AI Meets ICM: Realizing the Next Generation of Regional Mobility *(VDOT)*:

- Grant Amount: $4,355,000.
- Project Goals: This project uses advanced data management and communications technologies to provide transportation system operators, service providers, commuters, and travelers with multimodal information and tools that enhance safety; optimize system performance; mitigate congestion; improve travel time reliability; and support on-demand, multimodal trip options.
- Technologies Being Deployed: DSS, AI, a cloud-based data store, and a portal regional commuter parking management system.

Deployment of the Washington State Virtual Coordination Center (VCC) for Multimodal Integrated Corridor Management *(WSDOT)*:

- Grant Amount: $3,424,361.
- Project Goals: This project enhances both individual and interconnected agency operations in the day-to-day management of regional mobility to ensure the transportation system is safe, reliable, and sustainable, and it promotes economic vitality for the entire region. This project also enables real-time information flow to allow shared map-based situational awareness; facilitates joint action in a virtual workspace to speed incident response, mitigate traffic effects, and manage congestion daily; provides actionable information and alerts to agencies, mobility providers, and the traveling public; and enhances coordinated regional planning and operations through data analytics and predictive modeling.
- Technologies Being Deployed: A robust cloud-based system that enables multiagency, multimodal ICM through real-time information data collection, analysis, modeling, and dissemination.

FISCAL YEAR 2018 PROJECTS

Bay Area Mobility-On-Demand Project *(Contra Costa Transportation Authority, California)*:

- Grant Amount: $8 million.
- Project Goals: This project provides MOD to create a “one-stop shop” for viable mobility options by providing real-time, data-driven traffic updates and trip planning so travelers can make informed decisions about cost, travel time, mode, and route choices for their daily travel needs. The project will improve mobility, trip reliability, and congestion in the county.
- Technologies Being Deployed: MOD apps and services, mobility assets, and systems integration.

Advanced Connected Transportation Infrastructure and Operations Network (ACTION) *(University of Alabama)*:

- Grant Amount: $8,034,003.
- Project Goals: This project deploys CV and ITS technologies to allow the regional TMC to implement adjustments to traffic control strategies across the system. The grantee will use the data to enhance long-term planning in the region, and it will share the information with drivers.
- Technologies Being Deployed: Communications; DSRC radios; advanced data-logging traffic controllers; active signal control; wireless vehicle detection; TISs; cable median crash sensors; and an end-user mobile app that provides benefits including pedestrian detection, work zone warnings, curve warning, emergency vehicle preemption detection, and more.

Wolf Creek Pass Advanced Technology Deployment *(CDOT)*:

- Grant Amount: $2,366,298.
- Project Goals: This project transmits real-time information to travelers and dispatches emergency responders and incident management teams faster to improve safety on Wolf Creek Pass.
- Technologies Being Deployed: DSRC RSUs, weigh-in-motion technology and dynamic warning signs, road sensor systems, VSLs, cameras, variable message signs, and a fiber-optic and electric power network.

Artificial Intelligence-enhanced Integrated Transportation Management System (AI-ITMS) Deployment Program *(DelDOT)*:

- Grant Amount: $4,996,949.
- Project Goals: This project enables the deployment of an AI-ITMS and an AI-enhanced next-generation TMC to improve transportation systems performance for enhanced traffic safety, mobility, and air quality. In addition, the project will support people in making better transportation decisions by providing real-time information about incidents, travel times, anticipated delays, and routes.
- Technologies Being Deployed: Multimodal AI-enhanced transportation management and control system that collects and analyzes data to automatically detect anomalies and inefficiencies, disseminate real-time travel information through a Web-based dashboard and mobile app, and generate congestion -mitigation solutions; RSUs; advanced sensors, video cameras, and smart signals.

Georgia DOT Connected Vehicles *(GDOT)*:

- Grant Amount: $2,500,000.
- Project Goals: This project creates and operates a regionwide CV network, providing SPaT messages at all key intersections and freeway ramps, which will enable CV apps to use this network to improve road safety and operations.
- Technologies Being Deployed: DSRC RSUs at signalized intersections, metered ramps, supporting infrastructure, and an open data portal.

Multi-State Rural Integrated Corridor Management *(NDOT)*:

- Grant Amount: $2,755,000.
- Project Goals: This project provides information to travelers by expanding Wyoming's CV pilot, deploying a VSL in Nebraska, providing critical messages directly to freight vehicles, and disseminating truck parking information.
- Technologies Being Deployed: Information and communication management, regional data sharing, VSLs, DSRC, V2I apps, and a mobile RWIS.

Oregon Smart Mobility Network *(Oregon DOT)*:

- Grant Amount: $12 million.
- Project Goals: This project creates an integrated multimodal network and helps the Oregon DOT with performance measurement; decision support; and active traffic, incident, and weather management.
- Technologies Being Deployed: Automatic traffic recorders, bicyclist and pedestrian counters, Bluetooth travel-time systems, road weather decision support and information dissemination, CCTV monitoring cameras, adaptive ramp metering, dynamic speed limits, freight signal priority, queue warning systems, SPaT, dynamic routing, next-generation TSP, V2X pedestrian and bicyclist, automated speed enforcement, red-light-running crash mitigation systems, unmanned aircraft system crash reconstruction, and battery backup systems.

Work Zone Reservation and Traveler Information System *(PennDOT)*:

- Grant Amount: $2,697,750.
- Project Goals: This project enhances work zone operations and safety by providing accurate, standardized, and real-time work zone information across 40,551 miles of roadway traversing through Ohio and Pennsylvania. The system will also streamline work zone coordination between maintenance crews, construction crews, and traffic operation centers by removing the redundant and manual data inputs used today to schedule work zones.
- Technologies Being Deployed: Advanced TISs, advanced transportation management technologies, and a digital road work reservation system.

I–10 Corridor Coalition Truck Parking Availability System (I–10 Corridor Coalition TPAS) *(TxDOT)*:

- Grant Amount: $6,850,000.
- Project Goals: This project provides real-time parking information to truck drivers and dispatchers so they can make informed parking decisions. This project will increase public safety by reducing fatigue-related crashes with associated reductions in congestion and delay.
- Technologies Being Deployed: Advanced TISs; advanced transportation management technologies; infrastructure assessment technologies; and transportation system performance data collection, analysis, and dissemination systems.

Utah Connected *(UDOT)*:

- Grant Amount: $3 million.
- Project Goals: This project measures and improves the operational performance of the system to gain additional capacity, improves safety and preserves infrastructure, implements CV technology to improve safety and mobility, and uses AV technology to help solve the first-mile and last-mile problems.
- Technologies Being Deployed: Autonomous shuttle(s); fiber sensing; C-V2X apps (plow, signal, and transit priority as well as CSW and weather impact warning); and a cloud-based data analytics platform.

FISCAL YEAR 2017 PROJECTS

Loop 101 Mobility Project *(ADOT)*:

- Grant Amount: $6 million.
- Project Goals: This project improves safety and existing arterial capacity in the Loop 101 corridor by deploying technology and systems to support ICM, public transportation, the Maricopa County DOT's SMARTDrive Program℠, and other connected traffic management and real-time information technologies.
- Technologies Being Deployed: A DSS; adaptive signal control technology; CV apps, including transit and emergency vehicle signal priority; ramp metering technology; and an ICM mobile apps suite.

GoPort Freight Intelligent Transportation Systems *(Alameda County Transportation Commission, California)*:

- Grant Amount: $9,720,000.
- Project Goals: This project improves traffic flow and goods movement to and within the Port of Oakland, reduces congestion, improves safety, provides improved traveler information, and reduces transportation-related emissions. Collectively, these benefits will significantly improve port operational efficiencies, increasing the competitiveness of the port in the global market.
- Technologies Being Deployed: A new port-specific TMC, traffic sensors, advanced traveler information, traffic messaging, trucking information for mobile apps, a rail grade warning system, and terminal queue information.

Connecting the East Orlando Communities *(FDOT)*:

- Grant Amount: $11,946,279.
- Project Goals: This project improves pedestrian and bicyclist safety, enhances multimodal transportation, provides integrated real-time information for travelers, and connects and integrates data sources created and used by FDOT.
- Technologies Being Deployed: An innovative pedestrian and bicyclist collision avoidance system, RSUs, parking sensors, active detection technology, digital kiosks, advanced traffic signal controls, dynamic ridesharing, and information systems for elderly and disabled individuals.

SMART Arterial Management *(Ada County Highway District, Idaho)*:

- Note: FHWA and the grantee mutually agreed to terminate the grant, and the grantee returned the obligated funds.
- Grant Amount: $2,250,000.
- Project Goals: The grantee designed this project to improve signal timing on five corridors to reduce congestion, increase safety, and enhance traffic flow.
- Technologies Being Deployed: DSRC radios, OBUs, radar technology for bicycle and vehicle detection, traffic software, and accessible pedestrian signals.

Improving Safety and Connectivity in Four Detroit Neighborhoods *(City of Detroit, IL)*:

- Grant Amount: $2,182,000.
- Project Goals: This project improves safety at intersections, improves connectivity for residents, and increases the capacity for data communications.
- Technologies Being Deployed: Video detection and analytics, sensors, V2I communications, vehicle preemption, digital kiosks, DSRC, and an Internet of things gateway.

Connecting Cleveland Project *(Greater Cleveland RTA)*:

- Grant Amount: $5,850,000.
- Project Goals: This project improves communications infrastructure, enhances rider and passenger safety, and reduces rider travel time. The project also enhances the overall efficiency of the transportation system while contributing to community revitalization.
- Technologies Being Deployed: Advanced onboard equipment, real-time information and predictive maintenance software, Wi-Fi, and an upgraded radio system.

Greenville Automated (A-Taxi) Shuttle *(County of Greenville, SC)*:

- Note: FHWA and the grantee mutually agreed to terminate the grant, and the grantee returned the obligated funds.
- Grant Amount: $4 million.
- Project Goals: This project improves access to transportation.
- Technologies Being Deployed: Automated taxi shuttles using V2V and V2I technology, AV data collection and analysis, and real-time traveler information.

The Texas Connected Freight Corridors Project *(TxDOT)*:

- Grant Amount: $6,090,221.
- Project Goals: This project integrates high-quality data from the I–35 Advanced TISs into an existing route optimization software platform to enhance and optimize pretrip and en route planning for regional carriers, leading to safety and congestion improvements.
- Technologies Being Deployed: Advanced TISs and transportation management technologies, infrastructure condition-monitoring technologies, connected V2I and V2V technologies, freight parking system technologies, truck platooning technology, and border crossing technologies.

Truck Reservation System and Automated Workflow Data Model *(POV)*:

- Grant Amount: $1,550,000.
- Project Goals: This project creates a two-way data flow with the port and truckers, railroads, etc. The data model will simulate the size of scheduling windows and estimate the effects of congestion on mobility. RFID tag readers will automate the workflow of arriving trucks, reducing turnaround time.
- Technologies Being Deployed: A mobile app that enables truckers to confirm a reservation or retrieve appointment status, container availability, or electronic interchange receipts. The app also provides truckers with the ability to update minor elements of a reservation, such as a container number, to receive lane confirmation, and to supplement automatic truck identification where applicable, all from a mobile device. In addition, it has RFID tag readers, AI-based software integration with a container inventory management system, cameras, and a data model for standardizing status updates to truck dispatchers.

Multimodal Integrated Corridor Mobility for All *(SDOT)*:

- Grant Amount: $4,091,000.
- Project Goals: This project improves traveler safety and mobility and creates real-time traveler plans.
- Technologies Being Deployed: Traffic signal system upgrades, communications network, CCTV, DMSs, passive pedestrian detection and pedestrian demand-based signal timing, bicycle detection and mobile app, ICM solutions, mobility-as-a-service software, and kiosks.

FISCAL YEAR 2016 PROJECTS

Freight Advanced Traveler Information System (FRATIS) *(Los Angeles County Metropolitan Transportation Authority, California)*:

- Grant Amount: $3 million.
- Project Goals: FRATIS reduces truck congestion and fuel usage by optimizing freight routes.
- Technologies Being Deployed: Truck trip dispatching optimization software, real-time information exchange system, and ecodrive apps to communicate between vehicles and traffic signals to encourage fuel-efficient driving when trucks approach signalized intersections.

City of San Francisco Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Initiative *(San Francisco Municipal Transportation Agency, Calfornia)*:

- Grant Amount: $10,990,760.
- Project Goals: This project uses a series of advanced technologies to lower congestion in heavily trafficked areas, increase public transit speeds, reduce pedestrian collisions, decrease emergency vehicle response times, reduce truck signal delay, and lower truck speeds through sensitive neighborhoods.
- Technologies Being Deployed: New highway HOV lanes for transit and carpools; TSP and emergency vehicle preemption; electronic, autonomous shuttles; curb space for pickup and dropoff by carpools and ride-sourcing services; multimodal intelligent traffic signal systems located roadside and in-vehicle; and a connected, electronic toll system for the congestion pricing program.

Los Angeles DOT Implementation of Advanced Technologies to Improve Safety and Mobility within the Promise Zone *(LADOT)*:

- Grant Amount: $3 million.
- Project Goals: This project uses advanced technology on Los Angeles' transit vehicles to improve safety and traffic flow and provides real-time information to transit riders in low-income neighborhoods.
- Technologies Being Deployed: Upgrades to the automatic traffic control and surveillance connected signal system, Bluetooth Low Energy beacons, real-time bus arrival signs, and interactive digital kiosks with real-time information about transportation services.

Denver Smart City Program *(City and County of Denver, CO)*:

- Grant Amount: $6,000,007.
- Project Goals: This project uses connected fleets and DSRC technology to improve travel time reliability, freight efficiency, and traffic management to make pedestrian crossings safer.
- Technologies Being Deployed: DSRC in 1,500 city fleet vehicles, automated pedestrian detection devices, a CV operational environment at the Denver TMC, and flashing beacons for slower pedestrians.

A Connected Region: Moving Technological Innovations Forward in the NITTEC Region *(NFTA)*:

- Grant Amount: $7,813,256.
- Project Goals: This project deploys technologies and strategies to improve border crossing performance, travel time, commercial vehicle operations, and safety. Additionally, the project will improve incident management and promote operational integration within NFTA.
- Technologies Being Deployed: CV apps supporting in-vehicle dissemination of alerts, advisories, parking, traffic, and weather information; an improved traffic signal system, a parking management analytics engine, and a DSS.

NW 33 Smart Mobility Corridor *(NW 33 COG)*:

- Grant Amount: $5,997,500.
- Project Goals: This project creates a smart mobility corridor with CV apps across multiple communities to improve safety and congestion while enhancing access to large employment sites and economic development.
- Technologies Being Deployed: RSUs and V2I apps for queue warning and speed harmonization, dynamic SPaT, pedestrian warning systems on the local street network, and real-time road weather warnings and performance data.

SmartPGH *(City of Pittsburgh, PA)*:

- Grant Amount: $10,899,318.
- Project Goals: SmartPGH deploys SmartSpine corridors in Pittsburgh that layer environmental, communications, energy, and transportation infrastructure technologies to improve connections between isolated neighborhoods and major centers of employment. This project may improve real-time information access and optimize transit operations.
- Technologies Being Deployed: Conversion of nearly 40,000 City of Pittsburgh streetlights to LED technology with integrated control systems and installation of supplemental sensor technology, including pedestrian detection and air quality monitoring along SmartSpine corridors. In addition, Pittsburgh will deploy real-time adaptive traffic signals and DSRC units on buses for TSP, advanced TISs, and optimized mobility.

ConnectSmart: Connecting TSMO and Active Demand Management *(TxDOT)*:

- Grant Amount: $8,939,062.
- Project Goals: ConnectSmart integrates various mobility technologies for carpooling, ridesharing, and shared electric bicycles to provide reliable multimodal travel time information.
- Technologies Being Deployed: Various regional advanced TISs and data sources for predictive multimodal or intermodal travel time, cost, and reliability information in an app.

APPENDIX B. SUMMARY OF GRANTEE-REPORTED CHALLENGES AND LESSONS LEARNED

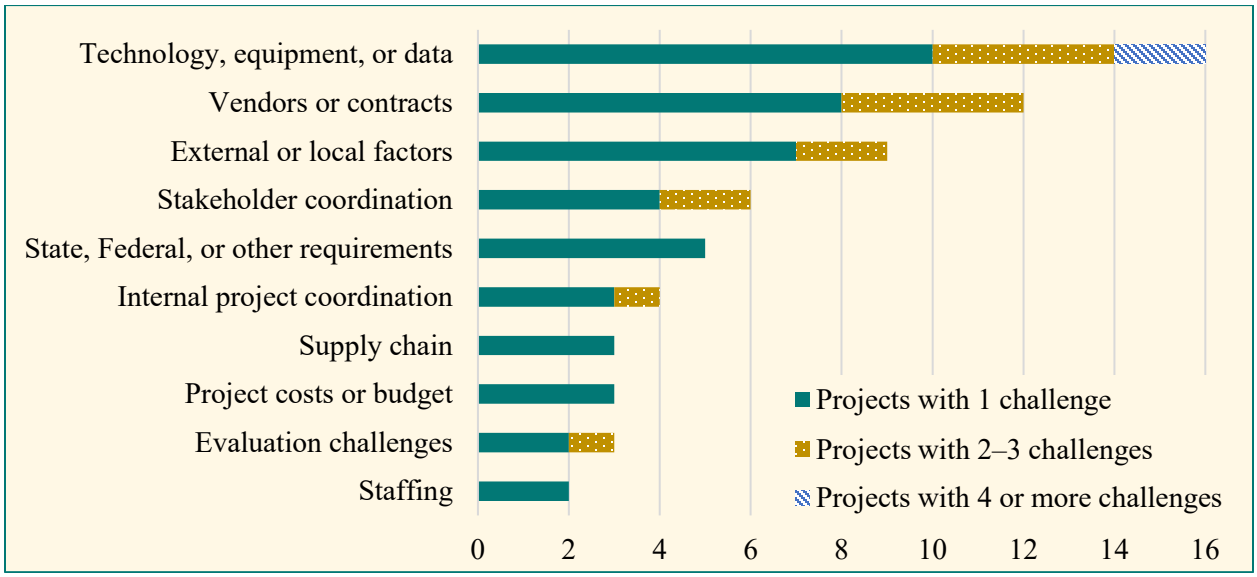
The following two sections focus on reported challenges and lessons learned from the 45 ongoing projects. For challenges and lessons learned reported from the nine completed projects, see *Grantee-Reported Insights*.

CHALLENGES

Figure 5 shows the top three challenges the grantees identified in their quarterly and annual reports, which include technology, equipment, or data problems; vendor or contract issues; and external or local factors. Six projects reported stakeholder coordination challenges, and five highlighted State, Federal, or other requirements. Fewer projects mentioned internal project coordination, supply chain matters, project costs or budget, evaluation challenges, or staffing.

Figure 5 also shows the frequency of challenges reported by projects, and in some cases, projects reported multiple mentions within the same challenge category. For example, 16 projects reported experiencing challenges related to technology, equipment, and data. Of those 16, 2 projects experienced 4 or more challenges within this category, and 4 projects had 2 or 3 distinct challenges within this category.

In performing this analysis, the research team sorted the individual challenges into only one category based on an assessment of the category providing the best fit (i.e., given the grantees' descriptions of the challenges). However, these challenges are often crosscutting and may contain elements of multiple categories. For example, external or local factors could be related to supply chain issues, or changes in staffing could contribute to internal project coordination challenges.

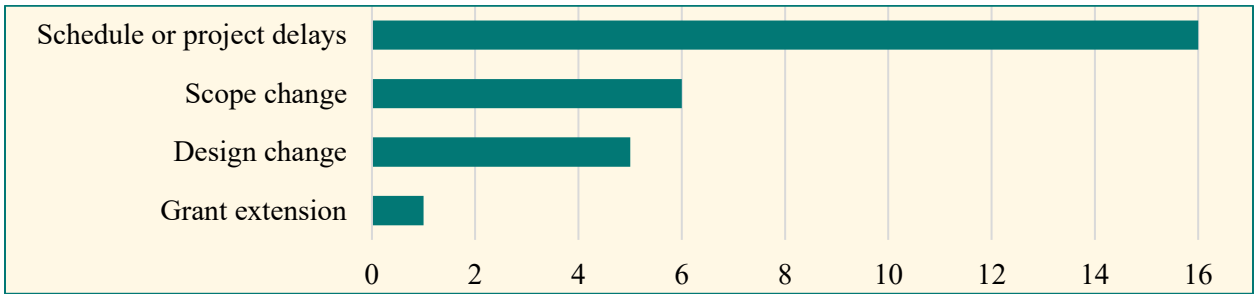


*Note: Projects may report challenges across and within challenge types.

Source: FHWA.

Figure 5. Graph. Number of projects by challenge types.

When describing their challenges, some projects reported outcomes associated with the challenges, including schedule or project delays, scope changes, design changes, or grant extensions. Figure 6 shows the number of projects that explicitly reported each outcome. The grantees' most mentioned outcome was schedule and project delays, which some projects mentioned multiple times (i.e., with respect to different challenges). Six or fewer projects reported other outcomes, including scope changes, design changes, and grant extensions.

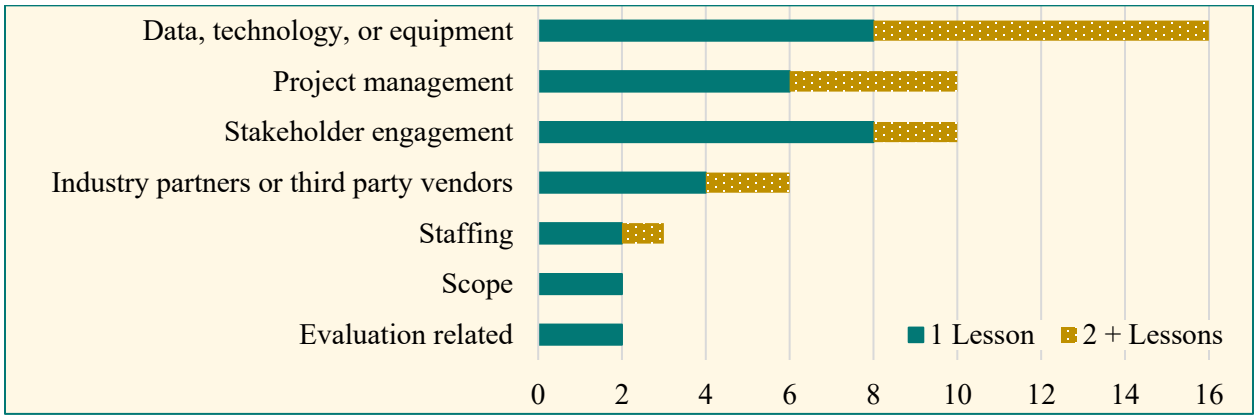


*Note: Projects may report multiple outcomes stemming from each challenge, and not all challenges have an associated outcome. The chart only includes outcomes mentioned by grantees in their quarterly reports or annual reports and does not reflect the total count for an outcome (e.g., more than one project obtained a grant extension).

Source: FHWA.
Figure 6. Graph. Number of projects by outcomes.

LESSONS LEARNED

Figure 7 summarizes project lessons learned described in grantees' annual reports. Sixteen projects reported lessons learned related to data, technology, or equipment, and 10 projects each mentioned project management and stakeholder engagement lessons learned. Slightly fewer projects reported lessons learned related to industry partners or third-party vendors, staffing, project scoping, or evaluation. Various projects reported multiple lessons learned within the same category; these are denoted on the bar chart as having two-plus lessons within that category.



Note: Projects may report lessons learned across and within types of lessons learned.

Source: FHWA.
Figure 7. Graph. Number of projects by type of lesson learned.

U.S. Department of Transportation
Federal Highway Administration
Office of Operations
1200 New Jersey Avenue, SE
Washington, DC 20590

Office of Operations Website
https://ops.fhwa.dot.gov
May 2026
FHWA-HOP-25-175