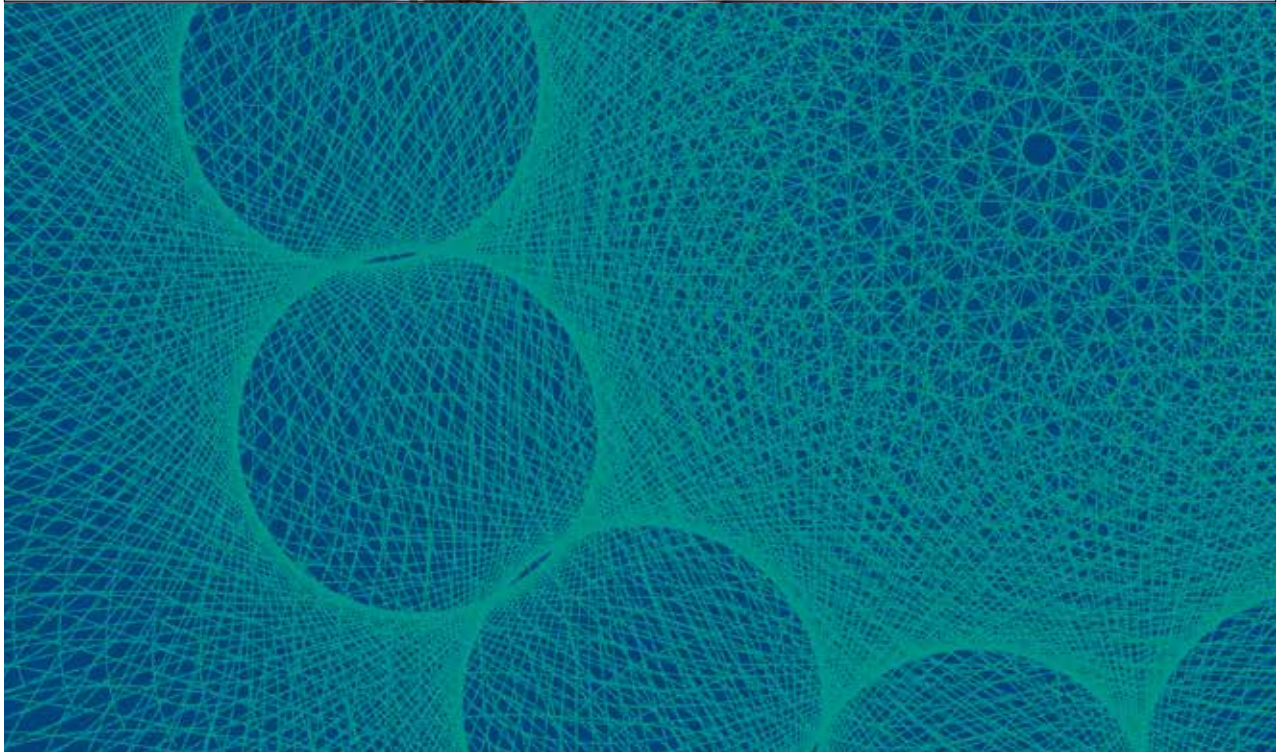




# ANNUAL ACCOMPLISHMENTS

JANUARY 2021

ADVANCING TRANSPORTATION INNOVATION  
FOR THE PUBLIC GOOD



## LETTER FROM THE DIRECTOR

January 2021

Dear Colleagues,

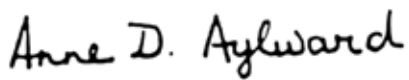
Happy New Year!

As we turn the page on 2020—the 50th anniversary year of the U.S. Department of Transportation's (U.S. DOT) Volpe Center and the challenges and anguish experienced during the ongoing COVID-19 pandemic—we look to 2021 with great anticipation and optimism. We are fully committed to carrying out our mission of improving the nation's transportation system by anticipating emerging issues and advancing technical, operational, and institutional innovations for the public good. We stand ready to support the objectives of the incoming Administration and the priorities of the new Secretary of Transportation.

Since our establishment in 1970, we have proudly served 17 Secretaries and nine Presidents, every operating administration within the U.S. DOT, over a dozen federal agencies, state and local governments, other public authorities, private organizations, and foreign countries. As a leader in transportation research, analysis, technology, and innovation, the Volpe Center's extensive cross-modal partnerships, historical perspective, and rapid response capability have led to innovative solutions that have advanced national and global transportation systems.

This publication represents some of our best work of 2020 and underscores our sustained support to U.S. DOT and others. I would like to thank our sponsors for collaborating with us on important work that strengthens the transportation system and prepares us for the future. I would also like to acknowledge the Volpe Center's multimodal, multidisciplinary, and multigenerational workforce. The past year tested our grit, but the Volpe team stepped up, balanced an extraordinary workload with personal demands, and went above and beyond to deliver high-quality technical work over and over again.

With sincere appreciation,



**Anne D. Aylward**

Director

Volpe National Transportation Systems Center

U.S. Department of Transportation

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Opposite: Our Cambridge, Massachusetts campus in Kendall Square, a premier global technology hub, fosters a dynamic atmosphere of intellectual excitement and professional ingenuity that enriches our staff and infuses our work. Source: U.S. DOT Volpe

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SAFETY

THE U.S. DOT VOLPE CENTER WORKS ACROSS ALL MODES TO SUPPORT THE DEPARTMENT'S TOP STRATEGIC GOAL—TRANSPORTATION SAFETY. OUR MULTIMODAL SAFETY EXPERTISE ENABLES US TO LEVERAGE PROVEN PRACTICES FROM ONE MODE TO IMPROVE SAFETY IN OTHERS.

#### HIGHWAY AND MOTOR CARRIER SAFETY

### Keeping Unsafe Drivers Off the Road with the New Commercial Driver's License Drug and Alcohol Clearinghouse

To advance the Federal Motor Carrier Safety Administration's (FMCSA) mission of reducing crashes, injuries, and fatalities involving commercial motor vehicles (CMVs), FMCSA requires CMV drivers and their employers to follow certain rules regarding drug and alcohol testing. These requirements address frequency of testing, which substances to test for, evaluation and treatment programs, and reporting violations. These measures are in place to ensure the safety of all vehicle operators and passengers. Drivers who violate these rules may be prohibited from operating a CMV. Up until January 2020, this system depended greatly on employees to self-report their violations, and on previous employers to report such information upon request during pre-employment screenings. This system proved to be time consuming, and opened the door for inaccuracies in reporting.

To remedy this, FMCSA officially launched the commercial driver's license (CDL) Drug and Alcohol Clearinghouse the first week of January 2020, an online database for reporting violations and other information about CDL holders, related to FMCSA's drug and alcohol testing program. The aim of the Clearinghouse is to provide a central location in which employers can more quickly identify drivers with possible drug and alcohol program violations, including those who

deliberately hide violations, and those drivers' behaviors can be addressed before they are able to operate CMVs again. It also aims to give law enforcement the ability to identify drivers with violations at the roadside.

FMCSA's Enforcement and Information Technology divisions partnered with the Volpe Center to design and develop the web system, including the requirements, system architecture, and user interface. Volpe also provides Operations and Maintenance support, and helped create and implement an outreach and education strategy. In addition, the Volpe Center continues to assist in providing direct technical support to users of the Clearinghouse.

Between the launch of the website on January 6 and the end of May, over 20,000 drug and alcohol program violations were reported in the Clearinghouse, including over 16,700 positive substance abuse tests. During that period, about 14,000 drivers were prohibited from operating a CMV due to a violation. Because employers no longer have to rely on drivers or their previous employers to report violation information, it is easier for employers to ensure they have the proper, accurate information in order to keep the nation's roads safe.

By the end of May, one million users had completed registration for the Clearinghouse—that number keeps rising, as more users register every day.

"We've seen encouraging results from the Drug and Alcohol Clearinghouse, but there's still work to do to ensure we identify more drivers who should not be behind the wheel," said FMCSA Acting Administrator Jim Mullen. "The Clearinghouse is a positive step, and the agency continues to work closely with industry, law enforcement, and our state partners to ensure its implementation is effective."

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The Volpe Center uses its multimodal expertise to support the U.S. DOT's mission of improving safety across the nation's transportation system. Source: ©iStockPhoto.com/Steve Estvanik

# Commercial Driver's License Drug and Alcohol Clearinghouse

The **Federal Motor Carrier Safety Administration (FMCSA)** collaborated with the U.S. DOT Volpe Center to develop the new **Commercial Driver's License (CDL) Drug and Alcohol Clearinghouse**, an online database for reporting drug and alcohol violations and other information about CDL holders who operate

commercial motor vehicles (CMVs). Employers must follow specific drug and alcohol testing requirements—frequency of testing, which substances to test for, evaluation and treatment programs, reporting violations, etc.—**ensuring overall safety on the road** for drivers and passengers.

In the first five months, **one million** users completed registration in the Clearinghouse.

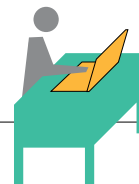
Between January 6 and the end of May 2020, over **20,000** drug and alcohol program violations were reported to the Clearinghouse.

## HOW WILL THE CLEARINGHOUSE IMPROVE HIGHWAY SAFETY?

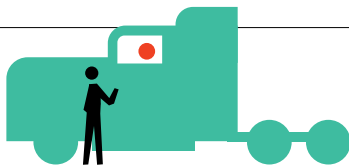
Make it easier for **employers** to meet their preemployment investigation and reporting obligations.



Make it more difficult for drivers to conceal their drug and alcohol program violations from **current or prospective employers**.



Make it easier for **FMCSA** to determine employer compliance with testing, investigation, and reporting requirements.



Provide **law enforcement personnel** with the ability to identify drivers with violations at the roadside.



FMCSA and Volpe continue to refine and improve the Clearinghouse through **continuous monitoring of the system**, resolving issues as they come up, and adding enhancements through quarterly releases.

Partnering with FMCSA's Enforcement and Information Technology divisions to design and develop the **Clearinghouse web system**, including establishing requirements, designing system architecture, and designing and developing the user interface.

Log In



Providing **Operations and Maintenance (O&M)** support for the Clearinghouse.



## DRUG & ALCOHOL CLEARINGHOUSE

Crafted and implemented an **outreach and education** strategy.



Providing support to system users needing **technical assistance** with the system.



FMCSA and Volpe continue to work diligently on this project; the development team is monitoring the system, resolving issues as they are detected, and adding enhancements through periodic releases, and the support team is assisting users directly with any technical issues they may face.

(Sponsored by FMCSA)

## FMCSA's Training Provider Registry Program Establishes Requirements for Commercial Drivers

To reduce injuries, crashes, and fatalities involving CMVs, a federal regulation requires states to administer knowledge and skills tests prior to issuing a CDL. Currently, training requirements for CDL holders varies from state to state. This has resulted in inconsistencies in the skills and knowledge of the national pool of entry-level drivers. To address this safety concern, FMCSA published the Entry-Level Driver Training (ELDT) final rule in 2016. It outlines the requirements for drivers, states, and training providers, and establishes the role of an online Training Provider Registry. The main goal of the registry is to equip states with the information they need to ensure that only applicants who have completed required training proceed with testing for CDL issuance, upgrades, or certain endorsements.

The Volpe Center is partnering with FMCSA's Office of Safety Programs and Information Technology division to design and develop the Training Provider Registry web system, including establishing requirements, designing system architecture, and designing and developing the user interface. Volpe's Safety Measurement and Analysis Team is leveraging their experience and expertise in motor carrier safety to provide ongoing operational and maintenance support to the registry, as well as developing and implementing an outreach and education strategy to ensure applicants understand the entry-level driver training requirements and how to use the registry.

This work will help meet the ELDT final rule mandate required by Congress in the Moving Ahead for Progress in the 21st Century Act, Section 32402, which aims to enhance performance-based transportation programs through the transformation of policies. The Volpe Center is providing support to help the registry meet its deadline to be fully operational by February 7, 2022.

The new entry-level driver training requirements will ensure that all entry-level drivers receive comprehensive training

from a self-certified training provider prior to obtaining a CDL, upgrade, or endorsement. These drivers will enter the next phase of their careers already equipped with the knowledge they need to safely operate CMVs at the level their job requires. Once operational, the Training Provider Registry will be a critical piece of this safety program.

(Sponsored by FMCSA)

## Improving Road Visibility for Trucks with the Blind Spot Measurement Application

Large trucks represent just 4 percent of registered vehicles on the nation's roads, but are involved in 7 percent of fatal crashes with vulnerable road users including pedestrians, bicyclists, and children. Approximately 500 pedestrians and bicyclists are killed each year by large trucks. The design of large trucks, buses, sport utility vehicles (SUVs), and pickup trucks can make it difficult for drivers to view their surroundings, resulting in blind-spot related crashes. The Santos Family Foundation asked the Volpe Center to develop a highly scalable application to help reduce the number of crashes related to vehicle blind spots.

The project began in 2017 as a Volpe-advised senior capstone project with five students at the Olin College of Engineering, in partnership with the Santos Family Foundation and the city of Boston. In 2019, the Santos Family Foundation asked Volpe to continue developing the app based on positive results achieved during the Olin student phase, and bring it into real-world use. The Visibility In Elevated Wide vehicles (VIEW) application was created, which makes it possible to precisely measure the visible area of a vehicle from the driver's seat in 10 minutes, using only a smartphone, tape measure, and a five-foot pole. The visibility score tells the user how much of the safety-critical areas directly in front of and to the right of the vehicle can be seen with the naked eye, and the result can be personalized for a specific driver. Volpe conducted live demonstrations of the app at the FMCSA Commercial Vehicle Safety Summit in Northampton, MA, with Republic Services (the nation's second largest waste hauling fleet), and in partnership with the cities of Boston and Cambridge locally as well as the Wisconsin State Patrol.

As the steward of VIEW technology, the Volpe Center provides both technical and planning support to the project. On the technical side, Volpe applies its data analytic, web and software development, human factors for user interface, and

stakeholder engagement skill sets. In addition, Volpe hosted a seminar with the city of London's Direct Vision Standard and recent European Union regulation of blind spots, and convened demonstrations with industry and fleet safety organizations.

Volpe organized and has hosted a Direct Vision Stakeholder Group several times since January 2020. The group includes 15 experts from FMCSA, the National Highway Traffic Safety Administration (NHTSA), Federal Highway Administration (FHWA), and the Federal Transit Administration (FTA), as well as the Centers for Disease Control and Prevention (CDC) National Institute for Occupational Safety and Health and the Commercial Vehicle Safety Alliance. The Volpe team is advancing the software and user testing in tandem with the Direct Vision Stakeholder Group's feedback.

At the U.S. DOT Safety Summit in July 2020, Secretary Elaine L. Chao addressed pedestrian safety as a top priority of the Department. The Volpe team continues to develop the VIEW app to help U.S. truck, bus, and SUV/light truck fleets identify models that offer superior direct vision and eliminate potential blind spots so that drivers can see and safely share the road with vulnerable road users.

**(Sponsored by the Santos Family Foundation)**

Screenshot of VIEW panoramic photo tracing of a truck's blind spot zone. Source: U.S. DOT / Volpe Center (Alexander Epstein).

## RAIL

### Addressing a Safety Standards Gap for Passenger Railcar Seating

Conventional passenger train seating is typically arranged row-to-row, but some seating is arranged in an open bay configuration—meaning, two seats face each other without a table in between. Accident investigations have revealed that passengers in open bay seats sustain more severe head and neck injuries in a collision than those in row-to-row seats. In 2018, the American Public Transportation Association (APTA) Construction & Structural (C&S) Working Group initiated Revision 3 of the APTA PR-CS-S-016-99 Passenger Seats in Passenger Rail Cars seat safety standard, which adds requirements for testing open bay seats. Prior to Revision 3, the standard only specified dynamic test requirements for row-to-row seats.

The Federal Railroad Administration (FRA) asked the Volpe Center to facilitate discussions with industry stakeholders to reach a consensus on the requirements proposed in the Revision 3 seat standard. Stakeholder consultations led to a compromise: dynamic seat tests with anthropomorphic test devices (ATDs) will only be conducted if more than 50 percent of a car's passenger seating is configured as open bay. In addition to facilitating meetings with industry stakeholders,





Photos show anthropomorphic test devices pre- and mid-test. Source: MGA

the Volpe Center team drafted proposed modifications to the APTA seat standard, developed a section analysis to provide further explanation for the proposed modifications, and provided quarterly project updates to the C&S Working Group.

In light of new requirements to test seats in the open bay configuration, industry stakeholders sought to learn whether existing open bay seats would comply with the safety requirements that apply to row-to-row seats. FRA sponsored research tests of four seat designs, which were donated by seat manufacturers, and sought the Volpe Center's technical expertise in passenger rail interior occupant protection to evaluate seat performance and determine if they complied with APTA's proposed test requirements. The research testing was conducted in Greer, South Carolina by MGA Research Corporation under contract to FRA. The Volpe Center supported FRA by drafting the statement of work

and test requirements, solicited seat donations, and assisted in coordinating the delivery of equipment and related installation drawings to MGA. Volpe also evaluated the test setup and interpreted the test results.

In November 2020, three of the four seat types were tested using standard Hybrid III 50th percentile male (H3-50M) ATDs. Test data show that measured injury criteria—particularly for the head, neck, and femurs—were 50 to 100 percent higher for the ATDs in open bay seats, when compared to row-to-row seats. This consequence is due to the larger distance a passenger will travel with respect to the interior before impact with a fixture, usually a seat back, when compared to row-to-row seating. As the rail car slows down in an accident, the speed of the passenger relative to the vehicle increases with distance traveled. Injury severity increases with impact velocity. The addition of human injury and seat attachment strength requirements to the APTA safety standard for the open bay configuration will address this safety issue. Of the three seat designs tested to date, one design complied with the proposed test requirements for the human injury and seat attachment strength test using H3-50M ATDs. MGA Research Corporation plans to test the fourth and final seat design in January 2021.

A draft report has been written and a final FRA report will be published in 2021. The preliminary test results were presented to the APTA C&S Working Group, which has balloted and approved Revision 3. The draft of Revision 3 has been through a public comment period and is awaiting approval from the APTA Executive Committee. The new test requirements will help ensure the safety of passengers in open bay seats is equivalent to the safety of passengers in row-to-row seat configurations. In future work, the Volpe Center plans to develop finite element models of selected seat designs to evaluate human injury and seat structural integrity considering smaller and larger ATDs and variable seat pitch, in both the open bay and row-to-row configurations.

(Sponsored by FRA)

## Preventing Suicides on the U.S. Rail System through Intervention Training Programs

Despite efforts to implement effective suicide prevention strategies, deaths from suicide have steadily accounted for about one-third of all fatalities that occur on the U.S. rail system. A lack of research on the effectiveness of preventative strategies may be contributing to uncertainty

## Suicide Intervention Training Program Basics

EARLY PREPARATION

IMPLEMENTATION PLANNING

CONTENT DEVELOPMENT

IMPLEMENTATION

CONTINUING IMPROVEMENT

among rail carriers when considering implementing countermeasures.

To address the lack of knowledge in this area, FRA sponsored research to review and analyze the most established suicide intervention training programs from around the world. A new report, “Review of Suicide Intervention Training Programs,” reviews ongoing programs in the United Kingdom, Germany, the Netherlands, and the United States. A Volpe Center team of human factors experts reached out to railroads to collect information on their programs and produced a high-level overview of intervention programs and strategies. Published in August 2019, the report serves as a source of information and insight for the rail industry.

The Volpe Center’s analysis found that no program meets the needs of all railroad carriers. Each carrier has its own unique constraints and needs which require a strategy specific to their situation. The report highlights key program attributes and decisions a carrier will need to consider during each step of the training program development process: 1) early preparation, 2) implementation planning, 3) content development, 4) implementation, and 5) continuing improvement. It also includes some general tips and guidance for successful implementation.

The report helps to fill the gap in research about suicide intervention training programs for railroad staff and crew members. It provides lessons learned and best practices based on successful programs that have been implemented around the world and aims to serve as a starting point for rail carriers in the United States to implement their own programs. The Volpe Center hopes that sharing this vital information will benefit the railroad industry as a whole and lead to fewer deaths across the national rail system.

(Sponsored by FRA)

### AVIATION

## FAA Manages Risk and Improves Safety with the Safety Assurance System

The mission of the Federal Aviation Administration’s (FAA) Hazardous Materials Safety Program is to increase safety in air transportation by managing risk. The vision of the program is to reach the next step in aviation safety through innovative safety management partnerships that proactively recognize and mitigate risks that impact the safe and efficient movement of hazardous materials by air.

The Hazardous Materials Safety Program has evolved significantly over the last 30 years. Perhaps the single largest incident that impacted the program occurred in 1996, when ValuJet Flight 592 crashed in the Florida Everglades, killing 110 passengers and crew. The crash was the result of an in-flight fire caused by improperly packaged dangerous goods stored in the cargo area. This accident called into question the effectiveness of the FAA’s oversight of dangerous goods (hazardous materials) shipments on commercial aircraft.

To better manage the increased risk to the National Airspace System, FAA sought the Volpe Center’s expertise in developing tools, such as the Safety Assurance System (SAS) to help the Office of Hazardous Materials Safety (AXH) and the Office of Aviation Safety (AVS) improve oversight.

Since its initial release in 2015, SAS has been FAA’s oversight tool for performing certification, surveillance, and continued operational safety of commercial flights. SAS was initially developed as a tool for Flight Standards (FS) aviation safety inspectors, but functionality was introduced soon after to support the needs of AXH’s hazardous materials aviation safety inspectors. In 2019, AXH developed and deployed the Other Regulated Entity (ORE) Risk Priority Index to help

manage the oversight of ground handlers, freight forwarders, shippers, repair stations, and individuals who have been involved with dangerous goods incidents. In 2019, AXH also released a Passenger Module application that enables the automated collection of passenger discrepancy reports from air carriers and processes submitted reports. In late summer 2020, FAA deployed a Risk Profile Assessment Tool (RPAT) and Certificate Holder Assessment Tool (CHAT) to enable safety inspectors to manage risk and prioritize inspections across air carriers.

RPAT helps hazardous materials aviation safety inspectors analyze risk across multiple datasets while incorporating data from FS. RPAT applies risk-based decision-making principles and a safety management system (SMS) approach to identify and address prioritized risks. The tool promotes the safe transportation of dangerous goods on aircraft through continuous oversight and risk evaluation.

The Volpe Center is highly involved with SAS methodology and works with AXH to understand their business rules to improve the risk-based decision-making process. A Volpe team worked with AXH in joint application development

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The Volpe Center will continue to support AXH by providing tools to assist in identifying potential risks and patterns that could impact safety, which will help FAA focus its resources on mitigating hazards and risks across air carriers. Source: [123rf.com/](https://123rf.com/) Leonard Zhukovsky.

meetings to define requirements, which FAA used to create a specification and design. Additionally, the Volpe Center developed software and databases for AXH, along with a mathematical risk model.

The Volpe Center continues to assist AXH in identifying trends and patterns that may suggest potential safety concerns, and proactively addresses those concerns before they become problems. By helping FAA effectively focus resources on safety hazards and risks, the Volpe Center improves the risk-based decision-making process and ensures air carriers comply with FAA's safety regulations.

(Sponsored by FAA)

## Mitigating Unintended Route Deviations in Future Air Traffic Operations

Unintentional route deviations and communication errors by pilots have the potential to significantly disrupt flight operations in the national airspace system (NAS). The FAA is researching the effectiveness of two modern concepts, currently deployed in the North Atlantic Region, to help streamline flightcrew and air traffic communications and to improve route compliance.



The FAA asked the Volpe Center to analyze altitude and route deviations that were recorded in the North Atlantic Region to identify root causes of pilot error and to propose mitigation strategies. Volpe's technical expertise in flight deck and air traffic control factors, and prior experience with studies related to pilot navigation, altitude deviations, and pilot-controller deviations aided this effort.

Half-degree waypoint coordinates for longitude and latitude may be used in the future NAS for planning dynamic routes to increase efficiency and capacity. These waypoints are usually communicated to the pilot via Controller-Pilot Datalink Communications (CPDLC)—a text-based means of communicating complex route data. The Volpe Center team analyzed these capabilities to better understand how the applications work and how they can mitigate potential route deviations.

The Volpe Center focused its analysis of altitude deviations on conditional air traffic clearances. Conditional clearances

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Waypoint data page showing the half-degree latitude-longitude coordinates for the waypoint with the label H5720. Source: U.S. DOT/Volpe Center (Divya Chandra)



require pilots to begin and/or complete compliance with a clearance according to specific conditions. CPDLC messages that restrict both when an altitude change can begin and when it must be completed are especially prone to error. The Volpe Center team studied events that occurred in the North Atlantic Region in 2017 and in the New York Oceanic Control Area from 2014-2018, and found that when controllers issue conditional clearances to pilots, vertical deviations are often the result. Volpe also researched lateral deviations and the use of unnamed half-degree waypoints, which can have ambiguous labels on flight deck displays. After examining 169 lateral deviations from 2017 and 68 from 2018, Volpe found that errors due to half-degree waypoints are relatively uncommon and contribute to only a small fraction of significant route deviations.

The Volpe Center team reached two important conclusions: 1) flightcrew procedures identified in guidance material published by FAA and the International Civil Aviation Organization relating to communication and route review are usually effective in catching route deviations linked to half-degree waypoints before there is a significant route deviation, and 2) random routes (which vary) are associated with a higher rate of route deviations than half-degree waypoints, and should be studied further. Based on these findings, the Volpe Center proposed that the NAS may need a system for monitoring route deviations with trajectory-based operations (TBO)<sup>1</sup> in a manner similar to monitoring route deviations in the North Atlantic Region.

The Volpe Center's work on this project fulfilled research that will help inform future flight deck procedures and identified other issues that can be researched in the future, supporting the development of future concepts for air traffic operations envisioned by the FAA.

(Sponsored by FAA)

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<sup>1</sup> TBO is an air traffic management method for strategically planning, managing, and optimizing flights throughout the operation. It relies on information exchange between air and ground systems, the aircraft's ability to fly precise paths, and time-based management. Source: <https://www.faa.gov/nextgen/faqs/>





INNOVATION,  
AUTOMATION,  
AND  
TECHNOLOGY

THE U.S. DOT VOLPE CENTER SUPPORTS U.S. DOT, DEPARTMENT OF DEFENSE (DOD), NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA), AND OTHERS BY PERFORMING RESEARCH AND ANALYSIS THAT LEADS TO NEW INNOVATION AND THE SAFE AND EFFICIENT INTEGRATION OF AUTOMATION INTO THE TRANSPORTATION SYSTEM.

## HIGHWAY

### Visualizing Changes in Roadway Transportation Activity with the COVID-19 Waze Traffic Alert Dashboard

The COVID-19 pandemic has caused significant disruptions across the nation's transportation system. With restrictions on travel and companies switching to remote work, fewer people are on the roads commuting to and from the office, going on businesses trips and vacations. U.S. DOT's Office of the Under Secretary sought the Volpe Center's assistance in applying an existing DOT data resource to track changes in traffic congestion and safety during this global pandemic.

Since 2017, the U.S. DOT has archived transportation data provided by the Waze application in near real-time. Using a nation-wide archive of user-reported traffic alerts provided by Waze, the Volpe Center developed tools to visualize changes in roadway transportation activity and developed a

prototype for the COVID-19 Waze Traffic Alert Dashboard. The dashboard builds on the analytic tools the U.S. DOT team developed under the Safety Data Initiative, which aims to predictively analyze safety challenges and trends through data integration and analysis.

The Volpe team applied its experience working with the Waze data archive to rapidly prototype the COVID-19 Waze Traffic Alert Dashboard and provide demonstrations of the application to the sponsor and other U.S. DOT stakeholders at the Bureau of Transportation Statistics (BTS), National Highway Traffic Safety Administration (NHTSA), and Federal Highway Administration (FHWA). Volpe staff applied their data science and visualization capabilities to build an advanced Tableau dashboard that shows Waze indicators of user reporting activity and traffic jams.

The COVID-19 Waze Traffic Alert Dashboard is used by the Volpe team to contribute weekly updates to the BTS Transportation Demand Early Indicator Report. The Waze indicators track the relative change in weekly traffic jam alerts for all U.S. metropolitan areas in 2020 compared to the previous week and to the same week in 2019. The dashboard provides the only rapid indicator of traffic jams that covers all U.S. metropolitan areas, increasing accessibility to state, metropolitan, and county-level time trends.

(Sponsored by U.S. DOT, Office of the Under Secretary)

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2020 changes in Waze Traffic Alerts compared to the same week in 2019 and to the 2020 baseline (average weekly reports from January 5th – February 8th). Source: Waze

# The Track Inspection and Maintenance Process

The **Federal Railroad Administration (FRA)** is collaborating with human factors experts at the **Volpe Center** to **understand how automation** will impact the safety and effectiveness of railroad

operations across the United States. Volpe staff focused their research on **automation-aided** and **visual** rail inspection processes to identify potential risks and safety hazards that could potentially lead to accidents.

## AUTOMATED INSPECTION EXAMPLES:



**Track geometry measurement system:** Specially equipped train cars measure track geometry in a loaded condition.



**Ground penetrating radar:** Electromagnetic waves examine layers of track structure.



**Machine-vision:** Computers examine data and images, alerting a human to review for defects.



**Vehicle-track interaction systems:** Sensors on the rail car identify track areas at higher risk of deterioration.

## “VISUAL” INSPECTION EXAMPLES:



**Walking the track:** A human inspector uses multiple senses to detect degraded conditions.



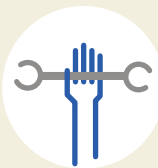
**Inspection by hi-rail vehicle:** A human inspector rides a hi-rail vehicle and looks for defects while also noting how the track feels (e.g., unusual bumps).

The Volpe team made **recommendations** that address potential risks at various stages of the track inspection process—detecting, assessing, and repairing defects—as well as levels of the system where both human and technological components can impact safety. The project focused on **track geometry measurement systems**; however, many of the recommendations can apply to other types of automated inspection technologies as well.

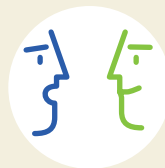
## Major themes that emerged from these recommendations include:



The need for strong **user-centered design** when incorporating new technologies.



The value of **hands-on** training for railroad personnel.



The importance of **communication** and coordination among railroad staff and inspectors.



The need to manage the impact of **production and resource pressures** on inspection and maintenance activities.

Railroads can use these recommendations to **assess their practices and mitigate potential risks**, which will strengthen the safety of their current inspection system. Railroads may use the Volpe Center's recommendations as a baseline when assessing future inspection technologies.



## Improving the Safety and Efficiency of Railroad Operations with Automation-Assisted Technology

Maintaining efficient railroad operations while ensuring overall safety is an essential part of the FRA's mission. Automation-aided technologies have the potential to save lives and improve safety while improving efficiency and effectiveness of track maintenance and inspection practices. FRA is working to understand how these innovative technologies will impact the safety and effectiveness of routine track inspections and maintenance procedures across the U.S.

FRA asked a team of Volpe Center human factors experts to research visual and automation-aided rail inspection processes. Volpe's objective was to identify factors that could lead to hazards during both types of inspections and to provide recommendations to mitigate those factors. The Volpe team focused on railroad inspection systems that employ automated track geometry technology, a widely used form of automation-aided track inspection used in freight and passenger rail.

The Volpe team studied three sociotechnical systems, where "sociotechnical system" refers to a combination of people, technologies, actions, and feedback that comprise the inspection process. To reflect current inspection practices and allow for the analysis of human-automation interactions, all three sociotechnical systems include a visual inspection component. The three sociotechnical systems included in the Volpe analysis were:

1. Visual inspection sociotechnical system: Only visual inspection is used to find track issues.
2. Track geometry measurement systems (TGMS) and visual inspection sociotechnical system: Both visual inspection and TGMS are used to find track issues.
3. Autonomous track geometry measurement systems (aTGMS) and visual inspection sociotechnical system: Both visual inspection and aTGMS are used to find track issues.

Volpe analyzed each of these systems using a hazard analysis approach designed to examine complex sociotechnical systems where human and technological components impact safety. Volpe used existing literature, information from multiple site visits, as well as additional discussions with subject matter experts to identify and document how the track

inspection process works, including the role of the inspector, the role of automation, and the types of human-technology interaction required. The team also sought to understand what railroads do once a rail defect is found and how the inspection process fits into the broader track lifecycle, which includes inspection, maintenance, and operations.

The Volpe team created a functional model of each socio-technical system, which was used as the basis for the hazard analysis. During the analysis, the team identified how each action in the inspection process could lead to undesirable conditions, or hazards. The team then developed a comprehensive set of scenarios describing how combinations of factors could lead to undesirable events or accidents. By identifying ways to address contributing factors from these scenarios, Volpe developed recommendations railroads can use to assess and strengthen their current inspection processes and safety measures.

The team's recommendations address potential risks at various stages of the track inspection process (i.e., detecting, assessing, and fixing defects) as well as different levels of the sociotechnical system (e.g., task, individual and team, organizational, tools and technology, physical environment, and external factors). Major themes that emerged from these recommendations include the need for strong user-centered design when incorporating new technologies, the value of hands-on training, the importance of communication and coordination, and a need to manage the impact of production and resource pressures on inspection and maintenance activities. Railroads may use these recommendations to address risks associated with visual inspection and track geometry measurement systems. Additionally, the recommendations can be used when assessing future inspection technologies.

(Sponsored by FRA)

## Using Unmanned Aerial Vehicles to Produce Accurate Grade Crossing Profile Data

Elevated highway-rail grade crossings present significant hazards for vehicles with long wheelbases and low ground clearance. Each year, about 14 percent of grade-crossing accidents involve a tractor-trailer, and a substantial number of those are a result of the vehicle getting stuck on the track. Motorcoach buses and lowboy trailers are at a higher risk for getting stuck or hung up at elevated crossings, where the tracks are at a significantly higher elevation than the roadway that approaches them.



UAV equipped with LiDAR is ready to take off and survey an elevated grade crossing in Suffolk, VA. Source: U.S. DOT Volpe Center

In March 2017, an accident in Biloxi, Mississippi involving a freight train and motorcoach resulted in the deaths of four passengers and injured 38 more. The accident was the direct result of insufficient ground clearance at the highway-rail grade crossing. To help solve this problem, FRA's Office of Research, Development and Technology asked the Volpe Center to study the viability of using unmanned aerial vehicles (UAVs) to produce accurate profile models of elevated highway-rail grade crossings.

The Volpe Center investigated several potential technological solutions, procured equipment for testing and evaluation, identified suitable grade crossings for field testing, and collected data. Volpe experts researched the capabilities of photogrammetry and Light Detection and Ranging (LiDAR) data captured using UAVs. The Volpe team found that photogrammetry with ground control points can produce three-dimensional models with similar accuracy as those produced using LiDAR technology at a much lower cost. The team determined the appropriate modeling process and provided recommendations to FRA for measuring ground clearance for elevated crossings.

The Volpe Center is currently developing a software tool to analyze photogrammetry and LiDAR three-dimensional models that will determine the amount of ground clearance vehicles need to safely traverse elevated crossings. The tool will assist road authorities in obtaining accurate measurements of crossing profiles, which will help identify and remediate problematic elevated crossings and improve public safety.

A final report detailing the results of Volpe's feasibility study on using UAVs to produce accurate grade crossing profile data was published by the FRA in December 2019.

(Sponsored by FRA)

## AUTOMATED VEHICLES

### Assessing the Hazards and Safety Implications of Automated Transit Bus Operations

As automated technology for light passenger and commercial vehicles continues to be developed, the once-considered futuristic idea of a roadway full of automated vehicles is closer to reality. Transit bus service is an important aspect of public transportation that must be included in the automated vehicle conversation. In 2019, the FTA asked the Volpe Center to study the feasibility of transferring automation systems that are currently available for light-duty vehicles and commercial trucks to transit buses. Volpe systems engineering experts concluded this was possible, though not straightforward. In 2020, FTA asked the Volpe Center to identify potential hazards and safety measures unique to the safe deployment of these technologies in transit bus applications.

The Volpe Center applied key concepts from the International Organization for Standardization (ISO) voluntary functional safety standard 26262, which provides guidance specific to transit buses. Functional safety refers to the process by which the industry ensures there is no unreasonable risk due to hazards caused by malfunctions in electrical or electronic systems.

Volpe engineers performed a risk assessment, tailoring its analysis to transit buses in two ways: by considering system interfaces unique to transit buses, such as the door control system, and aspects of operation unique to buses, such as the presence of standing and unrestrained passengers. Volpe applied the ISO standard to each identified vehicle-level hazard and assessed their severity, exposure, and controllability. Each hazard was given one of four Automotive Safety Integrity Levels (ASILs), ranging from ASIL A (least stringent) to ASIL D (most stringent).

At the conclusion of the study, the Volpe team identified 18 potential vehicle-level hazards related to the automation systems analyzed in the study. Two hazards were unique to transit buses, while the other hazards also exist for light-duty vehicles. The ASILs of the hazards in this study were generally

comparable between light vehicles and transit buses—meaning, the level of design rigor used when developing these systems for light vehicles would, generally, be sufficient for transit buses. The one exception was in steering-related hazards.

In addition, the study found that the severity and exposure ratings involving vulnerable road users (VRUs) were likely higher for transit buses, but the increases could be offset by increased controllability provided by a skilled transit bus operator. At higher levels of automation, where a skilled

transit bus operator would not be present, the severity and exposure ratings may still be higher.

Overall, the results of the study found that many of the functional safety measures used in light vehicles can be applied to transit buses, with modification. Safety measures included in the design of automation systems for transit buses have the potential to be more effective than relying solely on training or upskilling bus operators to respond to failures in electrical or electronic systems.

## Assessing the Safety of Automated Transit Buses

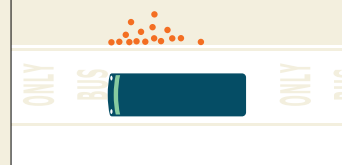
The **Federal Transit Administration (FTA)** asked the **Volpe Center** to study how level 1 and 2 driving automation systems that are available for light-duty vehicles and commercial trucks can be used on transit buses.

This research identified **18 vehicle-level hazards** for the systems. **Two** of the systems are potentially unique to transit buses:

### VEHICLE IN MOTION WHEN PASSENGER DOOR IS OPEN



### VEHICLE TOO FAR FROM THE CURB AT STATION/STOP



The study also discusses unique challenges that must be faced in an active urban environment.

For example, driving automation systems in transit buses may need to more reliably **detect and safely respond to pedestrians**.

At the same time, **high false-positive detection** rates reduce bus driver acceptance of and trust in driving automation systems.

**Subject matter experts shared several important examples of these pedestrian-centric situations:**

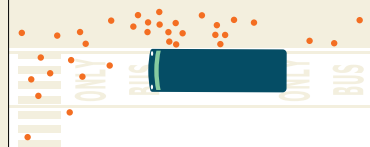
### OPERATING IN LARGE CROWDS



### DRIVING TOWARD PEDESTRIANS



### PASSENGER ACTIVITY AROUND THE BUS



**The results of this study may serve as:**

**1**

A baseline against which to compare the results of future system-specific hazard and safety analyses.

**2**

A reference for manufacturers that wish to pursue different hazard analysis strategies.

The full report can be found at  
<https://rosap.ntl.bts.gov/view/dot/49126>



The Volpe Center's research in this area provides a baseline for manufacturers and transit agencies to compare against results of their own analyses in order to consider future pilot deployments of transit bus automation.

(Sponsored by FTA)

## Developing a Framework for System Dynamics Modeling of Automated Vehicle Impacts

The Volpe Center, in support of the Intelligent Transportation Systems Joint Program Office (ITS JPO), is developing tools to help transportation planners and researchers better understand how highly automated vehicles (AVs) may fit within existing transportation systems. As an interim step, Volpe modelers and analysts, working in collaboration with members of the European Union-U.S.-Japan Trilateral Working Group for Automation in Road Transport, published a framework that enables modelers and planners to leverage the work of multiple research teams. The working group is co-chaired by a Volpe Center senior analyst. The work of the European researchers was supported by the European Commission's Horizon 2020 program through the Aligning Research & Innovation for Connected and Automated Driving in Europe (ARCADE) initiative.

The idea for creating such a framework originated during a workshop that Volpe staff co-organized at the University

of Leeds in the United Kingdom in 2019, where they began building a system dynamics model of possible impacts of AVs.

The Volpe Center developed the framework along with its European co-authors, and coordinated review with other participants from the University of Leeds workshop. In addition to the workshop, Volpe also held working sessions ancillary to the 2019 Automated Vehicles Symposium in Orlando, Florida. The work resulted in the paper, "Building feedback into modeling impacts of automated vehicles: Developing a consensus model and quantitative tool," co-authored by Volpe staff and published in April 2020.<sup>2</sup> Volpe's familiarity with impacts of automation, capability in developing system dynamics models, and experience collaborating with European researchers on these topics were vital to this project.

The framework lays out the relationships among transportation users, authorities, systems and technology providers in a generic sense, then considers specific entities in each category and how they could be affected by AVs. By taking a systems approach to defining the main roles in commercializing, controlling, and consuming transportation technology, the authors hope to spark expanded system dynamics modeling that can shed light on how automation can impact both older and newer modes. The main roles are defined to apply equally to new and traditional business models.

<sup>2</sup> Rakoff, H. E., Smith, S., Innamaa, S., Barnard, Y., Harrison, G., & Shaw, J. (2020). Building feedback into modeling impacts of automated vehicles: Developing a consensus model and quantitative tool. Transport Research Arena, April 2020 (conference canceled), Helsinki, Finland. <https://rosap.ntl.bts.gov/view/dot/48969>.

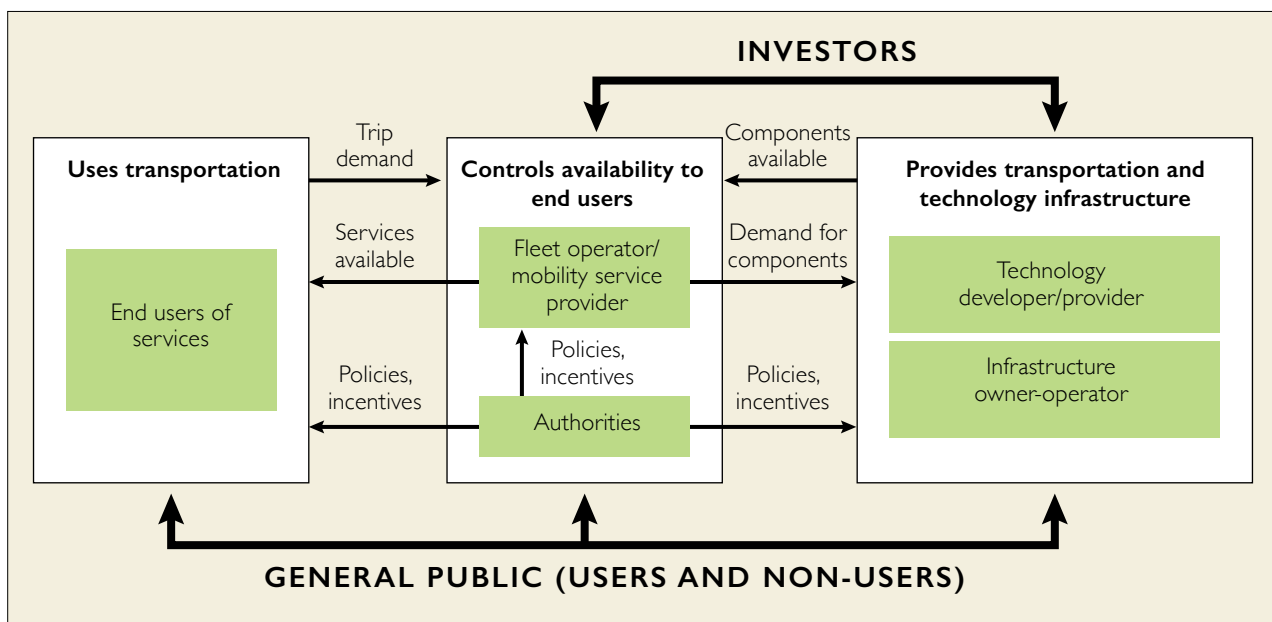


Diagram of major generic roles within the transportation system. Source: Rakoff, H. E., Smith, S., Innamaa, S., Barnard, Y., Harrison, G., & Shaw, J. (2020).

Establishing a generic structure to help researchers frame their questions about AV impacts from a systems perspective is just one milestone, but one that may help advance complementary modeling initiatives and with that, successful integration of automation into the transportation ecosystem.

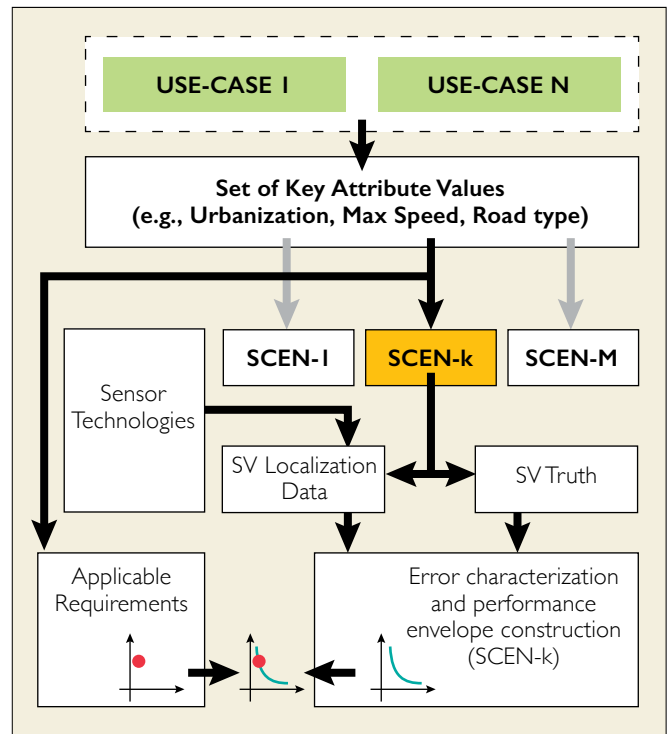
(Sponsored by ITS JPO)

## Positioning, Navigation, and Timing Technology Readiness for Safe Automated Vehicle Operations

Projected traffic fatality numbers for 2019 show that over 36,000 people were killed in motor vehicle crashes on the nation's roadways.<sup>3</sup> More than 90 percent of these crashes can be directly attributed to driver error. AVs and automated driving systems (ADS) have the potential to significantly reduce crashes while saving lives. Based on current data,<sup>4</sup> however, the average accident frequency for AV systems is approximately an order of magnitude larger than conventional driving. Resilient positioning, navigation, and timing (PNT) solutions are needed to ensure the accuracy, availability, and integrity requirements are reliably met for AV applications. As a result, the ITS JPO is working to define and meet a set of PNT criteria to ensure safe AV operations within the national transportation system.

The Volpe Center is providing expertise to ITS JPO by researching PNT requirements and candidate technology solutions for AVs and assessing the state of readiness of available and emerging PNT solutions. This work supports U.S. DOT's vision outlined in *Preparing for the Future of Transportation Automated Vehicles 3.0*, where PNT is identified as a technology area that can benefit from voluntary technical standards. Volpe's work also supports the mission of *Ensuring American Leadership in Automated Vehicle Technologies: Automated Vehicles 4.0*, to prioritize safety and emphasize cybersecurity by assessing sensor and sensor suite PNT performance in the event of signal jamming and spoofing attacks on one or more sensors.

A Volpe Center team leads the AV PNT technology assessment framework development and implementation effort. In early March 2020, the team submitted a report to ITS JPO



This process flow diagram shows the overall methodology used to assess PNT sensor capabilities in various scenarios. Source: U.S. DOT Volpe Center

that outlined a planned approach, defined representative use cases, and reviewed literature that will be used to determine PNT requirements. Additionally, the Volpe Center outlined a set of PNT attributes relevant to the representative scenarios and initiated test scenario development for the work.

In September 2020, the Volpe Center submitted a draft report to ITS JPO in which the team reviewed related efforts from standards organizations and industry and developed a methodology to derive technology agnostic localization and timing requirements for safe AV operation. Volpe's methodology included information on connected vehicle message standards, derivation of localization and timing error alert limits from physical geometry of vehicle and roads and operating speeds, and analysis of empirical naturalistic driving data.

The Volpe Center team will continue to investigate PNT sensor operating needs, as well as the performance of existing and emerging PNT sensors against current technology-agnostic requirements in future phases of this work. PNT sensors, sensor suites, and sensor fusion performance—in nominal, degraded, and intentional threat conditions such as GPS jamming and spoofing—can be assessed through both Modeling & Simulation (with sensor specifications referenced from sensor manufacturer and automaker literature) and

<sup>3</sup> <https://www.nhtsa.gov/press-releases/early-estimates-traffic-fatalities-2019>

<sup>4</sup> Examining accident reports involving autonomous vehicles in California; <https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0184952&type=printable>

closed-road driving tests. Evaluating sensor performance and determining PNT requirements can help improve the safety of AV operations within the national transportation system, reduce the number of vehicle crashes, and save lives. Pending approval by ITS JPO, the draft reports submitted by the Volpe Center team will be part of a final report to be released in March 2022.

(Sponsored by FHWA, ITS JPO)

## AVIATION

### Developing the Newest Service for FAA System Wide Information Management (SWIM): NAS Common Reference (NCR)

On any given day, nearly 5 terabytes (TB) of data—pertaining to flight movements, weather data, air traffic flow constraints, and more—move across the FAA’s System Wide Information Management (SWIM) enterprise between data producers and end users. While this data richness unlocks the potential for enhanced operational awareness and analysis, its sheer volume can create challenges for users of SWIM data (e.g., airline operators) who have to drill down to find the right information for their particular need.

The FAA SWIM Program Office develops and deploys information services that disseminate digital data essential to the real-time awareness of air traffic operations in the National Airspace System (NAS). An overarching mission of FAA SWIM is to deliver the right information, to the right users, at the right time. Currently, users of FAA operational data via SWIM need to connect to producer services individually to access different types of operational NAS data, such as en route flight data, terminal weather data, and aeronautical data. Users must develop separate interfaces to these services, as well as derive their own logic for parsing, storing, and correlating this data in space and in time.

The NAS Common Reference (NCR) is the newest information service that FAA SWIM plans to deploy to help fulfill this mission. NCR is a common, reusable service that leverages industry standards to ensure SWIM users can receive data from many SWIM producers in a consistently correlated manner. With NCR, users of enterprise SWIM data will have the ability to interface with a single SWIM service to access real-time, correlated data they need for decision making.



In support of the FAA, the Volpe Center developed a test tool that enables visualization of data sets that SWIM NCR correlates spatially and temporally in response to user requests. Source: U.S. DOT Volpe Center

The Volpe Center is the lead system developer of NCR service in support of the FAA SWIM Program Office. Drawing from more than 10 years of experience in developing and testing new SWIM services, Volpe is uniquely positioned to deliver the needed NCR capabilities to meet FAA operational objectives and program milestones. Specific capabilities applied include requirements development and analysis, system design, coding and testing, system and database administration, and data analysis.

Volpe experts have helped spearhead the use of innovative, industry-standard technologies for automating the process of testing and delivering software builds to the FAA. In the early phases of NCR system development, delivering software to the FAA required traveling to the test facility lab in Atlantic City, NJ, and installing physical media on FAA systems. This work could take more than a week to complete in some cases. After introducing software delivery “pipelines” directly between Volpe and the FAA test facility lab, this process now takes a matter of hours.

In July 2020, the NCR system was deemed operationally effective and suitable for entry into service into the NAS. This determination was collaboratively reached by numerous NCR stakeholders—including multiple FAA lines of business as well as the Volpe Center—based on results of rigorous system testing that demonstrate the NCR system baseline meets all applicable functional and performance requirements.

The FAA envisions NCR will be used by a variety of aviation stakeholders, and is already working on enhancements to the service to help meet future operational needs and user demand. The Volpe Center is a key partner in this endeavor, continuing to design, code, and test the NCR system in support of these objectives.

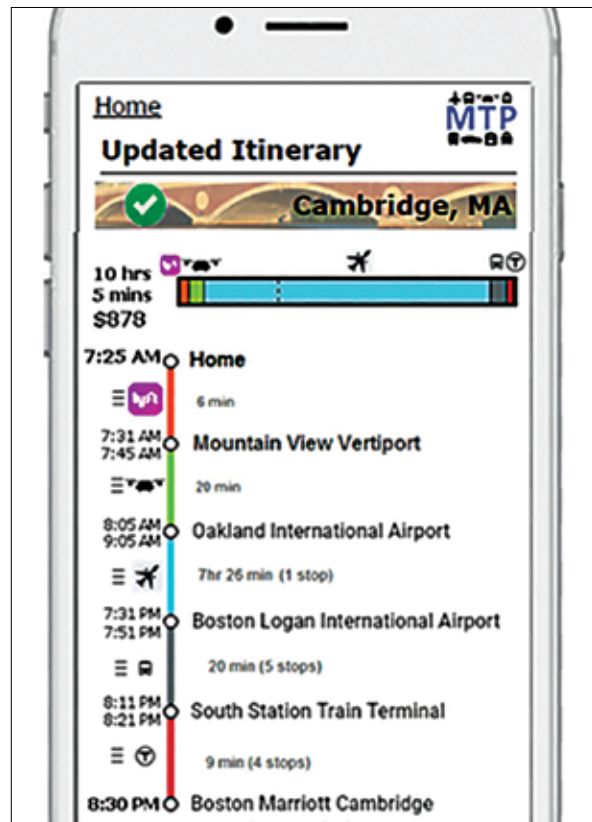
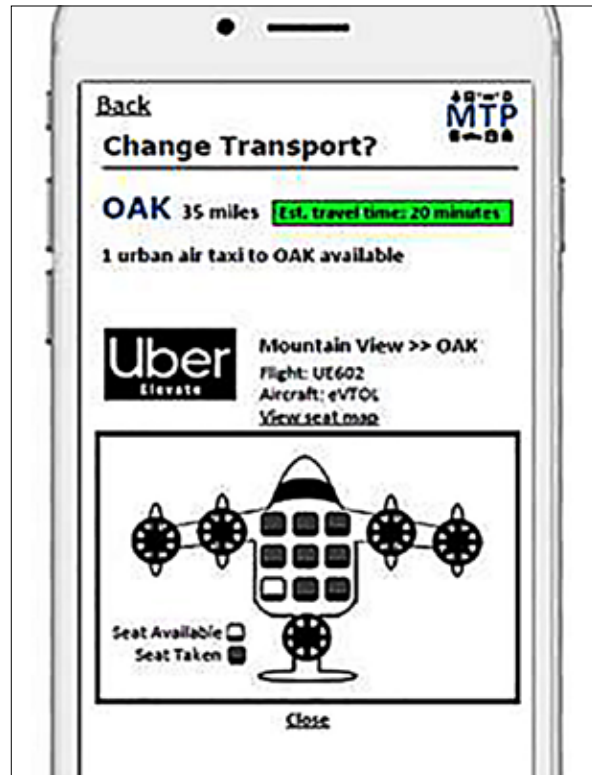
(Sponsored by FAA)

## Multimodal Transportation Operational Scenario and Conceptual Data Model Integration for Urban Air Mobility

The FAA and NASA envision highly autonomous short-haul and light passenger aircraft—or urban air mobility (UAM) vehicles—will play a significant role in the nation's transportation future. As UAM vehicles enter the aviation market, the function of aviation in a seamless, end-to-end multimodal transportation system will need to evolve to support these new entrants. In the next 10-15 years, FAA and NASA predict the general public will be able to request on-demand, point-to-point transportation in select cities using electric vertical take-off and landing (eVTOL) aircraft, also known as air taxis.<sup>5</sup> The FAA and NASA foresee hundreds of simultaneous air taxis flying in federated corridors in U.S. cities by 2035.<sup>6</sup>

To accomplish this goal, the U.S. DOT's multimodal research will need to include the growing role of UAM vehicles in our transportation system. UAMs will travel from vertiport to vertiport in low-altitude airspace within urban and suburban areas. UAMs are not themselves considered a door-to-door mode of transportation, and passengers will need to rely on other modes of transportation to complete their trips (transit, bike, pedestrian, rideshare, vehicle, etc.). Thus, it is imperative that all modes seamlessly exchange data (such as location and intent) with each other to achieve the cost and efficiency benefits that UAM can provide. Previous research in this area has primarily focused on surface urban mobility, where multiple ground transportation modes compete with and complement each other.

The FAA currently has a robust data exchange architecture in place to support traditional air transportation. UAM vehicles are not planned to operate in traditional controlled



The proposed multimodal application alerted passengers about scheduling delays and disruptions, and included UAM as a travel option. Source: U.S. DOT Volpe Center

5 NASA Advanced Air Mobility Ecosystem Working Group: <https://nari.arc.nasa.gov/aam-portal/>

6 FAA UAM CONOPS version 1.0: [https://nari.arc.nasa.gov/sites/default/files/attachments/UAM\\_ConOps\\_v1.0.pdf](https://nari.arc.nasa.gov/sites/default/files/attachments/UAM_ConOps_v1.0.pdf)

airspace, however, and private UAM service providers will manage these air taxis. This impending evolution of the public airspace with respect to UAM and other emerging air and ground autonomous vehicle systems, will require new and revised data exchange models. Similar to what we are experiencing today with the challenge of integrating new mobility systems into existing infrastructure, many U.S. cities are not prepared to integrate UAM into their transportation systems.

The Volpe Center has a long history of developing and revising international standard data exchange models for the FAA, such as the International Civil Aviation Organization (ICAO) Flight Information Exchange Models (FIXM), as well as defining other transportation data, communication, and safety standards. NASA asked the Volpe Center to research existing data exchange models that may need to be revised under a new UAM paradigm, including FIXM and the adopted General Transit Feed Specification (GTFS) that is used for transit and other modes. These models allow public transit agencies and private operator companies (e.g., ride-hailing companies) to release their data in a format that can be utilized by a variety of commercial and government applications.

In a future transportation system, remote operators may control several autonomous vehicles at a time. With this in mind, a Volpe team also proposed data exchange models that may need to be created, including the Passenger Information Exchange Model, the Operator Information Exchange Model, and the Vehicle Information Exchange Model. Volpe's research explored these potential data models and identified and defined preliminary conceptual data elements that will be necessary to support seamless, end-to-end mobility. These conceptual models consider all modes of transportation—pedestrian, scooter, car, bus, rail, boat, and air, and look to incorporate the most promising transportation data exchange models from among these systems.

In 2019, the Volpe Center demonstrated an operational scenario with a visual multimodal application (multimodal trip planner) for NASA that was passenger-centric and integrated UAM. The application alerted the passenger about scheduling delays due to traffic and weather disruptions along a cross-country route. It effectively rerouted the passenger based on available transportation modes, and the best route included UAM as an option. This application helped define the minimum set of data elements to be seamlessly shared between various modes in a disruption management scenario.

The Volpe Center discussed these findings in a paper presented at the Institute of Electrical and Electronics

Engineers (IEEE) Integrated Communications Navigation and Surveillance (ICNS) conference in September 2020.<sup>7</sup> The paper investigated the extension of current and new data exchange standards, security models, and frameworks that will work with existing and emerging transportation technologies. It also considers the revisions needed for existing data exchange models, and the work required to create new models.

The Volpe team envisions a transportation future that integrates UAM where travelers can plan and track the progress of their trips in real time using a smartphone application. The paper provides a detailed description of the proposed application and how it will streamline passenger trip planning and provide seamless, point-to-point transportation.

(Sponsored by NASA)

## ACCESSIBILITY

### U.S. DOT's Inclusive Design Challenge Seeks to Increase Mobility for All

An estimated 25.5 million Americans experience a travel-limiting disability that impacts their access to employment, medical care, and other essential resources and activities. As technology continues to evolve, AVs have the potential to improve freedom of movement for individuals with disabilities. Fulfilling this promise; however, will require innovation and creativity, not only in how AVs drive themselves, but also in how users access and interact with them. U.S. DOT's Inclusive Design Challenge (Challenge) seeks innovative design solutions that increase accessibility to on-demand transportation services for these vulnerable populations.

According to Finch Fulton, U.S. DOT Deputy Assistant Secretary for Policy, "The Inclusive Design Challenge provides a unique opportunity to help us all plan for the future of automation with the goal of developing truly inclusive approaches to passenger vehicles so everyone can benefit."

The Challenge asks researchers and innovators to develop design solutions that will allow people with physical, sensory, and cognitive disabilities to use AVs to access jobs, health-care, and other critical destinations. The prize competition

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<sup>7</sup> Tuchen, Sarasina. Multimodal Transportation Operational Scenario and Conceptual Data Model for Integration with UAM: <https://ieeexplore.ieee.org/document/9223002>

aims to attract ideas from around the nation to identify new solutions for common access issues. This year, the U.S. DOT sought the Volpe Center's assistance with the overall design and management of the Challenge.

Prior to the launch of Stage I in April 2020, the Volpe Center provided critical research and planning support. Volpe experts conducted market research to inform the development of the Challenge; developed the Challenge statement, structure, and judging criteria; and assisted with planning, developing, and executing a communications strategy to promote the Challenge to participants and relevant stakeholders. Volpe staff also developed and facilitated the evaluation process.

Stage I of the Challenge, for which proposals were due on October 30, 2020, requested that applicants submit written proposals describing their design solutions. The Volpe Center supported U.S. DOT subject matter experts in the review and selection of these proof-of-concept ideas, and on January 6, 2021, Secretary Chao announced the 10 semifinalists. The semifinalists will develop their prototypes for Stage II and present these ideas in summer 2022, where they will design and present prototypes. The final demonstrations and prizes are expected to be awarded in summer 2022, with a total prize purse of \$5 million for both stages.

The Volpe Center is providing planning and communications support to elicit these innovative ideas from a wide range of applicants, from academia to technology and automotive sectors. These innovations are expected to support the future development of AVs to become more accessible to, and useable by, people with disabilities and improving mobility for all.

(Sponsored by U.S. DOT)

## WORKFORCE

### Analyzing Potential Impacts of Automation on the Long-Haul Trucking and Bus Transit Workforce

Automated driving systems have the potential to significantly transform the nation's long-haul freight and transit bus industries, but uncertainty exists about how and when driving automation may be adopted and the associated impacts to the workforce. Congress directed the

Secretary of Transportation to conduct a study on the effects of automation on the nation's driving workforce. The Office of the Under Secretary for Policy sought the Volpe Center's expertise to help facilitate a detailed analysis of automated technologies to understand how long-haul freight and transit bus drivers could be affected.

The 2018 Consolidated Appropriations Act provided funding to the Secretary of Transportation for highly automated vehicle research and development, and requested that the Department, in consultation with the Secretary of Labor, "conduct a comprehensive analysis of the impact of Advanced Driver-Assistance Systems (ADAS) and Highly Automated Vehicles (HAV) technologies on drivers and operators of commercial motor vehicles, including labor displacement."

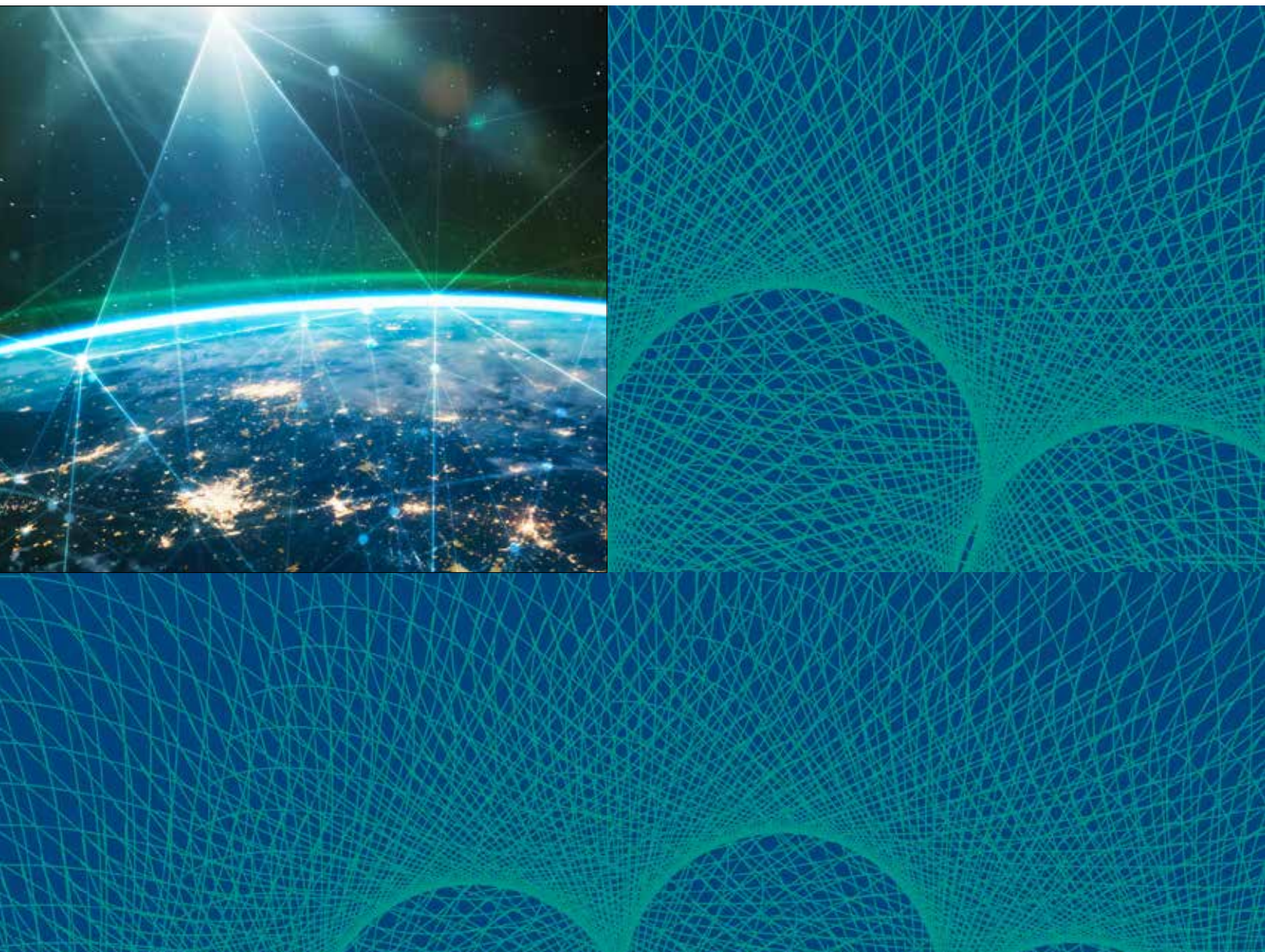
Volpe Center technical staff and communications experts collaborated with the Office of the Secretary to provide project management, research, economic analysis, writing and editing, literature review, stakeholder input analysis, facilitation of a high-visibility stakeholder event at U.S. DOT headquarters, and delivery of a draft report to Congress. A Volpe Center team supported an extensive internal and cross-agency review process to synthesize the varied perspectives and roles of multiple modes and federal agencies.

A draft report titled, "Driving Automation Systems in Long-Haul Trucking and Bus Transit: Preliminary Analysis of Potential Workforce Impacts Report to Congress" was developed by the U.S. DOT in coordination with the Department of Labor, Department of Commerce, and Department of Health and Human Services. The report analyzes the potential impacts of driving automation systems on the workforce. It also provides an objective resource for interested stakeholders to better understand the ways in which adoption of driving automation systems may impact professional drivers and the federal resources that are available to support workers. As driving automation systems are still at an early stage, the report can serve as a baseline for future reexamination of the topic.

The report profiles the current workforce in this field, explores the types of labor market impacts that may be experienced, and details the potential impacts on working conditions for different business models and levels of driving automation, emphasizing that there is inherent uncertainty in predicting how an emerging technology may affect jobs and workers in the future.

(Sponsored by the U.S. DOT Office of the Under Secretary for Policy)

# INFRASTRUCTURE AND TRANSPORTATION SYSTEM RESILIENCE



THE U.S. DOT VOLPE CENTER  
COLLABORATES WITH FEDERAL AGENCIES  
TO SUPPORT CIVILIAN AND DEFENSE  
INFRASTRUCTURE AND RESILIENCY  
EFFORTS THAT FURTHER U.S. ECONOMIC  
GROWTH AND ENABLE MORE EFFICIENT  
MOVEMENT OF PEOPLE AND GOODS.

#### MULTIMODAL

### The Volpe Center Coordinates U.S. DOT's First GPS Backup/ Complementary PNT Technology Demonstration

Accurate sources of PNT information support critical infrastructure, including the transportation sector, and are essential for national and economic security. The primary and most recognizable service that supports infrastructure is the Global Positioning System (GPS). However, since GPS relies on signals broadcast from a constellation of satellites located more than 12,000 miles from earth, its signals are very low received power and are vulnerable to intentional and unintentional interference. The National Defense Authorization Act for Fiscal Year 2018 (Section 1606 of Public Law Number 115-91, Page 131 Stat. 1725) directed the U.S. DOT, DoD, and the Department of Homeland Security (DHS) to conduct a complementary PNT and GPS backup capability demonstration.

The Volpe Center supported the joint effort between OST and the U.S. Space Force's Space and Missile

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Connected vehicles can communicate with each other, with drivers and pedestrians, and with the infrastructure. Source: ©iStockPhoto.com/jamesteohart

Systems Center in a partnership to plan and execute the demonstration. This involved substantial coordination of three demonstration sites, including setup of vendor equipment and installation of a government reference system to confirm vendor technologies' performance. These efforts culminated in a demonstration report that provides initial input to U.S. DOT's legislatively mandated responsibility for providing resilient PNT services that complement GPS.

In 2019, the Volpe Center developed and executed a rapid acquisition strategy to meet the demonstration schedule. Volpe awarded contracts to 11 vendors to support the demonstration and coordinated their participation.

In March 2020, a Volpe team conducted multiple demonstrations of the vendors' technologies at the Volpe Center's Aviation Weather Research Facility on Joint Base Cape Cod (JBCC) and the NASA Langley Research Center (LaRC) to collect data under a variety of scenarios. These scenarios provided vendors with a combination of use cases for static and dynamic positioning using two vans and multiple unmanned aerial systems (UAS) along with precision timing capabilities in the absence of GPS. The vendors were able to self-select their participation in nine available scenarios they believed would best demonstrate their technology. Vendor user equipment (UE) PNT outputs were collected by the Volpe data collection and reference system.

With the Volpe Center's help, the participating vendors showcased technologies capable of providing complementary PNT sources in the event of a GPS outage or disruption.

Analysis and assessment of each system was completed in May 2020. The Volpe team prepared a draft PNT technology

report to inform the National Space-Based PNT Executive Committee about the candidate technologies. The Office of Management and Budget will coordinate review of the report across federal departments and agencies as input to Congress.

## Resiliency of the Global Positioning System (GPS)



GPS is a U.S. government owned and operated network of satellites that provide precise position, navigation, and timing (PNT) information to military and civilian users all over the world.

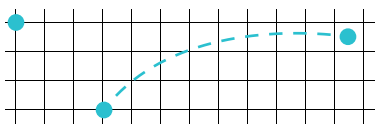
GPS receivers are susceptible to disruption and interference, including jamming and spoofing attacks. **The need for reliable sources of PNT is more important now than ever.**

The FY2018 National Defense Authorization Act gave authority to the **U.S. DOT**, the **Department of Defense**, and the **Department of Homeland Security** to conduct demonstrations of GPS Backup/Complementary PNT.

In support of and collaboration with the **Office of the Assistant Secretary for Research and Technology** and the **U.S. Space Force's Space and Missile Systems Command**, the Volpe Center conducted demonstrations of 11 vendor technologies that might provide a backup in the event of a GPS outage or disruption.

### WHAT TECHNOLOGY IS BEING DEMONSTRATED?

Sends **positioning** and/or **timing** information



At a **technical readiness** level of 6 or higher



**Independent** from GPS/Global Navigation Satellite System



Able to **interface** with the U.S. government's data collection



Meets **regulatory compliance** and without licensing restrictions



Must not produce information that threatens **national and economic security**



Volpe's dedication to standing up the demonstration sites, coordinating with the vendors, and collecting data was instrumental in making the backup GPS capability demonstration possible. Now, discussions around potential candidates for complementary PNT technology can take place leading to a more resilient PNT service that will support initiatives to improve safety and automation of the transportation enterprise.

**(Sponsored by U.S. DOT Office of the Assistant Secretary for Research and Technology/DoD)**

## BUILD Discretionary Grant Program: Technical, Cost-Effectiveness, and Readiness Evaluations

Since 2009, the Better Utilizing Investments to Leverage Development (BUILD) Discretionary Grant Program (formerly known as TIGER) has provided an opportunity for the U.S. DOT to invest in road, rail, transit, and port projects that have the potential to achieve national objectives. As the largest discretionary grant program within U.S. DOT, the BUILD Grant Program supports surface transportation infrastructure investment in local communities, with funding of \$1.5 billion in 2018, \$900 million in 2019, and \$1 billion in 2020. Due to the highly competitive nature of the program and the large number of anticipated applications, the Office of the Secretary (OST) sought the Volpe Center's expertise and support.

The Volpe Center assists OST in the project selection process by rigorously evaluating the technical merit, cost-effectiveness, and readiness of submitted proposals. In this way, Volpe helps ensure the selected projects meet the goals of the BUILD program and will yield societal benefits.

In May 2020, Volpe staff received training to conduct technical reviews, benefit cost analysis, and readiness reviews from OST staff to prepare for this effort. Approximately 75 Volpe staff members from various divisions and all four technical centers conducted technical reviews, economic analyses, and evaluated project readiness over a two month period. The technical review team finished reviewing all 660 applications in seven weeks, while benefit-cost and readiness reviews continued on for several more weeks, focused on evaluating highly recommended projects that emerged from the technical review phase.

Volpe Center staff worked in multidisciplinary teams to conduct technical reviews of submitted projects, assessing applicants' alignment with overall BUILD program merit

criteria. Volpe Center economists reviewed applicants' benefit-cost analyses, verifying the information provided and correcting methodological errors, while Volpe environmental specialists reviewed project readiness levels with respect to environmental requirements.

The BUILD grant awards for 2020, which will provide up to \$1 billion in funding for the development of critical transportation infrastructure to states across the U.S., were announced by Secretary Chao in mid-September. The 70 projects in 44 states support a variety of urban, rural, and planning projects that will make transportation safer and more efficient, including new and expanded roads, bridges, transit systems, freight hubs, and bicycle/pedestrian facilities. Volpe's review helped inform OST's surface transportation discretionary grant awards to projects that both advance U.S. DOT's priorities and serve local surface transportation needs.

Additional Volpe Center staff provide assistance to states throughout the grant lifecycle on rail projects, from applications to pre-award obligation to project oversight support, documenting, tracking, and reporting on all grantee projects through FRA's program management software. This collective work across the Center helps ensure these projects meet BUILD program goals of improving access to reliable, safe, and affordable transportation and infrastructure for all.

**(Sponsored by U.S. DOT Office of the Assistant Secretary for Policy)**

## Evaluating Energy Scenario Impacts on Transportation Demand, Mode Choice, Cost, and Emissions with the Freight and Fuel Transportation Optimization Tool

The efficient transportation of goods is a large part of what drives the U.S. economy. It is essential for government agencies to understand flow patterns and what they can do to minimize transportation costs and maximize the fulfillment of downstream demand. To analyze freight and fuel transport options, the Volpe Center created the Freight and Fuel Transportation Optimization Tool (FTOT) on behalf of FAA, the Department of Energy (DOE), and the U.S. Navy's Office of Naval Research. Since its initial public release in 2019, the Volpe Center has since updated and expanded FTOT's capabilities to support a variety of different agencies and organizations.

FTOT is a flexible, supply chain-oriented scenario-testing tool. It draws on a range of data to help government agencies analyze freight and fuel transport options and optimize multimodal transportation flow patterns and emissions associated with freight and energy scenarios. The Volpe Center originally developed FTOT as a way for the FAA's Office of Environment and Energy and the DoD's Office of Naval Research to test future alternative energy scenarios for the aviation sector. Its capabilities were expanded to support both FAA and DOE in their efforts to evaluate energy scenario impacts on transportation demand, mode choice, cost, and emissions—and beyond.

Recent updates to the tool allow for the evaluation of any material flows over the transportation network and can evaluate how potential transportation system disruptions (e.g., loss of capacity on a given network link) or supply chain characteristics affect optimal transportation solutions. In addition to ongoing development and future aviation fuel scenario analyses in support of FAA, Volpe is supporting FHWA in a pilot study to evaluate the potential to adapt FTOT for long-range transportation planning. FTOT has the potential to serve as a resource for state DOTs and metropolitan/regional planning organizations to evaluate how key freight corridors intersect with planned and potential transportation projects and how those projects may address critical freight needs.

The Volpe Center leverages its multimodal perspective on operations research, geospatial and networks analysis, and expertise in freights and fuels to update the tool on a quarterly basis. FTOT models and tracks commodity-specific information and can take into account conversion of raw materials to products (e.g., crude oil to jet fuel and diesel).

FTOT will help government agencies, non-governmental organizations, researchers, and private sector companies explore and optimize supply chain scenarios and evaluate how supply chain and network disruptions could affect transportation patterns, mode choice, costs, and emissions. These organizations can use FTOT to plan for future energy innovations, assess transportation network infrastructure needs and utilization under various future conditions, and potentially prioritize infrastructure investments based on their intersection with critical supply chains.

FTOT is publicly available at <https://github.com/VolpeUSDOT/FTOT-public>.

**(Sponsored by Federal Aviation Administration, 2012 – present;  
Dept. of Defense Office of Naval Research, 2012 – 2014;  
Dept. of Energy Office of Policy, 2015 – 2018;  
FHWA, 2018 – present)**

## HIGHWAY

### The Importance of Highways to U.S. Agriculture

Agriculture comprises the single largest component of U.S. freight transportation, and agricultural production is projected to increase through 2045. The movement of agricultural products represents 27 percent of all ton-miles moved on the U.S. transportation which includes highways, waterways, and railroads. Agricultural goods are the single largest category of freight that travel on U.S. highways by volume. The nation's highway network is an essential component of the agriculture industry, moving grains, oilseeds, livestock, dairy, fruits, and vegetables from farms and processors to the marketplace as efficiently as possible.

The U.S. Department of Agriculture (USDA) partnered with transportation analysts at the Volpe Center to examine the infrastructure and performance of the U.S. highway system that supports the nation's agriculture industry. A Volpe team studied the economic significance of the agriculture industry and the component of agriculture costs that come from transportation.

By analyzing several data sources, the Volpe team identified High-Volume Domestic Agriculture Highways (HDAH) in the U.S., based on 2018 domestic agricultural commodity flows, and analyzed the performance of these highways in terms of reliability, congestion, and safety. These highways are key to moving agricultural goods to market, carrying approximately 80 percent of domestic agricultural freight, but representing only 17 percent of highway mileage.

An economic analysis found that 3 to 4 percent of the final cost of domestic agricultural products are transportation costs. This low cost is reflective of the high-performing freight network that is available in the U.S., which provides a distinct competitive advantage for U.S. agriculture producers who sell their products internationally. Because profit margins are very thin in the agriculture industry, however, maintaining these low costs is critical to the industry's long-term health.

Volpe managed the research project in cooperation with the U.S. DOT Office of the Assistant Secretary for Policy, and performed all aspects of the technical work. A multidisciplinary team of economists, data scientists, geographic information system specialists, policy analysts, operations research analysts, and transportation planners was assembled for this project, encompassing several different areas of research and technical skills. The team developed a report that communicates the importance of the highway mode in supporting a competitive U.S.

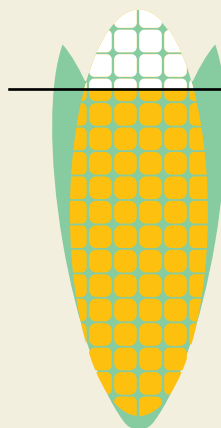
## The Importance of Highways to U.S. Agriculture

Agricultural products are the single largest category of freight transported on U.S. highways by volume. The Volpe Center collaborated with the **U.S. DOT Office of the Assistant Secretary for Policy** and the **USDA Agricultural Marketing Service** to study the economic impacts of the agriculture industry and the associated costs from transportation.

**17%** OF U.S. HIGHWAYS CARRY ...

The Volpe team's research highlighted the following key findings:

- Most agricultural freight shipments begin or end with a truck trip.
- Transportation makes up 3 to 4 percent of the total cost of agricultural goods. This is significant because agriculture industry margins are very tight.
- Maintaining low transportation costs is critical for long-term competitiveness of the U.S. agriculture industry.
- Agricultural freight volumes are projected to increase faster than the rate of population growth.



**80%** OF ALL U.S. AGRICULTURAL FREIGHT.

### ESTIMATED IMPACT OF STATE FREIGHT PLAN PROJECTS (2016 – 2020)

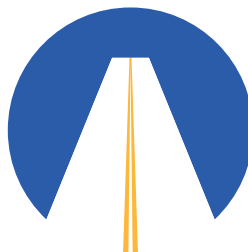
**\$17B**

Funding programmed in State Freight Plan Projects from **National Highway Freight Program**



**24%**

Projects located on highways that are part of the **High-Volume Domestic Agriculture Highways**



**\$540M**

Estimated **annual** truck operating **cost savings**



- Looking to the future, the Volpe team also analyzed planned freight-oriented **highway investments**. Projects in each of the 51 State Freight Plans, as of December 2019, were systematically catalogued and geocoded.
- These projects represent approximately **\$17 billion in investment** from the National Highway Freight Program for fiscal years 2016 to 2020, plus additional projects funded from other sources.
- Roughly one-fourth (24 percent) of these projects are on the **High-Volume Domestic Agriculture Highways**. Using the Highway Economic Requirements System (HERS) model, the Volpe team estimated that this planned investment level would generate **\$540 million** per year in truck operating cost savings.

agriculture market, including potential investment scenarios and a framework for conceptualizing and coordinating efforts to better address agricultural freight movement in highway planning and decision making.

This project produced the first national-scale analysis of the performance of domestic agricultural highway freight, providing state DOTs, local governments, and agriculture stakeholders with new information about the performance of the highway system for this important sector of the U.S. economy. The report provides stakeholders with strategies and notable practices, which may be considered as future actions to further strengthen the transportation system and prepare for the future.

The U.S. Department of Agriculture released the report on December 17, 2020.

(Sponsored by U.S. DOT Office of the Assistant Secretary for Policy; U.S. Department of Agriculture—Agricultural Marketing Service)

## Keeping Drivers Safe with Innovative Intersection Design Research and Evaluation

According to recent data, more than 50 percent of fatal crashes and crashes resulting in injuries occur at or near intersections.<sup>8</sup> The FHWA conducts intersection and interchange safety research to reduce crashes and keep drivers safe on the nation's roadways. An early goal of this research was to develop novel intersection and interchange designs to significantly improve the safety of standard intersections.

FHWA initiated the Research and Technology (R&T) Evaluation Program in 2014 to assess the benefits of its R&T efforts and to ensure it was effectively communicating guidance to the transportation industry. In 2019, FHWA asked the Volpe Center to conduct an evaluation of Innovative Intersection Design (IID) research, which is part of a larger portfolio of evaluation work the Volpe Center has performed for FHWA.

The IID evaluation report provides critical insight into FHWA's decision-making processes, research activities, role within the broader infrastructure research community, efforts to promote deployment of innovative intersection and interchange designs, and the safety impacts of those efforts. The purpose of this evaluation is to assess the effects of FHWA's investment in IID research, the availability and quality of such research, the adoption of IIDs in the U.S., and

the impacts of intersections on safety and the operational performance of the U.S. transportation system. A Volpe Center team evaluated the IID program using a range of qualitative and quantitative capabilities, including expert interviews, literature review, bibliographic data collection and analysis, infrastructure deployment tracking, benefit-cost analysis, and sensitivity analysis.

The report highlights FHWA's R&T efforts and the direct impacts of IID deployments on safety and the implementation of innovative intersection designs. The Volpe Center provided recommendations to improve FHWA's research efforts for safety and infrastructure programs as well as for R&T programs in general.

The final report was delivered to the FHWA Office of Research, Development, and Technology in November 2019 and is currently under review. Key findings include the cumulative number of states that have implemented at least one of the innovative intersection and interchange designs recommended by FHWA. From 2007 to 2018, there was a dramatic increase in the number of states that deployed at least one innovative design, including continuous flow intersections, diverging diamond interchanges, mini-roundabouts, median U-turns, and restricted crossing U-turns. The report aligns closely with the U.S. DOT's strategic goals of safety, infrastructure, and innovation.

FHWA played a critical role in increasing adoption of IIDs across the country, particularly after the release of the Alternative Intersections/Interchanges: Information Report in 2010.<sup>9</sup> Stakeholder interviews highlighted additional ways FHWA impacted implementation of IIDs by helping potential adopters overcome barriers. One interviewee put the impact of FHWA's efforts this way:

"I want to reinforce the value that FHWA, the Resource Center, some of the research material produced by FHWA... some of the one-on-one help, whether that's the Resource Center or the local division office. Perhaps we could have gotten to where we are, but it would have taken several years longer, and I'm not sure that we would have gotten to where we are."<sup>10</sup>

(Sponsored by FHWA, Office of Research, Development, and Technology)

<sup>9</sup> Hughes, W., Jagannathan, R., Sengupta, D., and Hummer, J. (2010). *Alternative Intersections/Interchanges: Informational Report (AIIR)*, Report No. FHWA-HRT-09-060, Federal Highway Administration, Washington, DC. Available online: <https://www.fhwa.dot.gov/publications/research/safety/09060/09060.pdf>, last accessed September 11, 2019

<sup>10</sup> State transportation agency employee, phone interview conducted by Jonathan Badgley, Joshua Fowler, and Kendall Mahavier (evaluation team), July 2019

<sup>8</sup> Intersection Safety: <https://highways.dot.gov/research/research-programs/safety/intersection-safety>

## Quantifying Emissions Benefits with the CMAQ Emissions Calculator Toolkit

The Congestion Mitigation and Air Quality Improvement (CMAQ) Program provides funding to state and local governments for transportation projects and programs that help meet the requirements of the Clean Air Act and its amendments. The CMAQ program has invested \$38 billion in about 40,000 projects since 1992. To receive CMAQ funding, transportation agencies must demonstrate that their projects will provide emissions reduction. The CMAQ Emissions Calculator Toolkit (CMAQ Toolkit) is a suite of spreadsheet-based tools available to transportation agencies and project sponsors to estimate emissions benefit of CMAQ-funded projects.

Since 2015, the Volpe Center has provided support to FHWA's Office of Natural Environment in the development of the CMAQ Toolkit. The Volpe Center's in-depth knowledge of and expertise in emissions and traffic modeling, and their understanding of FHWA priorities and practices, has enabled the development of user-friendly tools for a wide range of stakeholders.

The Volpe Center developed the CMAQ Emissions Calculator Toolkit with FHWA in 2018-2019 in response to increased interest in using CMAQ funds for high-occupancy vehicle and high-occupancy toll lane projects. The Managed Lane Facilities tool relies on emissions and vehicle activity data from the Environmental Protection Agency's Motor Vehicle Emissions Simulator (MOVES). It was tested by several state DOTs and metropolitan planning organizations prior to being published. Source: FHWA and U.S. DOT Volpe Center. Source: U.S. DOT Volpe Center

The CMAQ Toolkit covers a wide range of CMAQ-eligible project types. Eleven tools are currently available, covering over 20 project types, including transit service expansion, alternative fuels, bicycle and pedestrian improvements, managed lanes, and dust mitigation. These project types may improve air quality by smoothing the drive cycle of vehicles (i.e., less stop-and-go and idling), reducing passenger vehicle mileage, incentivizing cleaner vehicles and fuels or targeting a specific pollutant process, such as road dust. In addition to air quality benefits, many CMAQ-funded projects help reduce congestion on the nation's roadways. Projects such as transit service expansion and bicycle and pedestrian improvements encourage shifts to public transit and non-motorized modes, which reduce passenger vehicle traffic and emissions.

In 2020, the Volpe Center developed methodologies for five new tools in the CMAQ Toolkit. Three of the tools address various ITS and vehicle-to-infrastructure (V2I)-related projects including electronic and open-road tolling; travel advisories; and adaptive traffic signal coordination. ITS/V2I projects can involve building new infrastructure, such as overhead tolling gantries and roadside messaging signs, which communicate with drivers and vehicles. These projects may also synchronize traffic signals in real time and send travel and weather advisories directly to in-vehicle displays. Emissions modeling for the V2I/ITS tools requires more complex approaches, such as traffic microsimulations and analyzing individual drive cycles and operating modes, compared with previous tools. These new methodologies align with research and pilot programs being conducted by the Office of the Secretary's ITS Joint Program Office.

The two other tools developed in 2020—construction and intermodal equipment and locomotive and marine engine retrofit and replacement—represent the first set of non-road tools available in the CMAQ Toolkit. Several cities located on waterways have recognized the adverse air

The screenshot shows the user interface of the CMAQ Emissions Calculator Toolkit. At the top left is the U.S. Department of Transportation Federal Highway Administration logo. In the center is the CMAQ Emissions Calculator Toolkit logo, which includes a grid of colored squares. To the right of the logo is a link for "Questions or Feedback? CMAQ\_toolkit\_help@dot.gov". Below the logo, the title "Managed Lane Facilities" is prominently displayed. Underneath the title, a paragraph describes the tool's purpose: "This tool provides estimates of emission reductions for CMAQ-funded projects that alleviate congestion on freeways and other high-speed limited access roads. Congestion reduction projects include implementation of new managed lane facilities, such as high-occupancy vehicle (HOV) and high-occupancy toll (HOT) lanes, and managed lane conversions, such as HOV-to-HOT conversions." Another paragraph states: "Emissions rates are primarily based on a series of national-scale and project-scale runs of the EPA MOVES model according to speed and road type. Emission estimates from tools in the CMAQ Toolkit are not intended for use in State Implementation Plans (SIPs) or transportation conformity analyses and do not meet the same requirements necessary for SIP and conformity reporting." At the bottom, there are two buttons: "New Facilities" and "Lane Conversions".

quality impacts of vessels and other equipment at ports, as well as increased congestion on roadways due to cargo movements by freight trucks. These tools will help transportation agencies accurately quantify project emissions benefits at ports, rail yards, intermodal facilities, and construction sites.

The CMAQ Toolkit serves as an easy-to-use resource for transportation agencies to streamline analyses, justify use of CMAQ funds, and prioritize projects. It also ensures consistency across submissions to the CMAQ program by various state agencies.

(Sponsored by FHWA, Office of Natural Environment)

## Using the Traffic Noise Model to Mitigate Highway Noise Impacts on Communities

Highway traffic noise and air pollution can have harmful effects on surrounding communities and neighborhoods. FHWA's Traffic Noise Model (TNM) helps states determine when highway barriers can feasibly and reasonably be used to help mitigate the impacts of traffic noise. Originally launched in 1998, FHWA has since released the TNM tool six additional times to include critical updates and enhance analytical capabilities. The latest version of TNM (version 3.0) was released in February 2020, replacing TNM 2.5 that was released in 2004. This updated version includes significant changes to the user interface and provides improvements to the acoustics algorithms. These enhancements provide users with more flexibility and accuracy during the data entry process, and better visual representations when conducting noise analysis.

The Volpe Center has been involved with data collection and development of TNM since its inception, and continues to improve TNM and related tools and provide technical support to the TNM user community.

TNM 3.0 helps highway agencies optimize noise barrier design resulting in cost savings and noise reductions that will benefit the impacted communities. TNM 3.0 allows highway agencies to use base maps to more easily add objects to the study that are not already included, for example, in highway construction plans. This information provides a human readable input format that others can write to in order to develop new methods for adding data to a TNM study. This capability provides long-term benefit to states by making workflows more efficient and keeps TNM current with the latest data formats.

Volpe Center staff made significant improvements to TNM 3.0, including updates of the acoustical formulae, modernization of the acoustics code, and release of an enhanced graphical user interface. Accompanying the release of TNM 3.0, Volpe experts also developed a number of documents and manuals including the model validation report, technical manual, and a guide to help users get started with TNM 3.0. To assist FHWA in TNM 3.0 deployment, the Volpe Center hosted two roll-out webinars, developed and published six instructional YouTube videos, and conducted user group virtual meetings.

The Volpe Center continues to provide effective and comprehensive technical support to FHWA to address project-specific issues related to the implementation of TNM 3.0. Since its release in February 2020, the Volpe Center has addressed 150 technical support issues, with roughly 10 percent involving detailed analysis utilizing the more maintainable programming code in TNM 3.0. The Volpe Center continues to assist FHWA in improving TNM, with plans to release the next update in early 2021.

(Sponsored by FHWA, Office of Natural Environment)

### LONG-TERM RECOVERY

## FEMA Region I COVID-19 Long-Term Recovery Technical Support

The U.S. DOT Volpe Center has been providing subject matter expertise to the Federal Emergency Management Agency (FEMA) Region I COVID-19 Long-Term Recovery Task Force since May 2020. FEMA Region I oversees federal emergency management for Tribal Nations of New England and the six New England states. FEMA Region I established the COVID-19 Long-Term Recovery Task Force under the National Disaster Recovery Framework (NDRF), which promotes effective recovery from large-scale incidents and enables orchestrated support to impacted states, tribes, and local jurisdictions. The NDRF focuses on how best to restore, redevelop, and revitalize the health, social, economic, natural, and environmental fabric of the community as well as build a more resilient nation.

The Volpe Center's technical staff have been performing a variety of activities to support FEMA Region I in gaining a better understanding and support of the economic, health, housing, and transportation impacts of COVID-19 long-term recovery on state, local, and tribal governments in Region I.

Volpe's federal experts have been serving as liaisons between the FEMA Region I COVID-19 Long-Term Recovery Task Force and State Economic Recovery Managers in New England. Volpe has also facilitated and supported discussions and engagement with the Bureau of Indian Affairs, United South and Eastern Tribes, and the Tribal Nations in Region I to support tribal recovery efforts. The Volpe Center is also serving a key role in vaccine distribution planning efforts and has supported FEMA's efforts on a Transportation Resource Guide, Healthy Buildings Resource Guide, and other COVID-19 recovery-related resource guides.

(Sponsored by FEMA)

## INTERNATIONAL

### Partnering with the Millennium Challenge Corporation to Improve Accessibility in Malawi

The Millennium Challenge Corporation (MCC) works with developing countries around the world to promote economic growth and stability, help reduce global poverty, and invest in future generations. MCC is currently partnering with Malawi, where 70 percent of the population live below the international poverty line of \$1.90 per day and 80 percent live in rural areas. Key constraints to economic growth in Malawi are the high costs of rural transportation and weak farm-to-market linkages caused by poor road conditions, inadequate road network coverage particularly in rural areas, and ineffective government planning, financing, and coordination. The Volpe Center is collaborating with MCC to find solutions to these critical problems through U.S. government investments.

In early 2020, Volpe Center transportation experts traveled to Malawi with MCC's Transport and Agriculture teams to discuss potential road infrastructure investments and structural reforms with government officials and representatives of the private sector and civil society. While there, Volpe staff conducted site visits of potential road projects and agribusiness sites to help inform ideas for development.

Volpe helped develop initial project concepts for new policies and reforms to support a shift to evidence-based



Farmers in Malawi typically bring their goods to market using carts pulled over dirt roads. Source: U.S. DOT Volpe Center

planning and decision-making processes that prioritize road investments and ensure sustainability through improved road management processes. This work, which will be implemented over a five-year period, invests in the transport infrastructure and structural institutional reforms for rural agricultural development in Malawi.

The Volpe Center is working with MCC to develop projects that enhance farm-to-market linkages by reducing transport costs for the agriculture sector. This work will improve accessibility to transportation, which will enhance the livelihoods of small farmers and improve access to vital health and social services for the people of Malawi.

For several years, the Volpe Center has been providing transportation planning, policy, and infrastructure work internationally through an interagency agreement with MCC. MCC has utilized the Volpe Center's expertise to help solve transportation-related issues and strengthen institutions in 10 countries—Indonesia, Tunisia, Lesotho, Liberia, Nepal, the Philippines, Cote d'Ivoire, Sri Lanka, The Gambia, and now Malawi. The Volpe Center has enlisted a cross-disciplinary team of transportation planners, engineers, economists, and data scientists to work on this project.

(Sponsored by MCC)



ACCOUNTABILITY

U.S. DOT VOLPE CENTER EXPERTS HELP  
TO STREAMLINE PROCESSES AND  
PROMOTE GREATER EFFICIENCIES TO  
ENSURE A SAFE, EFFICIENT, ACCESSIBLE,  
AND CONVENIENT TRANSPORTATION  
SYSTEM FOR ALL AMERICANS.

#### PERMITTING AND ENVIRONMENTAL ANALYSIS

### Federal Permitting Improvement Steering Council Annual Report to Congress

Since its establishment in 2015, the Federal Permitting Improvement Steering Council (FPISC) has been leading efforts to modernize the federal review and permitting process for large, complex infrastructure projects across the United States. As part of Title 41 of the Fixing America's Surface Transportation Act (FAST-41), FPISC provides a framework for improving environmental reviews and authorization processes across agencies. To evaluate the Permitting Council agencies' progress toward implementing best practices, the Volpe Center assists FPISC in the development and delivery of the Annual Report to Congress.

The report highlights and assesses federal agencies' progress toward implementing the best practices outlined by FPISC, and identifies where decision requirements can be streamlined across agencies in order to increase efficiency. The Volpe Center team delivered the final draft of the Annual Report to Congress for Fiscal Year 2019 to FPISC in May 2020, which was then delivered to Congress.

The FY 2019 report indicated that the environmental review times for projects covered by the Permitting Council were reduced by an average of 1.5 years, which supported more than 127,000 temporary construction jobs and over 3,000 permanent jobs across the country. The report also noted that FAST-41 projects that completed the federal permitting process represent \$12.7 billion in economic investment. These findings emphasize the important role that FPISC plays in positively impacting the economy, workforce, and development of complex infrastructure projects across the nation.

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Previous page: The 2019 Federal Permitting Improvement Steering Council Annual Report to Congress highlighted environmental review times for infrastructure projects were reduced by 1.5 years.

Source: <https://www.123rf.com/Mike>

In developing the FY 2019 report, the Volpe team was instrumental in managing feedback from the 13 Permitting Council member agencies, assisting FPISC in analyzing and incorporating agency input, and identifying opportunities for

## Accelerating and Improving Environmental Reviews and Permitting Processes

The **Federal Permitting Improvement Steering Council (FPISC)** coordinates environmental reviews and authorization decisions among federal and state agencies, and establishes best practices for improving the review and approval process for complex infrastructure projects. The *FPISC Annual Report to Congress for Fiscal Year 2019* assesses Permitting Council member agency progress in implementing best practices throughout the year.

A Volpe Center team was instrumental in managing input and feedback from the 13 Permitting Council member agencies, assisting FPISC in analyzing and incorporating agency input, and identifying opportunities for improvement among the Council's agencies.

### KEY HIGHLIGHTS OF THE *FPISC ANNUAL REPORT TO CONGRESS FOR FISCAL YEAR 2019* INCLUDE:

<b>\$12.7 billion</b>	<b>Economic investment</b> represented by <b>FAST-41</b> projects that completed the federal permitting process in FY 2019
<b>\$104 billion</b>	<b>Domestic economic investment</b> during FY 2019 as a result of <b>FPISC's</b> coordination of environmental reviews and authorizations
<b>1.5 years</b>	Average <b>reduction in environmental review timeframes</b> for projects covered by FAST-41
<b>127,000</b>	Number of <b>temporary construction jobs</b> created across the country along with over 3,000 permanent jobs

**\$12.7  
Billion**

**\$104  
Billion**

**1.5  
Years**

**127K  
Jobs**



improvement among the Council's agencies. In addition to the development of the Annual Report, Volpe experts helped to develop important materials for distribution to Congress, which included distilling complex information into a press release and developing an informational one-page fact sheet.

The Volpe Center team continues to support FPISC in the development of the FY 2020 Annual Report to Congress, assisting with the creation of a more nuanced agency evaluation methodology, gathering feedback from agencies, updating the best practices, conducting analysis of data on the Permitting Dashboard, and producing a report that again highlights the important work being done by FPISC and its member agencies.

(Sponsored by FPISC)

## Protecting Public Health through Highway Noise Assessment and Abatement Measures

Heavy highway traffic and congestion can have harmful effects on surrounding communities—from health risks due to air pollution and activity interference caused by excessive noise. FHWA's Office of Natural Environment seeks to protect the public from noise and air pollution while reducing regulatory barriers for the planning and design of highways. As part of this mission, FHWA is evaluating the Procedures for Abatement of Highway Traffic Noise and Construction Noise (23 CFR 772), and developing a Notice of Proposed Rulemaking (NPRM) to update the regulation.



Acoustic barriers protect residents from the noise generated by vehicle traffic. Source: 123rf.com/vladdon

State DOTs are required to investigate traffic noise impacts adjacent to federally funded highway construction projects and consider feasible and reasonable abatement measures. Based on feedback from stakeholders and the public, FHWA is working to revise 23 CFR 772 to improve clarity and ease of implementation. The Volpe Center is conducting research that will inform the development of the NPRM. Volpe's technical expertise in the area of environmental review and mitigation is key to helping FHWA identify regulatory reforms to propose in 23 CFR 772.

Originally developed in 1973, the intent of 23 CFR 772 was to provide highway agencies with procedures to assess noise impacts and abatement measures to protect the public's health and welfare. FHWA has revised and updated the federal code several times over the years, with the most recent update in 2010. In preparation for developing the draft NPRM, the Volpe Center conducted regulatory research to understand the history of past provisions and inform selection of and justification for proposed changes to the current regulation.

A Volpe team participated in regulatory writing for the proposed rule and preamble, which explains recommended changes to 23 CFR 772. In addition, Volpe acoustics engineers conducted scenario analyses using the FHWA Traffic Noise Model to assess possible regulatory changes under consideration by FHWA, and provided recommendations for policy options through technical reports.

With the Volpe Center's expertise, FHWA will assess ways to streamline its regulation, increase overall clarity and understanding of the requirements, and improve highway noise abatement processes.

(Sponsored by FHWA Office of Natural Environment)

## ECONOMIC ANALYSIS

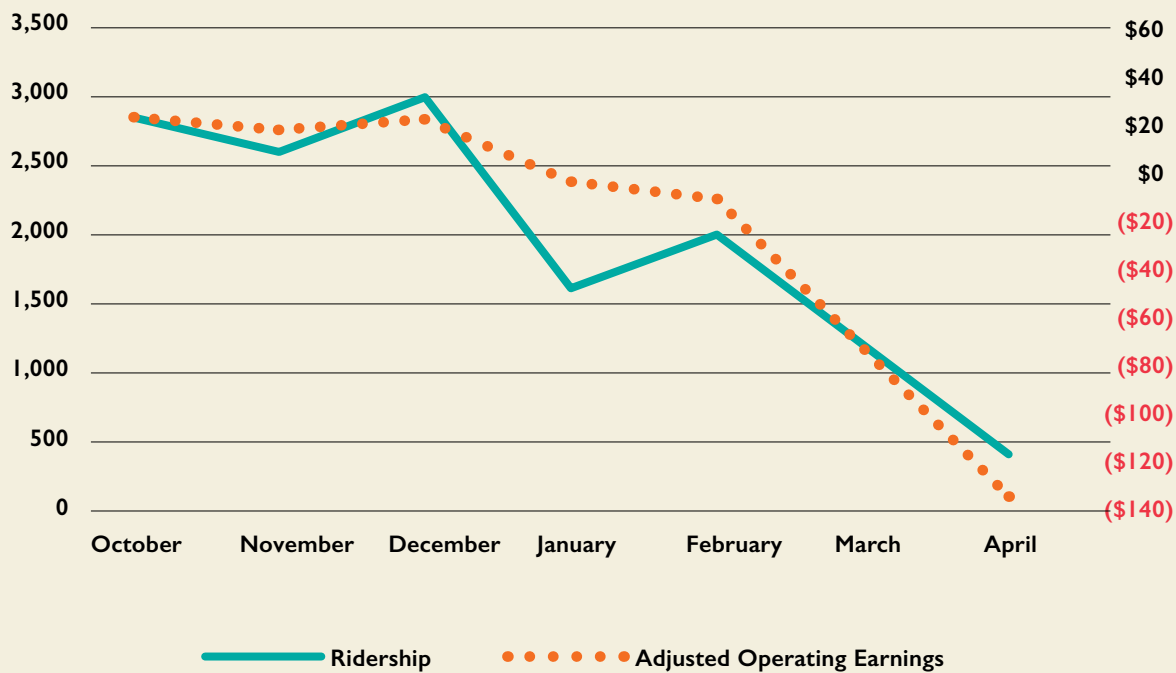
### State and Amtrak Intercity Passenger Rail Committee Financial Data Analysis and Support During the COVID-19 Pandemic

The COVID-19 pandemic has significantly impacted the nation's passenger transportation services, and Amtrak has been hit especially hard over the past year. As ridership and revenue began to plummet in March 2020, Amtrak and the 17 states that jointly fund 28 passenger routes across the U.S. faced the difficult decision to reduce service levels. Understanding the financial impact of the reduction in Amtrak passenger service was critically important to federal and state decision makers.

In April, Amtrak's ridership dropped by roughly 95 percent. Prior to COVID-19, Amtrak was having one of its best financial years, with adjusted operating losses averaging under \$1 million per month. In March, Amtrak had an adjusted operating loss of over \$67 million, followed by adjusted losses exceeding \$115 million in April. In addition, state tax revenues, a primary source of operating support payments to Amtrak, have fallen during this crisis. This factor potentially limits a state's ability to support future Amtrak passenger service.

Based on the Volpe Center's experience with Amtrak's financial systems and state-supported service agreements, the State-Amtrak Intercity Passenger Rail Committee (SAIPRC) asked a Volpe team, as part of an agreement for financial and policy analysis, to research the magnitude of the financial impact of COVID-19 on the 28 routes. The Volpe

## AMTRAK RIDERSHIP (THOUSANDS) AND ADJUSTED OPERATING EARNINGS (\$MILLIONS)



Amtrak Ridership (in thousands) and Adjusted Operating Earnings (in \$ millions) from October 2019 through April 2020.

Source: U.S. DOT Volpe Center

Center team developed a tool to analyze the cost components of each route during the pandemic and compared it with baseline costs during normal operations. In collaboration with SAIPRC staff, Volpe analysts led a detailed review of route financials including any shifts in costs shared among other Amtrak routes, supplementing the initial tool with additional monthly data as available.

This analysis allowed SAIPRC and its membership to track the impact of dramatically reduced or eliminated service on route financial performance. The results will inform state and Amtrak stakeholders both during the current crisis as well as for future service agreements. The Volpe Center provides SAIPRC with analytical support for several tasks related to the cost-sharing agreements between Amtrak and state agencies and related reporting per the Passenger Rail Investment and Improvement Act (PRIIA) Section 209 Cost Sharing Methodology. The PRIIA 209 Methodology is largely built upon the Amtrak Performance Tracking (APT) system. As one of the developers of the APT system in past cooper-

ation with Amtrak and FRA, the Volpe Center was uniquely positioned to support the analysis, interpretation, and description of that data for the benefit of SAIPRC's members.

For more than 10 years, the Volpe Center has collaborated with Amtrak on behalf of FRA to provide critical financial expertise. In 2005, Volpe worked with Amtrak and FRA to develop the APT cost accounting system that Amtrak uses in its systemwide financial reporting. Since then, the Volpe Center has provided a range of analyses and support including collaboration with SAIPRC membership and staff, Amtrak, and FRA, to develop the cost validation reporting prototypes that will be reviewed with this work.

This project promotes transparency between the full SAIPRC membership including the states, Amtrak, and FRA and builds on prior and ongoing Volpe Center work with FRA and Amtrak to develop the cost accounting system that is the foundation for state-supported service billing and reporting. PRIIA Section 209 shifted certain passenger rail costs to

states allowing them to more actively manage their own rail service. Currently, 20 agencies in 17 states fund 28 Amtrak passenger service routes. This state-supported service line is a key driver of Amtrak's financial performance. Amtrak and the states use a jointly negotiated, common cost-sharing policy for state-supported routes.

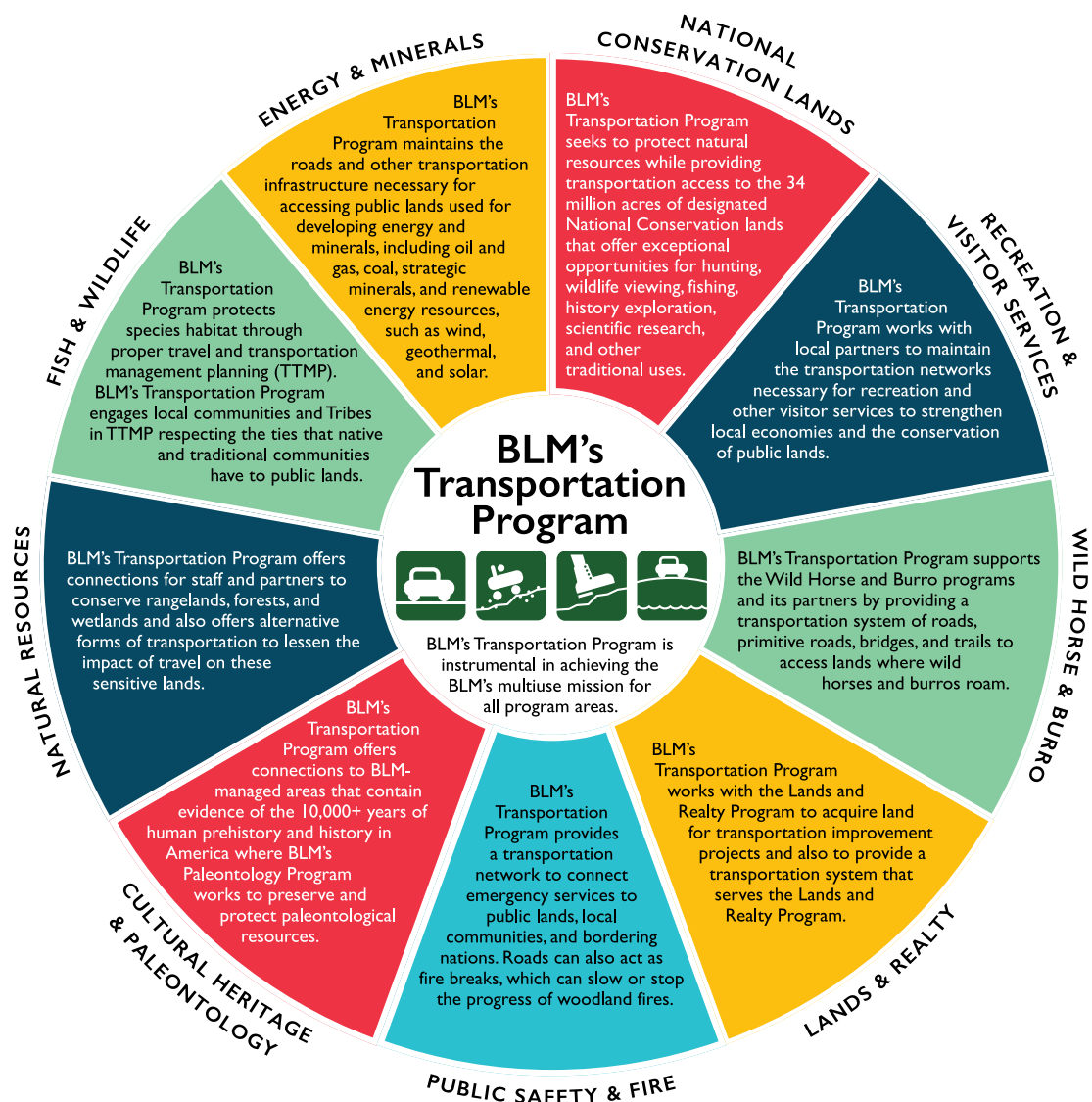
Improved financial reporting and cost sharing between Amtrak and the states will improve accountability and support states and Amtrak in making informed decisions required to face the current budgetary crisis. Prior to the COVID-19 pandemic, Amtrak's state-supported business line was its fastest growing passenger rail service area.

(Sponsored by SAIPRC)

## PERFORMANCE MANAGEMENT

### Establishing a Framework for Performance-Based Planning with the Bureau of Land Management's National Long Range Transportation Plan

Since its establishment in 1946, the mission of the Bureau of Land Management (BLM) has been to sustain the health, diversity, and productivity of public lands for the use and enjoyment of present and future generations. A reliable, efficient, and safe transportation system is integral for the



This infographic shows the importance of the BLM's Transportation Program for supporting the Bureau's multi-use mission. Source: U.S. DOT

BLM to achieve this multi-use mission. To meet a congressional mandate in the Fixing America's Surface Transportation (FAST) Act, the BLM moved to establish a framework for performance-based transportation planning and decision making. To accomplish this goal, the BLM sought the expertise of transportation planners at the Volpe Center to lead development of a National Long Range Transportation Plan with BLM partners and the FHWA Office of Federal Lands Highways. The first of its kind for the agency, the plan develops a set of prioritized implementation strategies and performance measures for the BLM.

In step with the Secretary of Transportation's priorities, the Volpe Center worked with the BLM to establish baseline conditions, analyze issues, and develop a performance-based approach for specific, measurable improvements related to safety and infrastructure. Several of the implementation strategies include data collection and management innovations, such as crowd-sourced data collection, improved geographic information system management, and traveler information system deployment. To ensure accountability and allow the BLM to use this plan to invest its limited transportation funds wisely, the Volpe team incorporated a performance-based framework for implementation and monitoring, including a consensus-built set of goals, objectives, strategies, and performance measures.

The BLM leveraged the Volpe Center's effective stakeholder engagement strategies to assemble an interdisciplinary core team and advisory committee of staff from different program areas and various parts of the country. As part of the development process, Volpe staff facilitated collaborative workshops with stakeholders to foster open discussions and create an opportunity to hear and understand the BLM's unique challenges. Workshop discussions were used to inform the plan and ensure the BLM considers and responds to all stakeholder perspectives.

The BLM National Long Range Transportation Plan provides a data-driven analysis of baseline conditions for the agency's transportation system; a practical, strategically prioritized list of actions the BLM can take to implement the plan and achieve its objectives; and a set of meaningful and feasible performance measures to monitor progress. As the BLM transportation program evolves, the plan will be reviewed and updated to ensure effective and up-to-date performance monitoring. This plan will provide the strategic direction to move forward with transportation-related projects and innovations that will increase accessibility to public lands for all.

(Sponsored by BLM)

## DATA MODERNIZATION

### Modernized Data, Code, and Analytics Platforms Promote Access and Collaboration

It used to take more than a year to get data from U.S. DOT-supported innovative technology deployments to researchers. With the modernization of the ITS DataHub and other platforms, that process has now been reduced to weeks or even days.

Over the last several years, the ITS JPO Data Program and its partners in the U.S. DOT Office of the Chief Information Officer (OCIO) and the Volpe Center, have completely rebuilt and modernized two data- and software-sharing platforms, replacing them with the ITS DataHub and ITS CodeHub. In addition, the team created a new, secure data repository and collaborative transportation research analytics platform known as the U.S. DOT Secure Data Commons (SDC). Data generated from the ITS JPO Connected Vehicle Pilot (CVP) Deployment sites in Tampa, Wyoming, and New York City now flow into and are available in the SDC from between a few minutes to a couple of days after they are generated at the pilot sites. A subset of the Tampa and Wyoming CVP data, cleaned of personal identifiable information or confidential business information, is also available to the general public in ITS DataHub.

ITS DataHub, ITS CodeHub, and SDC are intended to:

- Reduce the time from conducting research to providing insights and results.
- Increase return on investment by enabling third-party research into the effectiveness of emerging ITS technologies and preliminary development of third-party applications.
- Increase interoperability by harmonizing data across similar collections.
- Increase reuse and encourage community contributions to common software tools and software systems.
- Encourage collaboration and information exchange between researchers to further U.S. DOT goals.

These platforms utilize state-of-the-practice, cloud-based approaches for data and code sharing and both public and controlled-access (secure) collaborative use among internal and external stakeholders.



Homepage of the ITS JPO/U.S. DOT ITS DataHub. Source: U.S. DOT ITS JPO; January 2020

The Volpe Center provided subject matter expertise to the ITS JPO to deploy, iterate, and operate the ITS DataHub, ITS CodeHub, and SDC. This included contributing to the design and communications strategies for each platform, creating the initial wireframe SDC proof-of-concept, driving user-centered design processes, and developing and executing against platform roadmaps. The Volpe Center also provided extensive support as the SDC was transitioned from contractor to an OCIO-managed Department-wide shared service in November 2020 and continues to support OCIO in the operation of the SDC. This support includes helping OCIO identify new users, supporting the product owner, and prioritizing the product backlog to support user needs and analyses.

(Sponsored by ITS JPO Data Access and Exchanges Program and U.S. DOT OCIO)

## QUALITY ASSURANCE

### Achieving Capability Maturity Model Integration (CMMI) Maturity Level 3 Certification to Improve Software Development Processes

Developing software that meets sponsor needs or fulfills specific project requirements can be challenging for engineers and project managers. The process itself can be inefficient, involve multiple iterations, and require more time and resources than originally planned. In December 2019, the Volpe Center attained Capability Maturity Model Integration (CMMI) Maturity Level 3 certification, which will

streamline its approach to software development projects by creating standard practices and a process for identifying lessons learned and best practices.

The Software Engineering Institute created the CMMI certification by studying the highest-performing organizations and how they reach their success. CMMI is a model by which organizations may improve the project management, engineering, process management, and other support processes involved in developing and maintaining software. Volpe assists sponsors with many software-related projects, ranging from single website creation to multi-year development projects with large teams.

The goal of reaching CMMI Maturity Level 3 is to have a consistent, repeatable process that will encourage productive, efficient behaviors, which in turn will result in fewer defects, reduced costs, and shorter timeframes for completion. In 2018, the Volpe Center began its Software Continuous Improvement Program (SCIP) on its journey to CMMI certification. During the week of December 2-6, 2019, four in-scope projects—Safety Assurance System, Artemis, Aviation Environmental Design Tool, and the Maritime Safety and Security Information System—were evaluated by Volpe staff and a third party. After rigorous evaluation, Volpe achieved third-party approval and achieved CMMI certification, verifying that Volpe operates at a maturity level that is defined and standardized across the organization.

Regarding the attainment of the certification, Steve Popkin said, “The certification is valuable, but more so is our moving toward a regularized process for software development and its quality assurance. These are four signature IT projects and therefore make a great statement about Volpe’s commitment to SCIP.”

Some best practices and processes that were established through this project include: documenting decisions so future developers can better understand the code, maintaining proper versioning and history of documentation, and ensuring the rationale for how the code operates is clear. These practices may help foster better knowledge management, configuration management, and accountability in future Volpe software development projects.

The CMMI Maturity Level 3 certification is valid for three years, during which time Volpe will be working to add these new processes into the remainder of its software development projects that meet the minimum size threshold. Volpe will also prepare for the CMMI sustainment appraisal in December 2021.

(Sponsored by U.S. DOT Volpe Center)



# SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM

THE U.S. DOT VOLPE CENTER  
ADMINISTERS THE DEPARTMENT'S SMALL  
BUSINESS INNOVATION RESEARCH (SBIR)  
PROGRAM ON BEHALF OF THE OFFICE OF  
THE SECRETARY OF TRANSPORTATION.  
SMALL BUSINESSES THAT PARTICIPATE  
IN THE DEPARTMENT'S SBIR PROGRAM  
HAVE DEVELOPED NUMEROUS NEW  
AND INNOVATIVE TECHNOLOGIES THAT  
HAVE BENEFITED THE DEPARTMENT  
AND THE PUBLIC, AND HELPED SMALL  
BUSINESSES GROW.

## U.S. DOT's Small Business Innovative Research Program Supports Innovations in Transportation Technology

Congress enacted the Small Business Innovative Research (SBIR) program in 1982 to serve as an incubator for small businesses to develop new research ideas that solve the nation's most pressing transportation problems. U.S. DOT is one of 11 federal agencies that participates in the SBIR program, with involvement from eight other operating administrations including FAA, FHWA, FMCSA, FRA, FTA, NHTSA, OST-R, and the Pipeline and Hazardous Materials Safety Administration (PHMSA). Each year, U.S. DOT awards up to \$11 million in contracts for Phase I, Phase II, and Phase IIB awards to projects that aim to develop innovative solutions to the nation's transportation challenges.

The Volpe Center administers the SBIR program on behalf of the U.S. DOT, working with funding operating administrations and small businesses alike to support SBIR awards in working toward a successful outcome that can benefit the nation's transportation system.

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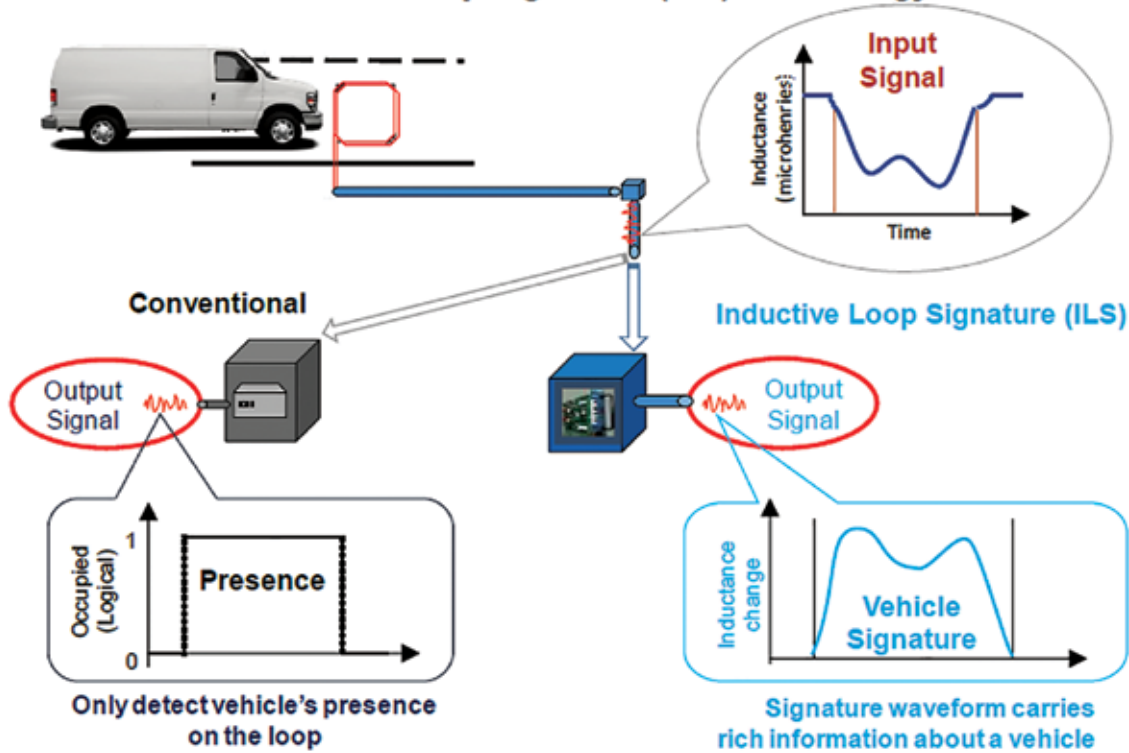
In support of the U.S. DOT, the Volpe Center administers the SBIR program. Source: [123rf.com/psisa](https://123rf.com/psisa)

Participating small businesses respond to U.S. DOT's specific solicitations by submitting their proposals. The proposals outline what the technology innovation is in response to a specific topic in the solicitation. The SBIR program favors research that has the potential for commercialization through the private sector transportation industry, state departments of transportation, or federal agencies.

In 2020, U.S. DOT added several new features to its solicitation process, including enhanced commercialization support for its awardees and an "Open House" feature that allowed those attending the Transportation Research Board (TRB) annual conference to meet with topic authors and ask clarifying questions as part of the pre-solicitation period. The Phase I Solicitation also introduced a new "Pitch Day" element as part of the proposal evaluation process. Small businesses who submitted Phase I proposals that received the highest rating(s) for the respective research topics were invited to make a virtual oral presentation to U.S. DOT evaluators to promote their idea. Pitch Day results led to 20 small businesses being selected to perform work in support of the solicitation's 12 topics. This resulted in a total of \$3 million—almost double the expected amount of awards.

Small businesses that participate in U.S. DOT's SBIR program have developed numerous new and innovative technologies that have benefited the Department and the public. Many of U.S. DOT's SBIR awards have resulted in promising innovations.

## Inductive Loop Signature (ILS) Technology



The VSign® Smart Vehicle Classification System I utilizes existing single or double loop sensors to classify vehicles and measure speeds under various traffic conditions based on Inductive Loop Signature and AI technologies. Source: CLR Analytics

One notable example of an SBIR project that has made an impact on the transportation sector is CLR Analytics' VSign Smart Vehicle Classification System, which uses artificial intelligence (AI) to provide more reliable and actionable traffic data under both normal and congested conditions. CLR has deployed this product in five states—Alabama, Alaska, California, Colorado, and Washington. VSign is just one example of the innovative thinking behind the small business community in the United States that the SBIR program aims to highlight and stimulate.

(Sponsored by U.S. DOT)

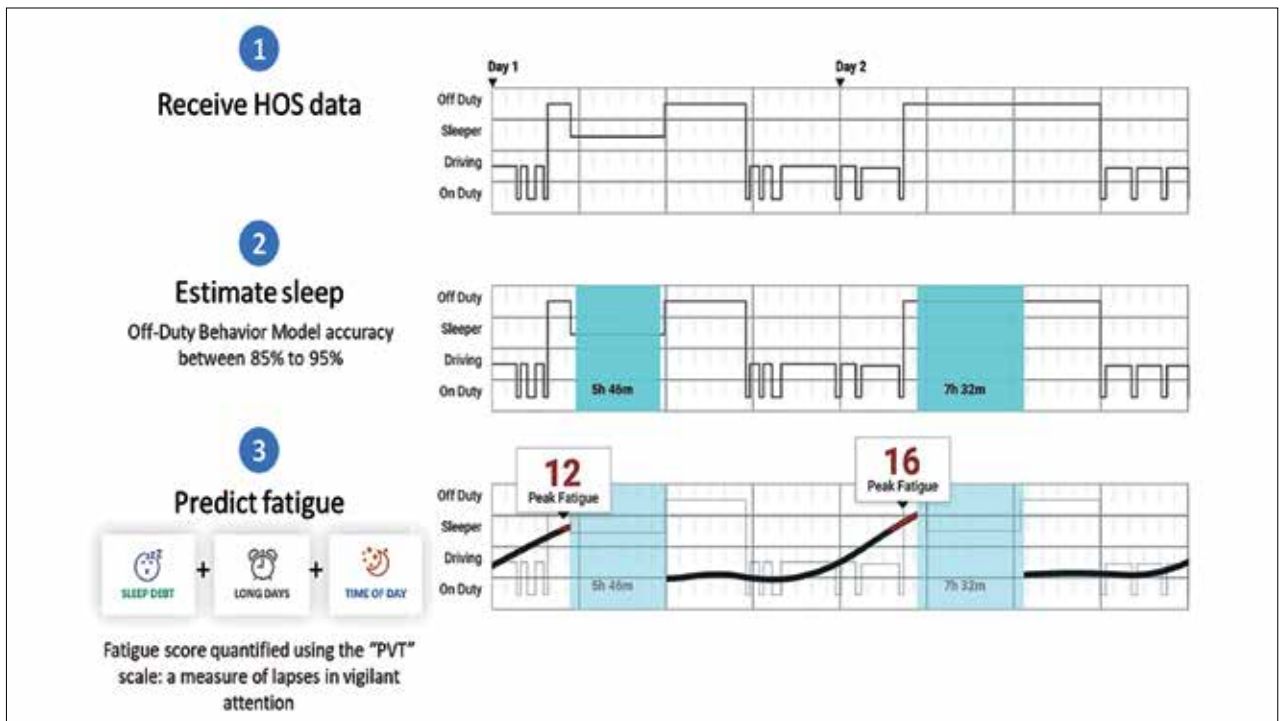
## Trucking Fatigue Meter Helps Keep Drowsy Drivers Off the Roads

When a driver is fatigued, they are at an elevated risk for being in a crash or directly causing one. NHTSA's most recent data shows there are approximately 90,000 police-recorded crashes involving drowsy drivers per year, which result in

about 50,000 injuries and 800 fatalities.<sup>11</sup> Fatigued driving is a causal or contributing factor in at least 20 percent of all truck crashes on our nation's roadways, according to National Transportation Safety Board (NTSB) data. In the past year, NTSB added reducing fatigue-related crashes to its Most Wanted List of Transportation Safety Improvements, and is considering several comprehensive approaches to solve this problem.

Scientific studies show that drivers underestimate the degree and severity of their own fatigue. An innovative tool was recently created as part of the U.S. DOT's SBIR Program that will help drivers and trucking companies monitor and mitigate fatigue. Developed by Pulsar Informatics, the Trucking Fatigue Meter is a Phase III SBIR project that directly supports FMCSA's mission of preventing commercial motor vehicle-related fatalities and injuries by reducing driver fatigue and increasing safety on U.S. highways. The objective of a Phase III SBIR project is for a small business to pursue commercialization of its innovative technology based on

<sup>11</sup> Drowsy Driving, <https://www.nhtsa.gov/risky-driving/drowsy-driving>



This diagram shows the steps to develop a fatigue score. Source: Pulsar Informatics

Phase I/II research and development activities. The Volpe Center, which administers the U.S. DOT's SBIR program on behalf of DOT's Office of the Secretary, worked closely with FMCSA in awarding the Phase I, Phase II, and Phase IIB contracts leading to the Phase III contract with Pulsar Informatics from 2017-2020.

FMCSA's funding of these contracts supports the goal of the Trucking Fatigue Meter to reduce fatigue-related crashes by providing drivers, dispatchers, and safety managers with a fatigue score that identifies risks and potential accidents before they happen. The fatigue score relies on data from Electronic Logging Devices (ELDs) that record driving hours, which are already being collected to meet FMCSA's regulations. The system sends an alert to carriers and drivers when their fatigue score is high so they can take corrective action.

The Trucking Fatigue Meter was recently integrated with industry leading ELD and safety monitoring products and is being adopted by the trucking industry. Data collected with the Trucking Fatigue Meter indicates that when drivers receive a fatigue alert, they are 2 to 7 times more likely to be in a crash. A case study conducted at a large U.S. trucking company demonstrated that incorporating the Trucking Fatigue Meter into the safety management process reduced critical events by 30 percent and resulted in significant cost savings. In the first year of adoption, the Trucking Fatigue Meter saved the carrier an average \$832 per driver. This innovative technology will enable trucking companies to take a proactive approach in removing fatigued drivers that may be a risk to themselves or others on the road.

(Sponsored by FMCSA)

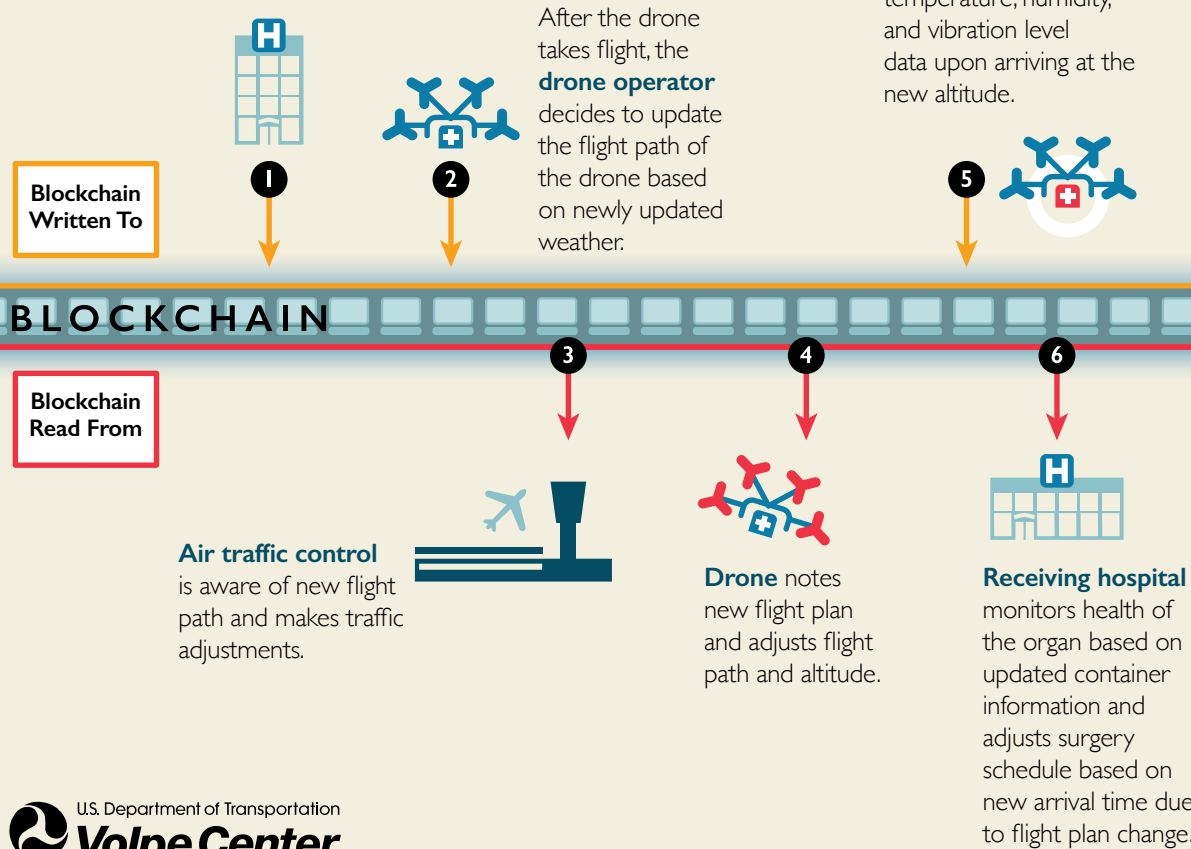
# THOUGHT LEADERSHIP

## Blockchain/UAS Case Study Example

The different actors and their actions or types of data needed in the case of a route and altitude adjustments due to a change in weather for the organ transfer by drone.

**Organ-supplying hospital** provides donor's blood type and age, time of harvesting, and other information upon obtaining the organ in order to minimize the likelihood of medical error at receiving hospital.

The **drone** updates the time of arrival and the drone's **organ container** updates its internal pressure, temperature, humidity, and vibration level data upon arriving at the new altitude.



THE U.S. DOT VOLPE CENTER  
LOOKS BEYOND THE HORIZON TO  
ANTICIPATE FUTURE TRANSPORTATION  
ISSUES AND DISCUSS FRESH  
APPROACHES TO EMERGING  
TRANSPORTATION CHALLENGES.

## Blockchain and Unmanned Aircraft Systems

Unmanned aircraft systems (UASs)—commonly known as drones—are increasingly being used both recreationally and commercially. The FAA forecasts the number of recreational and commercial UASs will reach between 2.2 and 2.4 million by 2024. Some promising applications for UASs range from air taxis and package delivery to fighting wildfires and search and rescue. The potential for continued growth and variety in application makes UASs especially suitable to the trust and integrity provided by blockchains.

In April 2020, the Volpe Center published the report, “Blockchain for Unmanned Aircraft Systems,” which included a case study of UASs and their flight operations that may benefit from blockchain technology. The Volpe Center previously published a paper that explored blockchain technology and how it could be applied to transportation.

A blockchain is a time-stamped digital ledger that is distributed and managed by a cluster of computers and allows digital information to be distributed—read, shared, and added to—but not copied or changed. Blockchain technology allows non-trusted parties to interact over a network in a verified way and without a trusted intermediary. Because falsifying a single record would mean falsifying the entire chain in

millions of instances, blockchain technology readily allows for the introduction of trust into a group or network.

The case study presented in the report explores organ transfer as an example of an operation that may be especially suited to the use of blockchain technology. In this hypothetical scenario, an organ must be delivered from an organ-supplying hospital to a receiving hospital by UAS. Different data—such as organ donor information, weather and flight path information, time of arrival, and organ container information—must be shared, read, and modified along its route in order to ensure successful delivery and transplant. Factors such as time of transfer and the receiving hospital’s awareness of the organ’s progress are paramount to this success. Adding blockchain allows each actor within the process to have varying levels of access to the ledger and make changes or add information as needed (e.g., add a new route based on weather changes). Because of blockchain technology, this information is both readily available and secure.

The report concludes that blockchain technology may be a way to address privacy and security risks in UASs by providing a means of confidential and secure communication.

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Blockchain technology has the potential to deliver a framework that can be used by stakeholders in the commercial drone industry to ensure security and provide identity management, while also supporting aircraft traffic management, UAS conflict management, and flight authorization. Source: U.S. DOT Volpe Center

# 50TH ANNIVERSARY



Left to right: U.S. GSA Regional Administrator Christopher Averill, U.S. GSA Chief of Staff Robert Borden, MIT Vice President for Research Maria Zuber, City of Cambridge Mayor Marc C. McGovern, U.S. Secretary of Transportation Elaine L. Chao, Massachusetts Governor Charlie Baker, Office of Senator Edward Markey State Director James M. Cantwell, Deputy Assistant Secretary for Research and Technology Diana Furchtgott-Roth, and U.S. DOT Volpe Center Director Anne Aylward.

"This is a fabulous public-private partnership. One of the most important institutions in this Commonwealth, MIT, is going to have an opportunity to continue to build on the long and successful relationship it's had with the City of Cambridge and with the Volpe Center. It's hard to imagine a better win-win-win than the one ... we are celebrating today."

Charlie Baker  
Governor of the Commonwealth of Massachusetts  
October 30, 2019

"Today, as the Volpe Center heads into its 50th year of service, we celebrate past accomplishments, and look forward to new milestones ... This new state-of-the-art facility will help the Volpe Center and its multidisciplinary team build upon its rich legacy of research and analysis that is so critical for America's transportation system."

Elaine L. Chao  
U.S. Secretary of Transportation  
October 30, 2019



Secretary Elaine L. Chao and Governor Charlie Baker celebrate the official start of construction on the new Volpe Center facility.

Both photos on this page: Linda Haas Photography



## THE U.S. DOT VOLPE NATIONAL TRANSPORTATION SYSTEMS CENTER MARKED ITS 50TH ANNIVERSARY YEAR THROUGHOUT 2020.

The unofficial start of the Volpe Center's celebration began at an October 30, 2019 groundbreaking ceremony marking the official start of construction on an approximately 400,000-square-foot new U.S. Department of Transportation Volpe Center facility. The new facility is the result of a first-of-its-kind property exchange partnership between the General Services Administration (GSA), U.S. Department of Transportation (DOT), and the Massachusetts Institute of Technology (MIT) aimed at revitalizing the Volpe Center site in the Kendall Square neighborhood of Cambridge.

When Volpe Center staff arrived at the office in January 2020, they were greeted by 50th Anniversary banners draped in front of the Volpe Center building and an engaging historical timeline display in the lobby. The 50th Anniversary exhibit went on tour to the Transportation Research Board's (TRB) Annual Meeting, U.S. DOT headquarters, and FAA headquarters in Washington, DC.

Volpe Center director Anne Aylward, distributed a 50th Anniversary commemorative publication, *Five Decades*, to each Volpe Center staff member. The Volpe Center also released a short video that highlighted the important work of the Volpe Center over the last 50 years.

Shortly after the New Year, Volpe Center staff convened for a special 50th Anniversary breakfast and the unveiling of *Volpe Vintage*, an exhibit featuring organizational artifacts and historical documents. The Recreational Association of Volpe Employees (RAVE) made 50th Anniversary shirts available in recognition of the momentous occasion.

Throughout the year, the Center staff found ways to celebrate. When the pandemic hit and the Volpe Center workforce shifted to remote work—the 50th Anniversary program went virtual.



Top: The Volpe Center's 50th Anniversary exhibit was featured at U.S. DOT Headquarters in the Jeffrey N. Shane Gallery, FAA headquarters, and the TRB Annual Meeting. Source: U.S. DOT Above, middle: Rendering of the new facility. Source: Massachusetts Institute of Technology Bottom: The Volpe Center released a commemorative publication, *Five Decades* to mark its golden anniversary.

# 50 YEARS



At the 50th Anniversary breakfast, Volpe Center director Anne Aylward welcomes the staff.

Anne Aylward presents a Volpe t-shirt to Diana Furchtgott-Roth, Deputy Assistant Secretary for Research and Technology U.S. Department of Transportation.

Below: The breakfast also marked the launch of *Volpe Vintage*, an interactive display housed in our Technical Resource Center.





Top row: The Volpe Center's Returned Peace Corps and AmeriCorps Volunteers hosted a LEGO Building event the first week of March.

Left: As part of the 50th Anniversary celebration, the Volpe Center's Federal Women's Program sponsored a virtual event that featured four Volpe Center alumnae who have left their marks on the national and global transportation system: The distinguished panel, moderated by Kim Cardosi, included Mary Stearns, Karen Van Dyke, Jane Lappin, and Ruth Hunter.

Below: In June, the Volpe Center hosted a virtual panel celebrating the 50th anniversaries of both the Volpe Center and Earth Day. Volpe's Green Team moderated the panel discussion, which included Gina Solman, Kristen Lewis, Rebecca Blatnica, Kevin Green, and Christopher Zevitas. Also pictured are Emma Vinella-Brusher and Karen Petho.



“From the beginning, Volpe has been known as the go-to place for tackling complex challenges. It helps the Department of Transportation and the broader transportation community anticipate issues and navigate change ... Volpe is also helping enable a better future during this historic period of transportation innovation.”

Elaine L. Chao  
U.S. Secretary of Transportation  
July 1, 2020  
Special 50th Anniversary video message



“Volpe does unparalleled research. All of us at the Department of Transportation are fortunate to be able to have such a large pool of talent just a phone call away.”

Diana Furchtgott-Roth  
Deputy Assistant Secretary for Research and Technology  
U.S. Department of Transportation  
July 1, 2020



On July 1, Volpe marked its official 50th Anniversary with a virtual event that provided staff an opportunity to share reflections on the Center's history. Pictured at right: Andrea Goldstein, Kam Chin, Angela Cutone, J.K. Pollard, Chris Roof, and Eric Plosky shared perspectives, and Ellen Bell moderated the event.



"Today, we celebrate our team's resiliency, our unwavering dedication to our mission, and our sustained impact in transportation over the past 50 years."

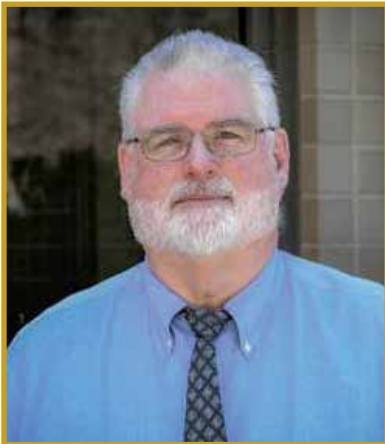
Anne D. Aylward

Director

Volpe National Transportation Systems Center

U.S. Department of Transportation

Awards Ceremony, December 8, 2020



Cassandra Allwell moderated Volpe's virtual 50th Anniversary Awards Ceremony. Suzanne Sloan received the Dr. Richard R. John Award, Glenn Goulet received the Dr. Frank Tung Award, and Lauren Nichols received the inaugural 2020 Courage in Public Service Award.

Prior to the start of the anniversary year, Volpe Center staff convened in front of the building for a group photo.

50  
YEARS



# THANK YOU TO OUR SPONSORS

## U.S. DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Federal Highway Administration

Federal Motor Carrier Safety Administration

Federal Railroad Administration

Federal Transit Administration

Maritime Administration

National Highway Traffic Safety Administration

Pipeline and Hazardous Materials Safety Administration

Saint Lawrence Seaway Development Corporation

Office of the Secretary of Transportation

Office of the Under Secretary of  
Transportation for Policy

Office of the Assistant Secretary for Aviation and  
International Affairs

Office of the Assistant Secretary for Research  
and Technology

Bureau of Transportation Statistics

Intelligent Transportation Systems Joint  
Program Office

Office of Research, Development & Technology

Positioning, Navigation and Timing &  
Spectrum Management

Transportation Safety Institute

Office of the Assistant Secretary for Administration

Office of Intelligence, Security and Emergency Response

Office of the Chief Information Officer

Office of Drug & Alcohol Policy & Compliance

## OTHER FEDERAL AGENCIES

Department of Agriculture

U.S. Forest Service

Department of Commerce

National Oceanic and Atmospheric Administration

Department of Defense

Air Mobility Command

Defense Threat Reduction Agency

Joint Improvised-Threat Defeat Organization

Naval Air Systems Command

Office of the Chief of Naval Operations

Office of the Secretary of Defense

U.S. Africa Command

U.S. Air Force

U.S. Army

U.S. Navy

U.S. Naval Forces Africa

U.S. Navy International Programs Office

U.S. Transportation Command

Department of Energy

Vehicle Technology Office

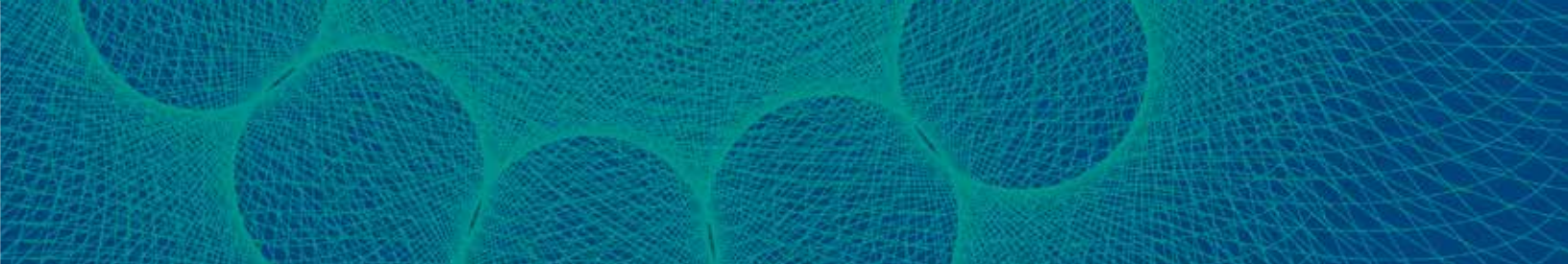
Bioenergy Technologies Office

Department of Homeland Security

Federal Emergency Management Agency

Science and Technology Directorate

U.S. Coast Guard



Department of the Interior

Bureau of Land Management

Bureau of Reclamation

National Park Service

U.S. Fish and Wildlife Service

Environmental Protection Agency

Millennium Challenge Corporation

National Aeronautics and Space Administration

National Capital Planning Commission

Presidio Trust

U.S. Access Board

U.S. Capitol Police

#### STATE AND LOCAL

Chicago Metropolitan Agency for Planning

City of Cambridge, MA

City of Colorado Springs, CO

City of New York, NY

City of San Francisco, CA

Delaware Department of Transportation

Houston-Galveston Area Council, TX

Maryland State Highway Administration

Massachusetts Bay Transportation Authority

Massachusetts Department of Transportation

Massachusetts Port Authority

New York State Energy Research and  
Development Authority

Oregon Department of Transportation

Pennsylvania Department of Transportation

State of Arizona

State of Maryland

Washington Metropolitan Area Transit Authority

#### INTERNATIONAL

Transport Canada

United Kingdom Ministry of Defence

#### NONPROFIT ORGANIZATIONS, ACADEMIA, AND THE PRIVATE SECTOR

Applied Physical Sciences Corporation

Blue Ridge Research and Consulting, LLC

Cambridge Systematics, Inc.

Columbia River Pilots

Gannett Fleming, Inc.

Meister Consultants Group

National Academy of Sciences

National Association of City Transportation Officials

National Motor Freight Traffic Association, Inc.

Pennsylvania State University

Resource Systems Group, Inc.

Uber Technologies, Inc.

Wright State Applied Research Corporation

Wyle Laboratories, Inc.

# VOLPE CENTER HIGHLIGHTS: KEY CONTRIBUTIONS 1970 – 2020

PRESIDENT OF  
THE UNITED STATES  
SECRETARY OF  
TRANSPORTATION

1970	Richard M. Nixon	John A. Volpe	<ul style="list-style-type: none"> <li>• Simulating <b>national air traffic flow</b></li> <li>• Developing anti-hijacking <b>aviation security</b> screening systems</li> <li>• Examining constraints and required characteristics for <b>anticipatory sensing of impending automobile crashes</b></li> <li>• Pioneering the use of <b>alcohol breath analysis</b> for transportation safety</li> <li>• Examining the control and information system and operational requirements for the <b>St. Lawrence Seaway</b></li> <li>• Supporting introduction of advanced <b>urban transit</b> technologies</li> <li>• Conducting the first federal study on <b>automated fare</b> collection</li> <li>• Informing the first <b>Corporate Average Fuel Economy</b> standards</li> <li>• Examining highway-rail <b>grade crossing</b> protection in high-density corridors</li> </ul>
	Gerald R. Ford	Claude S. Brinegar	<ul style="list-style-type: none"> <li>• Testing <b>wake vortex</b> sensing systems at major U.S. airports</li> <li>• Conducting engineering tests and demonstrations of <b>rail rapid transit</b> vehicle technology</li> <li>• Exploring the potential for flexicab services and <b>innovative uses of taxis</b> and jitneys for public transport</li> <li>• Informing <i>National Transportation Trends and Choices to the Year 2000</i></li> </ul>
1975		William T. Coleman, Jr.	
1980	James Carter	Brock Adams	<ul style="list-style-type: none"> <li>• Studying the impact of <b>energy trends</b> on the automobile industry</li> <li>• Contributing to the <b>financial analysis of the motor vehicle industry</b></li> <li>• Developing the first-ever U.S. DOT-DoD <b>Federal Radionavigation Plan</b></li> <li>• Evaluating airport <b>ground access capacity</b> at commercial airports</li> <li>• Assessing <b>fire safety</b> in a transportation setting</li> <li>• Conducting <b>noise assessments</b> of transportation systems</li> <li>• Analyzing <b>ridership</b> levels of the Morgantown Personal Rapid Transit System</li> </ul>
		Neil Goldschmidt	<ul style="list-style-type: none"> <li>• Deploying groundbreaking <b>air traffic management</b> concepts, including the Enhanced Traffic Management System</li> <li>• Assessing the capability of the <b>GPS</b> to meet civil navigation requirements</li> <li>• Examining <b>transportation security</b> issues and countermeasures</li> <li>• Creating an assessment tool to evaluate the <b>safety record of air carriers</b>—both military and commercial</li> <li>• Contributing to an aviation <b>human factors</b> research plan</li> <li>• Assessing prospective safety hazards associated with <b>commercial space launch</b> activities</li> <li>• Studying the influence of <b>advanced communications</b> on the future of transportation</li> <li>• Exploring <b>public-private partnerships</b> for urban transportation</li> <li>• Studying <b>rail integrity</b> and the behavior of propagating fatigue cracks</li> <li>• Examining the implications of stalling on <b>motor vehicle safety</b></li> <li>• Evaluating the effects of mandatory <b>seatbelt use</b> laws on safety</li> </ul>
1985	Ronald Reagan	Drew Lewis	
		Elizabeth Hanford Dole	
1990		James H. Burnley, IV	
	George H.W. Bush	Samuel K. Skinner	<ul style="list-style-type: none"> <li>• Supporting development and implementation of the <b>intelligent vehicle highway system</b> program</li> <li>• Studying the effect of the <b>65 mph speed limit</b> on highway safety</li> <li>• Assessing the use and design of <b>flight crew checklists and manuals</b></li> <li>• Evaluating the <b>ridership, cost forecasts, and performance</b> of federally funded transit projects</li> <li>• Supporting DoD's <b>strategic mobility and logistics</b> priorities</li> <li>• Conducting a <b>port needs study</b> for the U.S. Coast Guard</li> <li>• Contributing to <i>Moving America: A Statement of National Transportation Policy</i></li> </ul>
		Andrew H. Card, Jr.	

PRESIDENT OF THE UNITED STATES SECRETARY OF TRANSPORTATION		
1995	William J. Clinton	Federico F. Peña
		Rodney E. Slater
2000		
2005	George W. Bush	Norman Y. Mineta
		Mary E. Peters
2010	Barack Obama	Ray H. LaHood
2015		Anthony Foxx
2020	Donald J. Trump	Elaine L. Chao

- Developing and installing a real-time communications and navigation system for the **Panama Canal**
  - Assessing the **crashworthiness of rail passenger equipment**
  - Laying the foundation for Amtrak's all-electric **Acela** high-speed service
  - Testing and analyzing commercial vehicle **front and side collision warning systems** and adaptive cruise control
  - Developing the system to calculate **aviation's contribution to global fuel burn and emissions**
  - Enhancing the **integrated model for prediction and analysis** of aviation and highway traffic noise
  - Implementing an **integrated security plan** for the U.S. Capitol area
  - Contributing to a **surface transportation vulnerability assessment**
  - Undertaking major **environmental remediation** at U.S. DOT and Superfund sites
  - Supporting development of U.S. DOT's **policy architecture for transportation decision making**
  - Supporting White House **National Science and Technology Council's** transportation initiatives
- 
- Supporting U.S. DOT's response to the **September 11** attacks
  - Performing groundbreaking research and analysis on **GPS vulnerability**
  - Supporting installation of a **communications-based train control system** in Iraq
  - Expanding the multinational **maritime situational awareness** network
  - Designing and deploying a landmark **Automatic Identification System-based data network** on the St. Lawrence Seaway
  - Advancing **motor vehicle crash avoidance** research
  - Strengthening analysis of **federal motor carrier safety** programs
  - Synthesizing data and information related to **Electronic On-Board Recorders** for reporting hours of service
  - Assessing the U.S. Postal Service's Alaska **hovercraft demonstration** project
  - Supporting **Intelligent Transportation Systems** programs
  - Contributing to **Transportation Vision 2030**
- 
- Supporting the **Next Generation Air Transportation System** program
  - Pioneering **GPS spectrum interference protection**
  - Advancing safety of **crude oil and ethanol by rail** initiatives
  - Supporting **connected and automated vehicle** research, evaluation, and planning
  - Supporting **high-risk motor carrier** prioritization
  - Providing analytical and engineering support related to **High-Speed Intercity Passenger Rail** service
  - Bolstering development of the first-ever **aviation CO<sub>2</sub> emissions standard**
  - Developing a national model to evaluate **freight and fuel transport options**
  - Supporting **global disaster relief efforts** in Haiti and Japan in the aftermath of the devastating earthquakes
  - Responding to natural disasters, including **Superstorm Sandy**
  - Supporting development of **Beyond Traffic 2045**
- 
- Providing **infrastructure** and **automated vehicle** policy support, including **AV 3.0**
  - Enhancing the **Environmental Review and Permitting Process**
  - Applying **machine learning** methods to inform transportation safety decision making
  - Assisting in the design and development of the technology for transmitting **electronic logging device** motor carrier data to safety officials
  - Advancing **safe integration of new entrants** into the National Airspace System
  - Advancing **data sharing** across the aviation community through the System Wide Information Management system
  - Informing potential changes to **supersonic flight** regulations
  - Conducting Global Positioning System (**GPS**) adjacent band compatibility assessments
  - Providing technical reviews and benefit cost analysis for the **BUILD Discretionary Grant Program**
  - Developing a first-ever National Long Range Transportation Plan for the **National Park Service**
  - Responding to natural disasters including **Hurricanes Harvey and Irma**
  - Preparing for relocation to a **new U.S. DOT Volpe Center facility** in Kendall Square, Cambridge, Massachusetts





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