

ANNUAL ACCOMPLISHMENTS

January 2024

Advancing
Transportation
Innovation
for the
Public Good

U.S. Department of Transportation
Volpe Center





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JANUARY 2024

Happy New Year!

We are finally settled in our new home, a beautiful state-of-the art facility located at 220 Binney Street, in the heart of Kendall Square, Cambridge, MA. We are delighted to be strategically situated in a globally recognized innovation hub where research, technology, innovation, and ingenuity converge, ideas flourish, and big things get done.

To provide a brief historical perspective on this amazing undertaking, it was nearly a decade ago that U.S. DOT recognized that the surface parking lots around the Volpe Center were underutilized federal assets in a red-hot real estate market. Since U.S. DOT does not have development authority, an agreement was reached that GSA would build the new building and then hand the property back to U.S. DOT after a shake down period that ensures our building systems are operating smoothly. GSA put the project out to bid and signed a \$750 million exchange agreement with MIT, paving the way for the redevelopment of the 14 acres of land in Cambridge, owned by the U.S. Department of Transportation.

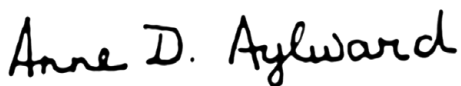
We gathered to break ground on this project over four years ago, which was the eve of our 50th anniversary. On September 19, 2023, we were joined by an extraordinary delegation from our U.S. DOT leadership team in Washington including Under Secretary of Transportation for Policy Carlos Monje; Dr. Robert Hampshire, Deputy Assistant Secretary for Research and Technology and Chief Science Officer; Philip McNamara, Assistant Secretary for Administration; Nuria Fernandez, Federal Transit Administrator; Robin Hutcheson, Federal Motor Carrier Safety Administrator; Victoria Wassmer, Assistant Secretary for Budget and Programs and Chief Financial Officer; Cordell Schachter, Chief Information Officer; and Stephanie Pollack, Coordinator for Project Delivery; and other honored guests—Massachusetts Governor Maura Healey; Federal Chief Sustainability Officer Andrew Mayock; the President of MIT, Dr. Sally Kornbluth; and GSA Administrator Robin Carnahan. We are so grateful they were here to celebrate with the Volpe Center team and U.S. DOT regional colleagues and to help cut the ribbon on our new facility.

As we look down the road to the next 50 years and beyond, we know that our exceptional new facility and its collaborative spaces will stimulate our innovative spirit and the new conference center will allow us to continue our tradition of convening the transportation enterprise on emerging issues of importance to the nation. Our partnerships with the U.S. DOT's eight operating administrations, Secretarial Offices and other sponsors including DoD, Department of the Interior, NASA, and the Millennium Challenge Corporation continue to be essential to our mission and our success.

We also know that what drives innovation at the Volpe Center is our people. Their imagination, dedication to transportation innovation and commitment to public service to the nation is what makes us tick!

We hope you come visit us in Cambridge!

Wishing you and your families a joyous 2024!



Anne D. Aylward
Director
U.S. DOT Volpe National Transportation Systems Center

Your New U.S. DOT Volpe Center



Our new state-of-the-art facility combined with our top-notch workforce creates an extraordinary moment of unprecedented opportunity.

The U.S. DOT Volpe Center Opened Its New Facility in September 2023

The U.S. Department of Transportation (U.S. DOT) Volpe Center celebrated the official opening of its new state-of-the-art facility with a ribbon cutting ceremony on September 19, 2023. The event was attended by U.S. DOT leadership, state and local leaders, as well as partners from the U.S. General Services Administration (GSA) and the Massachusetts Institute of Technology (MIT).

U.S. DOT Volpe Center Director Anne Aylward opened the ceremony by welcoming guests and thanking distinguished speakers, who included the following: Carlos Monje, U.S. DOT Under Secretary of Transportation for Policy; Andrew Mayock, White House Council on Environmental Quality Federal Chief Sustainability Officer; Maura Healey, Massachusetts Governor; Sally Kornbluth, MIT President; and Robin Carnahan, U.S. GSA Administrator.

The new U.S. DOT Volpe Center is located at 220 Binney Street in Cambridge, MA—in the heart of Kendall Square, often called “the most innovative square mile on the planet.” The U.S. DOT Volpe Center has been an active part of the Kendall Square community since 1970. This premier location firmly positions U.S. DOT in the epicenter of technology, innovation, and entrepreneurial startups. The vibrancy, diversity, and energy of this location infuses our culture, helps inform our work, and supports current and future transportation needs of the country.

“Our workforce has witnessed and contributed to the transformation of our Kendall Square neighborhood for the past 50 years. And now, we open our doors in a globally recognized hub where research, technology, innovation, and ingenuity converge, ideas flourish, and big things get done.”

—U.S. DOT Volpe Center Director Anne Aylward



U.S. DOT leadership, state and local leaders, and redevelopment Volpe Exchange Partners cut the ribbon to officially mark the opening of the new U.S. DOT Volpe Center facility. Source: U.S. DOT Volpe Center

The ceremony marked a decade-long journey that began when GSA and U.S. DOT entered a property exchange partnership, with conversations beginning in 2012. Then in 2017, GSA and U.S. DOT partnered with MIT to revitalize the existing, 14-acre U.S. DOT Volpe Center site to a 4-acre single building facility, expected to meet LEED Platinum standards. The U.S. DOT Volpe Center held a groundbreaking ceremony in November 2019 to kick off the project.

WHERE IDEAS FLOURISH AND BIG THINGS GET DONE

The new facility will enable the U.S. DOT Volpe Center to continue its innovative work of addressing the nation’s most complex transportation challenges, which center on U.S. DOT’s strategic priorities of safety, economic strength and global competitiveness, equity, climate and sustainability, transformation and organizational excellence. The new facility will be home to more than 600 U.S. DOT Volpe Center staff, in addition to contractors, U.S. DOT Region 1 headquarters for Federal Highway Administration (FHWA), Federal Motor Carrier Safety Administration (FMCSA), Federal Railroad Administration (FRA), Federal Transit Administration (FTA), and National Highway Traffic Safety Administration (NHTSA), as well as regional offices for the Federal Emergency Management Agency and U.S. Army North.



“There isn’t a single success we’ve had in the last 52 years that hasn’t had Volpe’s fingerprints on it. And, after long last, Volpe has a headquarters worthy of its critical mission, of its brilliant staff, and of its strategic location.”

—U.S. DOT Under Secretary of Transportation for Policy
Carlos Monje



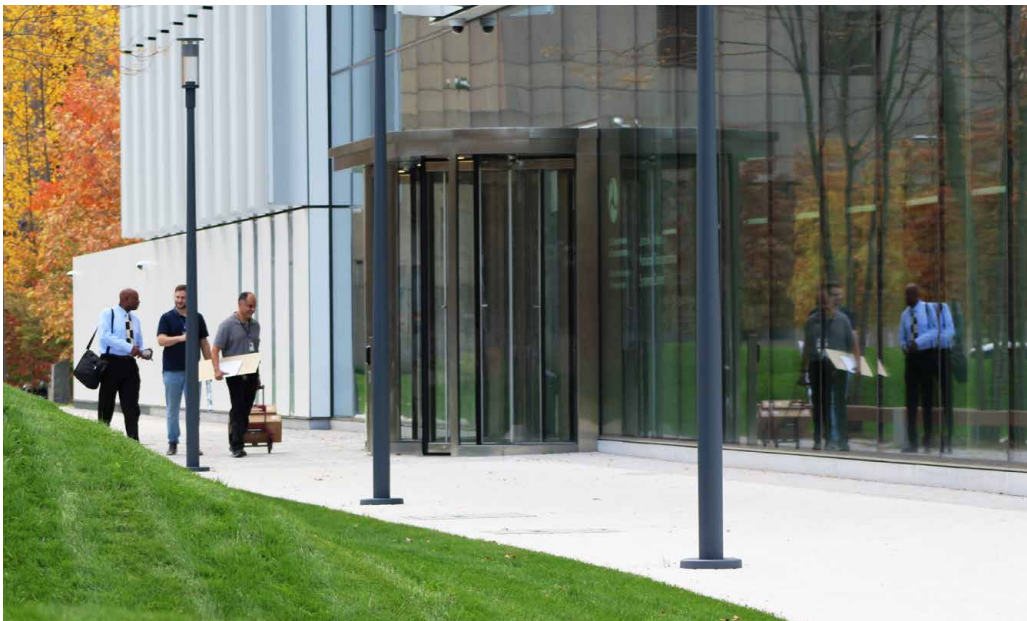
U.S. DOT Volpe Center Director Anne Aylward delivers opening remarks during the official ribbon cutting ceremony. Source: U.S. DOT Volpe Center

The remaining 10 acres of the Volpe parcel will provide an historic opportunity for MIT to create a dynamic multi-use center that will connect Kendall Square with new open space, a community center, pedestrian links, affordable housing, independent and small retail opportunities, and science and innovation space. The new facility is the result of a first-of-its-kind property exchange partnership between GSA, U.S. DOT, and MIT aimed at revitalizing the Volpe Center site in the Kendall Square neighborhood of Cambridge.



“It’s a partnership that has brought and will continue to bring tremendous benefits to our state. It’s providing federal employees with a great place to work in the heart of global innovation... unlocking new investment ...right here in Kendall Square that’s doubling down on the qualities that make this area, this region so great.”

—Massachusetts Governor
Maura Healey



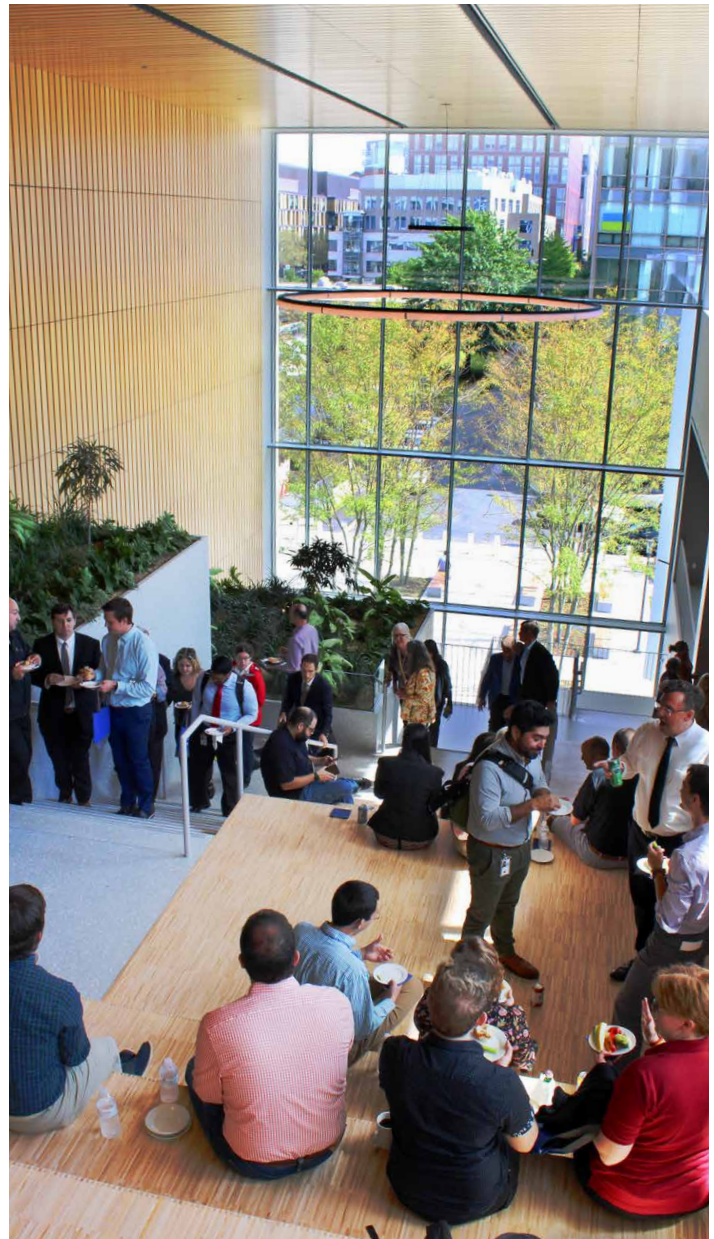
Volpe Center employees walk along the glass atrium and entryway at the new U.S. DOT Volpe Center facility. Source: U.S. DOT Volpe Center

A HEADQUARTERS WORTHY OF ITS MISSION

Key features of the new U.S. DOT Volpe Center facility located at 220 Binney Street include more than 400,000 usable square feet of space (USF), multipurpose labs, and modern conference and meeting rooms that will accommodate up to 800 people. The new facility will provide transportation experts with the technology and equipment to continue fulfilling the U.S. DOT Volpe Center's mission to advance transportation innovation for the public good.

The U.S. DOT Volpe Center is a national and global leader in transportation research, analysis, technology, and innovation with cross-modal expertise in multiple fields. The U.S. DOT Volpe Center's knowledge and capabilities are critical to the Office of the Secretary of Transportation, the operating administrations, and other federal agencies.

Volpe Center leaders and employees gather outside the new U.S. DOT Volpe Center facility and inside the glass atrium. Source: U.S. DOT Volpe Center





“All of you have shown clearly and dramatically that yes we can, yes we will, and yes we are doing big, bold things right now. And with examples like this, our clean energy future is clearly in reach.”

—White House Council on Environmental Quality
Federal Chief Sustainability Officer Andrew Mayock



DESIGNED TO PERFORM

The new U.S. DOT Volpe Center facility is designed to enhance the innovation, collaboration, flexibility, and partnerships that have long been part of its culture—and embrace the emerging transportation needs of the future.

- The new U.S. DOT Volpe Center facility includes laboratories, conference space, offices, open workstations, and joint use space that bring multimodal staff from across U.S. DOT together to encourage collaboration, foster connection, and the exchange of ideas.
- The open atrium, glass walls, and large-scale LED message boards will not only showcase the U.S. DOT Volpe Center’s innovation and spark ideas inside the building, but also bring the conversation outside into Kendall Square.
- Built with sustainability and resilience in mind, the new U.S. DOT Volpe Center facility features the highest levels of certification in energy and environmental design.

The new facility features landscaping with native trees and plantings. Employees enjoy lunch in the outdoor cafe area. Below left: The landscape art of sculptor Maya Lin can be seen in the foreground. Below right: Director for Research and Innovative Technology Steve Popkin greets former U.S. DOT Volpe Center Director and Director Emeritus Dr. Richard John. *Source: U.S. DOT Volpe Center*



“In this particular building ...we are optimizing for energy efficiency from the get-go in the design. We’ve got triple pane glass windows that turn out to make a huge difference. Electric heat pumps, electric chillers, and rooftop solar panels, all of which are going to make a dramatic difference in reducing the carbon footprint and energy use of this building.”

—Robin Carnahan,
U.S. GSA Administrator





“This acreage opened by this unique arrangement will be an appealing new hub of activity, a place for discovery and innovation, for grabbing a sandwich, for walking the dog, for making friends, for raising kids, and for meeting your next collaborator. Enhancing Kendall Square as a place will have countless benefits in many directions.”

— MIT President
Sally Kornbluth



DESIGNED FOR COLLABORATION

- The new U.S. DOT Volpe Center is built for collaboration with open floor plans and collaboration space designed with safety and the emerging needs of the workforce.
- The new facility features state-of-the-art, accessible lab space that allows U.S. DOT Volpe Center researchers to collaborate and innovate to test theoretical concepts in real-world simulations and put research to work to advance transportation innovation for the public good.
- With training rooms and conference space to accommodate up to 1,000 people, the U.S. DOT Volpe Center can open up its world-class expertise and expand its programming to meet the expanding needs of the transportation enterprise.

DESIGNED FOR FLEXIBILITY

- The new facility is built with accessibility in mind, poised to accommodate the mobile-ready needs of the workforce of tomorrow.
- Designed for agility, GSA is applying lessons learned from today to ensure the U.S. DOT Volpe Center can expand to accommodate future growth in line with the Department’s goals for the coming century and beyond.
- Bringing together world-class transportation expertise in one building—including the U.S. DOT Volpe Center, U.S. DOT Office of the Secretary of Research and Technology, and regional U.S. DOT offices—allows for efficiencies, connections, and scalability that benefit the traveling public.

Safety



Adobe Stock

U.S. DOT is working to make our transportation system safer for all people, across all modes. The U.S. DOT Volpe Center supports the Department's mission to ensure our nation has the safest transportation system in the world—our multimodal safety expertise enables us to leverage proven practices from one mode to improve safety in others.



PUBLIC TRANSIT

Improving Rail Transit Safety with Risk-Based Inspections

Since 2017, the number of rail transit-related fatalities across the nation has steadily increased. The Federal Transit Administration (FTA) has long considered risk-based inspections of rail transit systems a best practice for reducing injuries and fatalities and has encouraged agencies that oversee rail transit safety to implement risk-based inspection programs.

Passage of the Bipartisan Infrastructure Law (BIL) in November 2021 established a new legal requirement for all State Safety Oversight Agencies (SSOAs) to develop a risk-based inspection (RBI) program for the rail fixed guideway public transportation systems they oversee. FTA is required to oversee the effective implementation of these programs in alignment with compliance deadlines. Risk-based inspection programs rely on thorough data analysis—they look not only at precursors and root causes of accidents, but also at near misses, equipment failures, employee-reported safety hazards, and other data to inform inspection activities and prioritize limited resources to address the highest risk hazards and safety conditions.

FTA sought the expertise of the U.S. DOT Volpe Center’s safety measurement and analysis and human factors professionals to help implement this national safety initiative based on the Volpe Center’s experience analyzing data to make risk-based safety decisions. The Volpe Center has more than 20 years of experience collaborating with the Federal Motor Carrier Safety Administration to collect and analyze data on truck and bus companies and using the data to prioritize motor carriers for inspections and investigations based on safety risk.

Standing up risk-based inspections in every SSOA across the country will be a multiyear initiative. By October 2024, each SSOA must develop and begin to implement a risk-based inspection program plan. FTA will review each plan to ensure it meets all requirements and then approve SSOAs to begin implementing their risk-based inspection programs.

Once an SSOA has conducted an approved risk-based inspection program for at least six months, FTA, with support from Volpe Center experts, will verify the program has been effectively implemented by reviewing documentation and potentially monitoring SSOA staff while they complete rail transit agency (RTA) inspections. BIL requires FTA to: (1) assess that each SSOA has the resources and capability to conduct inspections, and (2) ensure the SSOA’s inspection practices are commensurate with the number, size, and complexity of the RTA the SSOA oversees.

While FTA, SSOAs, and RTAs must each take specific actions to respond to BIL’s risk-based inspections mandate, many of these efforts rely on cooperation among these entities to share data and perform thorough and efficient inspections. A collaborative approach among agencies will foster

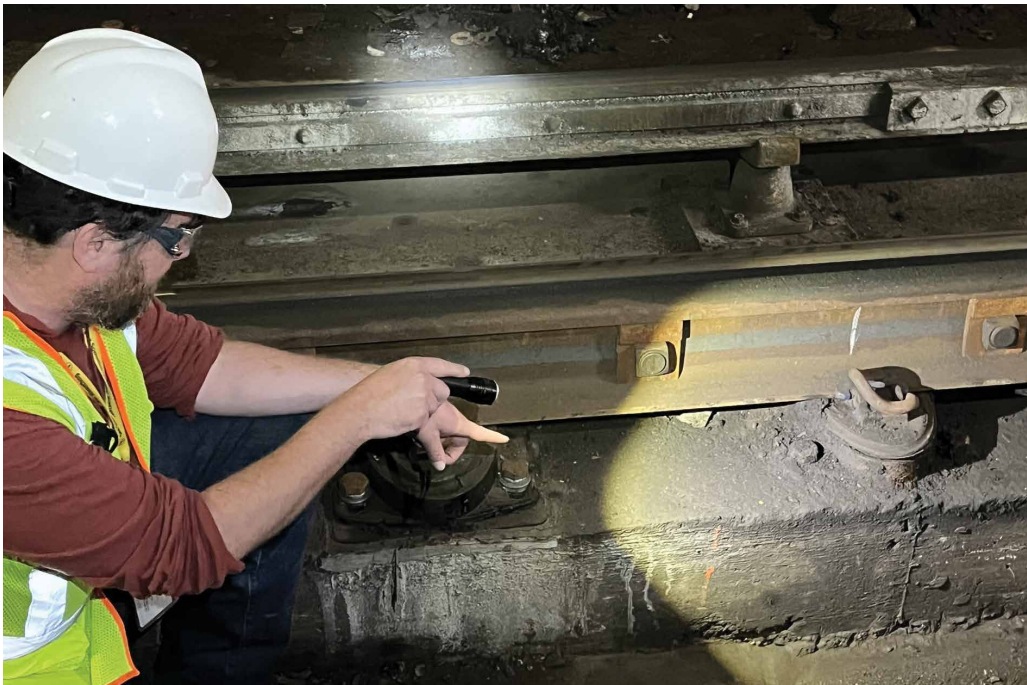
more regular and data-driven discussions about safety challenges and how to address them, which will help build a stronger culture of safety.

All 31 SSOAs across the country and in Puerto Rico are required to begin conducting risk-based inspections by October 2024, taking another step toward our shared national safety goal of zero fatalities on America’s rail transit systems. *(Sponsor: FTA Office of Transit Safety and Oversight)*

Addressing Transit System Safety Hazards in Massachusetts

In 2022, FTA determined it was necessary to expand safety oversight of the Massachusetts Bay Transportation Authority (MBTA) rail transit system. MBTA had been experiencing higher than the national average number of safety events, including derailments, train collisions, and runaway trains and had two open National Transportation Safety Board (NTSB) investigations. In an effort to curb the safety risk to the riding public in Boston and MBTA’s own employees, the FTA performed a Safety Management Inspection (SMI) of the MBTA’s rail transit operations and maintenance programs. In addition, FTA also included the Massachusetts Department of Public Utilities (DPU), within the scope of the SMI as the DPU is the State Safety Oversight Agency (SSOA), the entity primarily responsible for safety oversight of the MBTA.

This SMI consisted of a series of in-depth inspections of both the DPU and MBTA, focusing on processes, procedures, and resources for safety decision-making. FTA uses SMIs to identify safety deficiencies and the root causes so that safety risks can be truly corrected. If needed, FTA will then issue a special directive(s) to document safety deficiencies, known as “findings,” along with required



An inspector examines a section of subway track.
Source: FTA

actions FTA requires the receiving entity to correct. Special directives can be issued to an SSOA and/or a rail transit agency to correct the deficiencies.

To improve safety for the Boston area's rail transit system, FTA issued eight special directives to the MBTA and two special directives to the DPU. The special directives compel the agencies to take actions to address the identified safety hazards. In response to the special directives, the MBTA and DPU proposed Corrective Action Plans (CAPs) to resolve the deficiencies. FTA required that these CAPs address every finding in the special directive and describe specific actions the MBTA and DPU plan to implement. FTA reviews each action item in the CAP and creates a method for verifying effectiveness of the action items. When all action items have been successfully implemented, FTA staff verifies both the completion and effectiveness of the action item. Once all CAPs associated with a special directive have been addressed, and FTA has determined the CAP sufficiently addresses the finding initially documented in the special directive, FTA will close the special directives.

A U.S. DOT Volpe Center team of safety measurement and analysis experts supports the FTA in providing federal oversight to ensure the MBTA and DPU effectively and thoroughly correct safety deficiencies. Currently, the Volpe Center team is responsible for verifying the accuracy and completeness of more than 670 transit authority action items contained in 43 CAPs.

This project began in fall 2022 and will continue for several years until FTA and the Volpe team ensure the MBTA has successfully rectified all safety issues detected in the SMI. With the Volpe Center's support, FTA will ensure the public transportation system in the greater Boston area is accessible, reliable, and safe for all riders and MBTA employees working on or near the right-of-way.
(Sponsor: FTA)

ROADS AND HIGHWAYS

Supporting Data Collection and Tools Development to Enhance FHWA's Complete Streets Initiative

The Federal Highway Administration (FHWA) established a Complete Streets Initiative in 2021 to deliver a [Complete Streets Report to Congress](#) as requested by a U.S. House of Representatives committee.¹ The U.S. DOT Volpe Center led research and stakeholder engagement, and wrote the report, which was published in March 2022. The Complete Streets Report to Congress details five overarching opportunity areas: A) improving data collection and analysis to advance safety for all users; B) supporting rigorous safety assessment during project development and design to help prioritize safety outcomes across all project types; C) accelerating standards adoption and guidance to support innovative design and promote safety and accessibility for all users; D) reinforcing the primacy of safety for all users in the interpretation of design standards, guidelines, and project

¹ House Report 116-452 Departments of Transportation, and Housing and Urban Development, and Related Agencies Appropriations Bill of 2021. July 16, 2020. Available: <https://www.congress.gov/congressional-report/116th-congress/house-report/452>.

review processes; and E) making Complete Streets the default approach at FHWA for funding and designing streets and roads.

The Volpe Center is working with FHWA at the intersection of the first two opportunity areas to improve safety and access for vulnerable road users. Specifically, the Volpe Center is developing technical solutions through three parallel projects that 1) identify the highest-priority data for measuring multimodal safety and access; 2) identify the causal relationships between key data (inputs) and multimodal safety and access results (outcomes); and 3) develop a modeling framework to support analysis using those data and their relationships to understand how to build safer networks that provide more and better multimodal access.

The Volpe Center's work will help FHWA focus research budgets on improving data collection capabilities and developing new analysis tools. The goal is to help practitioners collect the most important data to accommodate the safe and practical use of non-auto transportation modes in the planning, design, delivery, and operation of transportation projects.

Through collaboration with U.S. DOT's internal Complete Streets Working Group, the Volpe Center team identified critical ways to leverage the work of three FHWA projects emerging from the Office of Planning, Environment, and Realty; Office of Safety; Intelligent Transportation Systems Joint Program Office; and the Office of Research, Development, and Technology at Turner-Fairbank Highway Research Center. Three primary projects are:

- Complete Streets Performance Measures (CSPM)
- System Dynamics Modeling for Complete Streets and Integrated Operations
- General Modeling Network Specification (GMNS)

The CSPM project identifies a core set of Performance Measures related to Complete Streets, defined by their relative impact to affect changes in planning, programming, and design to support rigorous safety assessment, as well as measure access, mode shift, equity, environmental outcomes, economics, and other areas. The Volpe Center is helping FHWA prioritize research into improving data collection and analysis to support these priority measures, especially where critical data are challenging to collect, or modeling and other sophisticated analysis techniques are required to quantify project benefits. Input gathered during two workshops (with internal and external partners) will help inform FHWA activities to address critical gaps in data resources and to facilitate partner adoption of performance measures to advance Complete Streets implementation.

The system dynamics modeling project builds upon the CSPM project to map the causal relationships between multimodal elements and users. The Volpe Center produced causal loop diagrams that make it easier to understand and communicate how changes to roadway infrastructure and operations may affect safety, access, mode shift, equity, and environmental and economic outcomes. Understanding these relationships allows Volpe and FHWA to identify priorities for data collection and new modeling capabilities to allow more modes to be taken into account when planning and evaluating transportation projects. This project provides a feedback loop to the CSPM project, helping the Volpe team confirm which Complete Streets performance measures are the most important.

The GMNS project is an effort to standardize the process of defining multiresolution, multimodal routable transportation networks with enough fidelity to provide a precise understanding of the effect of infrastructure on behavior not only of those driving motor vehicles, but also pedestrians, bicyclists, and other non-motorized road users under different scenarios. This capability also requires the right input data and analysis and will contribute to the critical standardization of ped/bike infrastructure data specifications for routable networks on a national scale. A key outcome of GMNS will be expanded capability for comparable analysis and evaluation of transportation network access and safety for vulnerable road users through rigorous safety analysis.

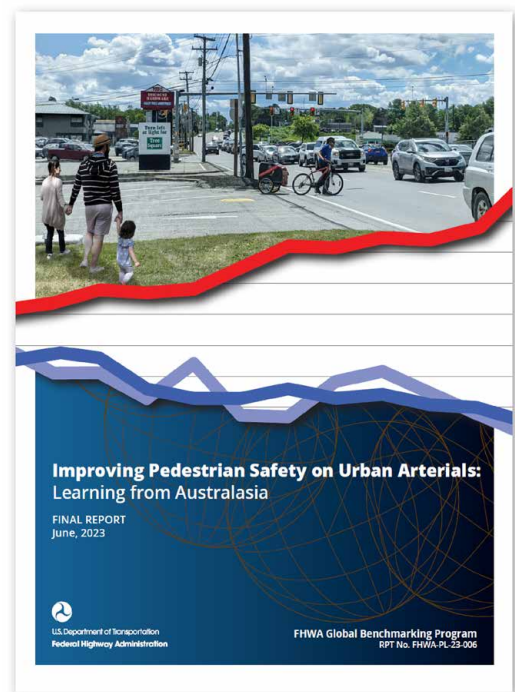
This set of projects leverages the Volpe Center’s capability in systems modeling. It demonstrates how Volpe’s multidisciplinary teams comprised of modelers and planners, with deep experience in defining performance measures and identifying their key interactions in systems, offer additional value to Volpe Center customers by connecting related but distinct projects. (*Sponsor: FHWA Complete Streets Working Group*)

Safeguarding Pedestrians through the Global Benchmarking Program

“We know roadway deaths are preventable because some places are doing a much better job at preventing them—both abroad and within certain U.S. communities. The U.S. Department of Transportation is committed to making real progress towards ending traffic fatalities, and we call on everyone to join us in this national effort that can only succeed when we work together,” stated U.S. Transportation Secretary Pete Buttigieg.²

According to the National Highway Traffic Safety Administration (NHTSA), total traffic fatalities in the U.S. rose 30 percent between 2010 and 2021—but these deaths were not distributed evenly between road users. While non-pedestrian/bicyclist fatalities were up 23 percent, bicyclist fatalities rose nearly 60 percent, and pedestrian fatalities increased over 70 percent. In 2021, 60 percent of pedestrian fatalities occurred on principal and minor highways and roads.³

To address this safety challenge, the Federal Highway Administration’s (FHWA) Office of International Programs conducted a Global Benchmarking Study and drew upon the U.S. DOT Volpe Center’s multidisciplinary expertise to examine noteworthy approaches and innovations used by other countries to achieve reductions in pedestrian serious injuries and fatalities on arterial roadways. The goal for Phase 1 of the study was to identify proven practices, policies, and innovations that could be successfully applied in the United States to make existing and planned



Global Benchmarking Program final report cover. Source: Created by the U.S. DOT Volpe Center

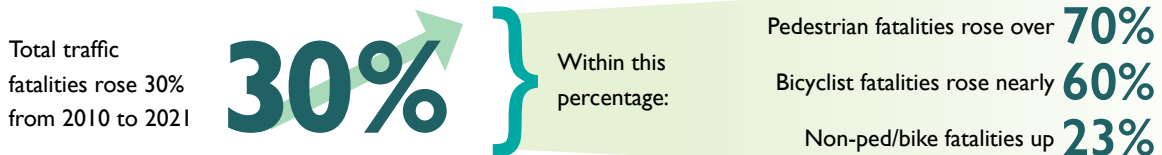
2 U.S. Transportation Secretary Pete Buttigieg’s Statement on the World Day of Remembrance for Road Traffic Victims. [Online] U.S. DOT 2022 Available: <https://www.transportation.gov/briefing-room/us-transportation-secretary-pete-buttigieg-statement-world-day-remembrance-road>.

3 National Highway Traffic Safety Administration. FARS Encyclopedia. [Online] U.S. DOT 2022. Available: <https://www-fars.nhtsa.dot.gov/Main/index.aspx>

Global Benchmarking to Improve U.S. Pedestrian Safety

NOTEWORTHY APPROACHES AND INNOVATIONS

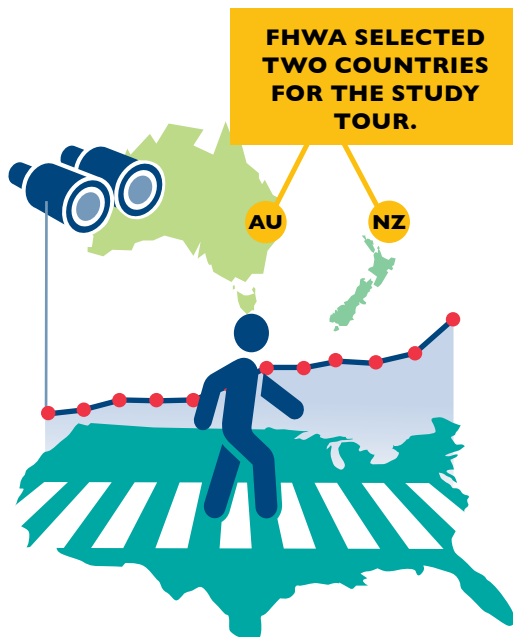
U.S. road users were killed in increasing numbers across all modes from 2010 to 2021. People walking and bicycling represent a disproportionately and increasingly greater segment of those killed over the decade. The U.S. DOT Volpe Center provided its multidisciplinary expertise to FHWA in studying noteworthy practices used by other countries to reduce pedestrian and bicyclist injuries with a focus on arterial roadways.



Source: NHTSA FARS Data; <https://www-fars.nhtsa.dot.gov/Main/index.aspx>

FHWA Global Benchmarking Study

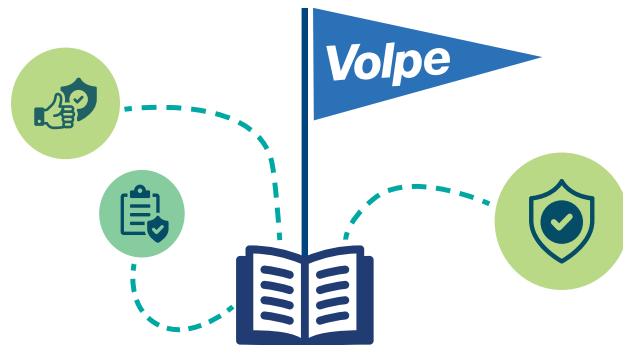
The Volpe Center study team researched 11 peer countries in Europe, South America, and Australasia that outperform the U.S. to gain innovative safety improvement techniques for further study. The team identified Australia and New Zealand as the most applicable peers based on similar transportation and land use context to that in the U.S.



01/2024

FHWA released the Global Benchmarking Program study report

Improving Pedestrian Safety on Urban Arterials: Learning from Australasia, in June 2023.



The report identifies key approaches that can be applied in the U.S. to reduce multimodal road user fatalities and serious injuries, including:

- **Movement & Place** as a framework for multimodal, systems-level safety and access planning
- **Speed Management** strategies to reduce vehicle speed through policy, design, and enforcement
- **Road Safety Audits** as a systematic process that parallels the transportation lifecycle

The Volpe Center is supporting FHWA in implementing key study findings and recommendations over a 2-year period with state departments of transportation, metropolitan planning organizations, and cities as identified in the study report.

urban signalized arterials safer for pedestrians. Phase 2 was to supplement current FHWA activities to address pedestrian safety and complement additional work being conducted by other public and private organizations.

In summer 2020, during Phase 1 of the study, the Volpe Center performed a literature review and conducted interviews with over 40 subject matter experts from 11 peer countries in Europe, South America, and Australasia (Australia, New Zealand, and surrounding islands). All 11 countries currently outperform the U.S. in pedestrian safety on urban, signalized arterials.

To identify which countries to best inform U.S. approaches among the 11 studied, the Volpe Center study team applied six evaluation criteria:

1. **Policy** (documented priorities, data-driven targets, funding protocols, and prioritization)
2. **Planning** (practices to align project prioritization with need and policy)
3. **Design** (engineering practices, signal design, geometric design)
4. **Technology** (innovations that make solutions feasible, cheaper, and better)
5. **Data** (information to measure baselines and targets, and to assess performance)
6. **Context** (land use patterns and transportation network attributes)

In fall 2021, FHWA published its results, [*Benchmarking Program: Reducing Pedestrian Fatalities and Serious Injuries on Urban Signalized Arterials*](#), detailing the performance of each of the 11 countries on the six key criteria. The study team concluded the countries with the best combination of innovative practices, demonstrated success in improving pedestrian safety over time, and contextual similarity were New Zealand and Australia.

In fall 2021, the Volpe Center also led a Global Benchmarking Program webinar, attended by over 400 people, that presented the results of the desk review and previewed the planned study tour to Australia and New Zealand.⁴

During the COVID-19 pandemic, the Volpe Center team participated in four virtual peer exchanges with Australia and New Zealand to maintain progress while international travel was on hold. From September 12–16, 2022, the team conducted technical site visits and meetings in both countries, coordinating with three agencies representing three levels of government: the New Zealand Transport Agency (national); Auckland Transport, New Zealand (municipal); and Transport for New South Wales, Australia (state).

The final Global Benchmarking Program study report, [*Improving Pedestrian Safety on Urban Arterials: Learning from Australasia*](#), was released in June 2023 by the FHWA Office of International Programs, completing the first phase of the project. The report:

⁴ Zoom for Government. The Office of International Programs: Global Benchmarking Pedestrian Safety. https://usdot.zoomgov.com/rec/share/panITSw59l0glELzmH3_9bQJVB0CtWOnjCoPA5o7PIOVQsOQheQhDDOSGJJ83pYoQr0YLRJPqIC_-A?start-Time=1662570056000.Passcode:6&Cjhs=2

- Identifies key innovations in policy, planning, and design that may be successfully applied in the United States to help reverse the current trend of increasing pedestrian and other vulnerable road user fatalities and serious injuries on arterial roadways;
- Focuses on policies that effectively prioritize, standardize, and fund engineering practices facilitating integration of new and emerging pedestrian safety strategies on urban signalized arterials; and,
- Identifies data-driven planning practices, and design standards and features, that effectively integrate pedestrian safety considerations into urban signalized arterial projects through a Safe System Approach, in conjunction with performance-based planning and programming that is coordinated with land use planning.

The Volpe Center is currently supporting FHWA in undertaking Phase 2 of the study, which involves a two-year effort to implement key findings and recommendations resulting from the study. Implementation activities include conducting a [four-part webinar series with the FHWA-funded Pedestrian and Bicyclist Information Center](#), a poster for use at multiple events, including the Transportation Research Board (TRB) Annual Meeting, a conference session at the October 2023 Association of Pedestrian and Bicycle Professionals, a moderated panel with Virginia DOT and California DOT and the FHWA Associate Administrator for Safety at the October 2023 AASHTO Safety Summit, and a workshop at the 2024 TRB Annual meeting. Additionally, the Volpe Center team is collaborating with the FHWA Complete Streets Working Group to scope a future phase of work to implement strategies from the report in partnership with U.S. state departments of transportation, metropolitan planning organizations, and cities, as noted in the study report. *(Sponsor: FHWA Office of International Programs)*

MOTOR CARRIER

The Level Up Initiative to Expand State Commercial Motor Vehicle Safety Deficiency Detection via PRISM



The Federal Motor Carrier Safety Administration’s (FMCSA) mission is to reduce crashes, injuries, and fatalities involving large trucks and buses. Since 2005,⁵ FMCSA’s Performance and Registration Information Systems Management (PRISM) initiative has provided states with the tools and processes to identify and immobilize motor carriers with serious safety deficiencies and hold them accountable through enforcement of federal out-of-service (OOS) orders. The U.S. DOT Volpe Center provides critical support to PRISM through project management, communications strategies and products, stakeholder engagement, web development, and technical training and services.

The new Level Up logo.
Source: FMCSA

⁵ PRISM originated as a pilot program mandated by Congress in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), P.L. 102–240. Congress authorized funding through the Transportation Equity Act for the 21st Century (TEA-21), P.L. 105-178 (1998) to expand PRISM nationally. The Safe Accountable Flexible and Efficient Transportation Equity Act: A Legacy of Users (SAFETEA-LU), P.L. 109-59 (2005), established statutory requirements for states to participate in PRISM and added a PRISM grant program. <https://www.fmcsa.dot.gov/PRISM>

PRISM has three commercial motor vehicle (CMV) safety participation levels:

Full Participation⁶ (mandatory) focuses on keeping large trucks (gross vehicle weight (GVW) of 26,001 pounds or more) with serious safety deficiencies off the nation’s highways. When a carrier is under a federal OOS order, a state suspends and/or revokes their active registrations and denies new registration requests for the motor carrier responsible for safety (MCRS). A state can also deny registration if the motor carrier has an inactive or deactivated U.S. DOT number.

Enhanced Participation (voluntary) adds another layer to the CMV vetting process if a “reincarnated” carrier evades their federal OOS order and attempts to register with a new U.S. DOT number under a different company name.

Expanded Participation (voluntary) enables a state to apply the Full Participation (mandatory) requirements to identify and immobilize federal OOS Non-IRP interstate lower-weight CMVs (GVW of 10,001 pounds–26,000 pounds).

In January 2022, 17 states were at the Full Participation level, while 32 states, including the District of Columbia, had advanced to the Enhanced level. The state of Washington achieved Expanded PRISM participation status.⁷ In 2022, PRISM significantly increased its safety impact over 2021, suspending over 5,300 large CMV carriers from operation, a 17-percent increase, and blocking over 2,200 large CMV carriers under a federal OOS order from reregistration, a 26-percent increase. The number of lower weighted CMVs (GVW of 10,001-26,000 pounds) on the road significantly increased. Twenty-four percent of interstate commercial trucks involved in crashes are lower weighted vehicles. Expanded PRISM participation therefore provides the tools states need to mitigate and implement lower weighted CMVs.

Achieving the higher PRISM tiers may require substantial effort. States may need to seek the appropriate authority and system updates at these participation levels. PRISM requires data management and interfacing between state and FMCSA databases; leveling up may require expenditures for these interfaces to occur and coordination with law enforcement. FMCSA encourages states to use Motor Carrier Safety Assistance Program (MCSAP) and High Priority CMV financial assistance authorized under the Bipartisan Infrastructure Law⁸ to increase their PRISM participation. Once a state levels up to Expanded Participation, it can continue to enhance the efficiency of its existing systems, educate carriers, and cover operation and maintenance of PRISM system capabilities.^{9,10}

In summer 2022, the Volpe Center developed a communications campaign for PRISM Level Up. The team presented a communications plan for the campaign, with success measured through states beginning to Level Up. The Level Up campaign was launched in September 2022 with the Volpe

6 The 2015 Fixing America’s Surface Transportation (FAST) Act made a state’s eligibility for Motor Carrier Safety Assistance Program (MCSAP) formula grant funding contingent upon achieving Full Participation status by October 1, 2020.

7 FMCSA. States Participating in PRISM. [Online]. Available: <https://www.fmcsa.dot.gov/information-systems/prism/states-using-prism>. October 25, 2023.

8 FMCSA. Bipartisan Infrastructure Law: Impacts for FMCSA Grant Programs. [Online]. Available: <https://www.fmcsa.dot.gov/Bipartisan-Infrastructure-Law-Grants>. November 28, 2023.

9 In order of descending priority.

10 FM-MHP-23-001, FY2023 High Priority Program–Commercial Motor Vehicle; U.S. DOT. [Online]. Available: <https://www.grants.gov/web/grants/view-opportunity.html?oppld=345679>. November 28, 2023.

Center's distribution of Enhanced and Expanded material at the American Association of Motor Vehicle Administrators Annual International Conference. Since then, the Volpe team has produced PRISM-specific materials, grant information, a PRISM Level Up video, PRISM Level Up FAQs and PRISM Level Up talking points, and a PRISM Level Up brochure. FMCSA's [PRISM Data and Activity Safety Hub](#) website hosts these resources.

By July 2023, participation was leveling up: Full PRISM Participation states had dropped to 15 and Enhanced Participation states increased to 35 with Idaho and South Carolina Leveling Up. By the end of 2023, Utah had Leveled Up from Full to Enhanced, and Indiana is working to achieve Expanded PRISM Participation.

Additionally, the Volpe Center will continue to host meetings for PRISM participants for states to informally share potential solutions to issues and benefit from access to the Volpe Center's technical assistance. (*Sponsor: FMCSA*)

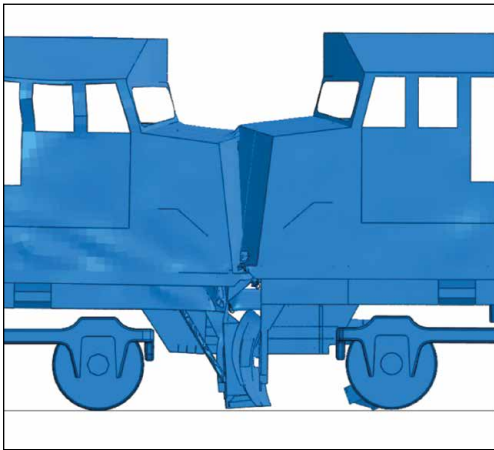
RAIL

Managing Train-to-Train Impact Tests for the Federal Railroad Administration's Locomotive Crashworthiness Research Program

The Federal Railroad Administration's (FRA) Office of Research, Development, and Technology is developing innovative technologies to increase the safety of railroad passengers and crew during train-to-train collisions. To support this effort, Volpe Center mechanical engineers designed two crash energy management (CEM) components that were integrated into locomotive end structures: a push-back coupler (PBC) and a deformable anti-climber (DAC). The CEM components work in unison to inhibit rail car override in the event of a collision.

Results of vehicle-to-vehicle override, where the strong underframe of one train vehicle (usually a locomotive) impacts the weaker superstructure of another vehicle, can be devastating and compromise the occupied volume of a rail car. The objective of this research and test program is to demonstrate the effectiveness and feasibility of these components in improving crashworthiness for equipped locomotives in a wide range of train-to-train impact scenarios, including collisions with conventional locomotives, passenger cars, and freight equipment.

The Volpe Center provides subject matter expertise to execute FRA's Locomotive Crashworthiness Program and conducts computer simulations required for research. Volpe Center staff are responsible for test planning and coordination, identifying the types of computer analyses and tests to be conducted, establishing equipment requirements for tests, and work in collaboration with FRA. The Volpe team organizes and oversees all impact tests and computer simulations, including coordinating personnel from FRA, the Volpe Center, Transportation Technology Center/ENSCO in Pueblo, Colorado, and multiple subcontractors, and facilitates communication between all parties to ensure successful impact test outcomes.



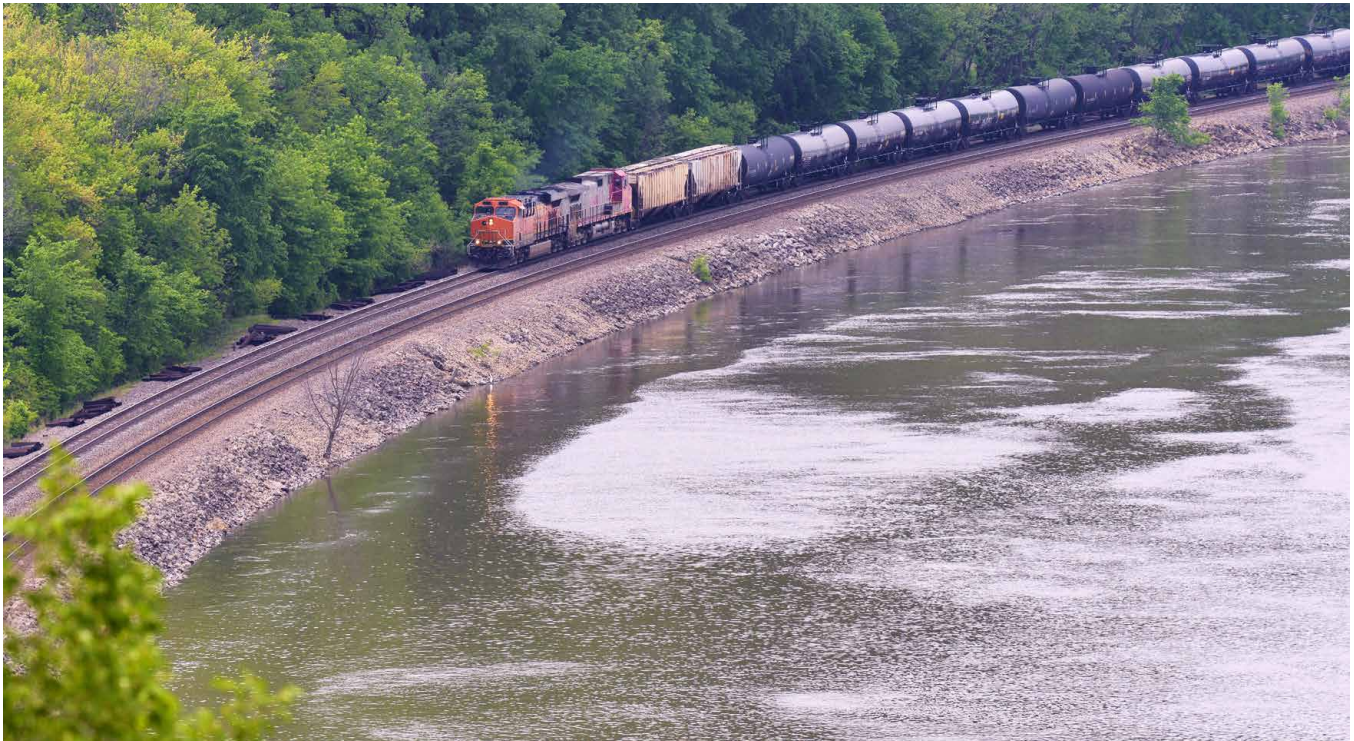
Locomotive crashworthiness train-to-train impact test: Finite element analysis predictions (left) of deformation at the collision interface were in very good agreement with impact test results (right). Source: U.S. DOT

The Volpe Center developed a test program to evaluate the CEM system and validated computer simulations. The locomotive tests conducted as part of this research program were based on a head-on collision scenario in which a locomotive-led train collides with a stationary train. The train-to-train impact test, the last and most complex test in the research program test series, was conducted in August 2022. During this test, a CEM-equipped locomotive leading two passenger cars impacted a stationary, conventional locomotive leading two freight cars at 24.3 miles per hour. The primary objective of the test was to demonstrate the effectiveness of the CEM system in managing the load path, absorbing impact energy, and inhibiting override and lateral buckling in a train-to-train collision scenario. The impact test resulted in the CEM system working exactly as designed—successfully absorbing collision energy and keeping the rail vehicles in-line with no derailment and no signs of override. Post-test computer simulation results at the actual test speed compared well with the test results. The CEM components absorbed a combined 1,680 ft-kips of collision energy, well over the minimum test requirement of 1,380 ft-kips.

Results of this research program demonstrate the effectiveness and feasibility of utilizing CEM components in improving crashworthiness for equipped locomotives in a wide range of potential collisions. Findings from this research will also provide FRA with information to consider the potential development of alternative compliance requirements for locomotive crashworthiness. (Sponsor: FRA)

Estimating the Costs of Rail Delays Due to HAZMAT Incidents

Rail incidents such as derailments and collisions can have serious impacts in terms of loss of life and damage to equipment and infrastructure. When the rail incident involves hazardous materials (HAZMAT), the consequences can be even more severe. The Pipeline and Hazardous Materials Safety Administration (PHMSA), in collaboration with the Federal Railroad Administration (FRA), asked the U.S. DOT Volpe Center to analyze an additional potential impact from HAZMAT rail incidents that was not well understood: the impact on rail operations in terms of delay and associated emissions resulting from a closure.



To develop a method to estimate delay, the Volpe Center synthesized a variety of data sources, including the Surface Transportation Board confidential waybill sample data, and utilized various transportation modeling techniques. PHMSA asked for the Volpe Center's expertise in this area based on similar support provided to Federal Motor Carrier Safety Administration (FMCSA) to estimate environmental and delay costs from [truck crashes](#).

The Volpe Center delivered a [final report](#) to PHMSA in October 2023. The report indicates that in the U.S., approximately 27 rail incidents per year result in the release of HAZMAT with an estimated cost of delay and additional emissions of \$3.3 million annually. On average, there are an additional nine rail-related HAZMAT releases that are not associated with a rail incident, which result in a cost of approximately \$260,000 dollars each year.

These findings can be used to support policy and regulatory decision-making related to transporting HAZMAT by rail. Further, the estimation method developed by the Volpe Center could potentially be used to evaluate costs of rail delay for a variety of purposes including the benefits of improving rail infrastructure or preventing other types of rail incidents, not just HAZMAT rail incidents.

The Volpe Center's multidisciplinary team included economists, geographic information system specialists, and subject matter experts on passenger rail and vehicle emissions. The team modeled the various factors that impact the cost of delay: freight rail volumes, passenger rail volumes, track capacity, the marginal impact of the presence of HAZMAT on the duration of closure, train congestion, locomotive emission rate, train crew costs, equipment costs, passengers per train, fuel costs, and the social costs of emissions. The Volpe Center combined the various model components to produce estimates for a variety of scenarios covering various locations on the U.S. freight rail network. (Sponsor: PHMSA, with coordination and support from FRA)

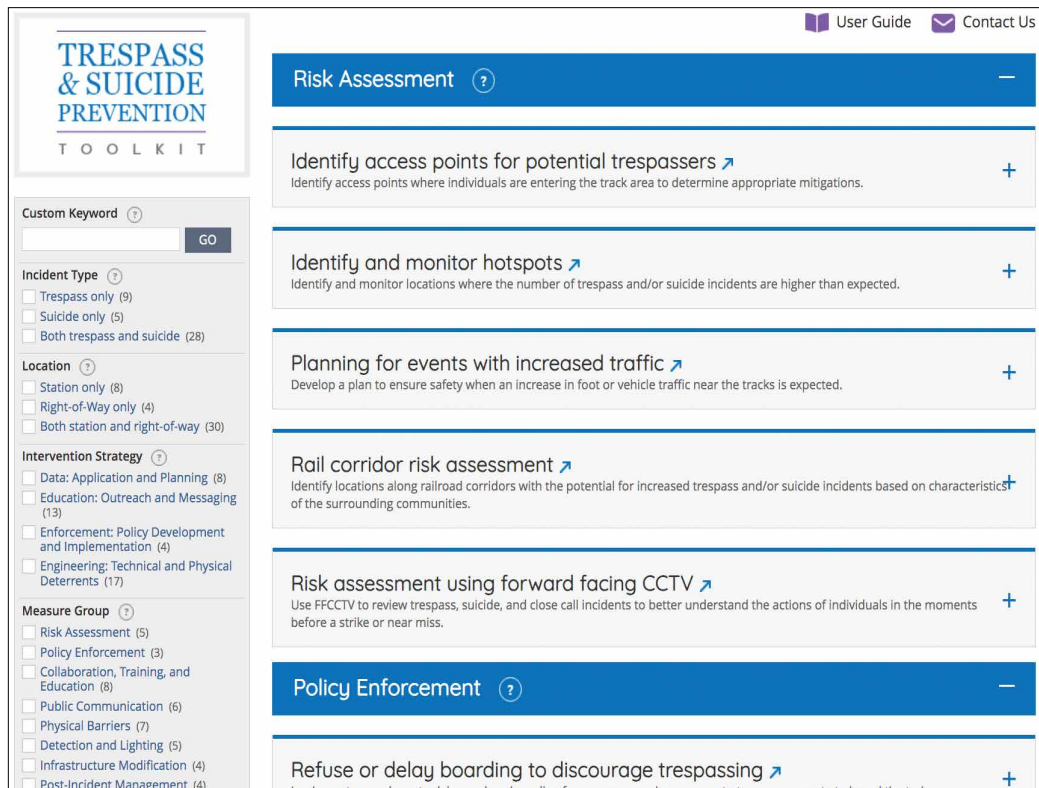
The Volpe Center's research could be used to evaluate the costs of rail delay for many purposes, not just HAZMAT rail incidents. Pictured are tank cars moving along the Mississippi River. Source: Adobe Stock/dvande

Preventing Rail-Related Deaths with the Trespass and Suicide Prevention Toolkit

The leading causes of rail-related fatalities are trespassing and suicide. From 2013 to 2022, there was an average of 713 fatalities per year away from highway rail grade crossings and an average of 250 fatalities at highway rail grade crossings related to trespassing and suicide. There is a tremendous amount of information available from the Federal Railroad Administration (FRA), railroads, and academia about how to prevent trespassing and suicide on railroads and mitigate the impacts of incidents; however, the information is often buried in journal articles and technical reports that are not easily found.

The FRA enlisted the U.S. DOT Volpe Center’s help in taking these reports and presenting them to users in a way that is easy to digest. A Volpe Center team created the [Trespass and Suicide Prevention \(TSP\) Toolkit](#), which helps to provide resources to individuals who can directly improve safety. The TSP Toolkit was launched in June 2022 and the first major content update was released in April 2023. Between January 1 and June 29, 2023, the TSP Toolkit logged over 690 visits to the website.

Volpe subject matter experts developed the concept and organizational structure of the TSP Toolkit and worked with FRA information technology (IT) to establish the website. All of the content was developed by the Volpe project team, and they will continue to maintain and update the website. The weekly number of visitors has trended upwards in 2023, so it is as important as ever to ensure the TSP Toolkit provides current research and good practices to users.



Screenshot from the Trespass and Suicide Prevention Toolkit. Source: FRA

Stakeholders nationwide can use the toolkit to help identify actions to take to reduce the occurrence of trespass or suicide-related incidents on the railroad right-of-way. The complexity of these issues makes it hard to know what can be done to prevent these incidents or mitigate their impacts. The TSP Toolkit is designed to allow users to explore potential solutions and learn about how to effectively implement them more easily. (Sponsor: FRA)

AVIATION

Evaluating the Performance of Runway Visual Range Sensors for the Federal Aviation Administration

At the 30 busiest commercial airports in the U.S., there were about 11.7 million arrivals or departures or approximately 5.9 million flights in fiscal year 2022, according to FAA’s annual publication, [Air Traffic by the Numbers](#). Every one of these flights was enabled by the accurate and consistent reporting of runway visual range (RVR) information.

For decades, the U.S. DOT Volpe Center has supported the FAA in evaluating new RVR sensors (especially forward-scatter meters) by operating and maintaining 1970s-era analog transmissometers, which have been established as the gold standard for measuring and testing new visibility sensors.

RVR is a measurement of the distance a pilot can expect to see when operating on or near a runway in the National Airspace System (NAS). RVR measuring equipment, located next to runway, provides airport traffic control (ATC) with visibility measurements at key points along a runway (e.g., touchdown location, runway midpoint, and rollout location)—providing visibility information that is critical to safe operation of the NAS. This information is key to determining which aircraft can operate safely when weather conditions reduce the ability of pilots to see their surroundings.

Transmissometers have been the standard visibility measurement instrument in the NAS for decades. Beginning in the 1980s, with scatter meter technology developed and validated, forward-scatter meters began to replace transmissometers in the NAS. Transmissometers have some disadvantages compared to forward-scatter meters—they are larger, typically more expensive to acquire, and more expensive to maintain in good working order. However, because a transmissometer provides a measurement that is more similar to human vision, the Volpe Center has supported the FAA in evaluating new RVR sensors.

Comparison of transmitter for existing gold standard (top) and test instrument. Source: U.S. DOT Volpe Center/ Christopher Scarpone



As these transmissometers are complex opto-electro-mechanical systems that have not been manufactured or supported by the manufacturer for many years, the FAA and Volpe Center determined the best way to maintain this resource was to evaluate the market and select at least one transmissometer for validation against the existing standard. After conducting market research, the Volpe Center recommended a transmissometer for acquisition and testing, which the FAA approved. Between September 2021 and October 2022, the Volpe Center operated the test transmissometer in a side-by-side installation with the existing gold standard transmissometer to evaluate whether the test transmissometer would work as a new standard.

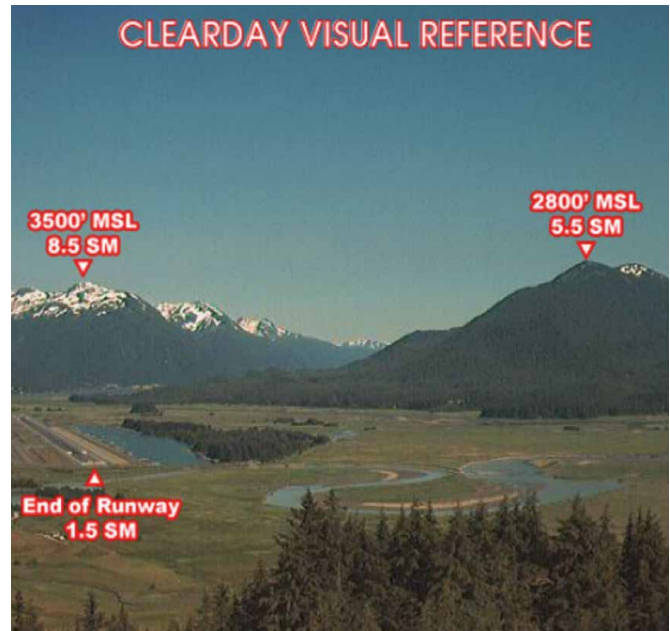
The results of the test were transmitted to the FAA in July 2023. A final report will be published in 2024. This project provides the FAA with the ability to continue independent testing and validation of the fundamental performance of new visibility sensors for years to come. Accurate RVR information is critical to the safe operation of the NAS and is a key part of maintaining the United States' world-leading aviation safety record. Data collection for this project was conducted at the U.S. DOT Volpe Center's Aviation Weather Research Facility (AWRF), located on Joint Base Cape Cod in Sandwich, MA. (*Sponsor: FAA*)

Performance Evaluation for Use of Native Wide Area Multilateration (WAM) Surveillance in Juneau, Alaska

Juneau International Airport is challenging for air traffic controllers to surveil with traditional radars due to Alaska's mountainous terrain. In 2010, the FAA deployed a Wide Area Multilateration (WAM) ground-based surveillance system in Juneau to alleviate weather-related congestion and delays, making flights safer and more efficient. The WAM system was originally used as a virtual radar, similar to existing en route radars. For air traffic control to take advantage of the full benefits of the WAM system with the existing automation system, WAM will now be used in its native format, increasing the frequency and accuracy of reports.

Separation standards analyses are a vital part of the FAA's safety risk management process. The U.S. DOT Volpe Center, as part of the Separation Standards Working Group, has been performing separation standards analyses for FAA for more than a decade and has experience in simulations, flight tests, and targets of opportunity (TOO) analyses. The Volpe team possesses knowledge of the air traffic control automation system that is used in Alaska and other remote locations known as the Microprocessor En Route Automated Radar Tracking System (Micro-EARTS). The Volpe Center previously performed separation standards analyses of Micro-EARTS fused display mode (fusion), which uses multiple surveillance sources as input to produce a smoothed aircraft track on the controller's display. The Volpe Center completed the analyses of Micro-EARTS fusion for en route air traffic (5 NM separation) in 2015 and terminal air traffic (3 NM separation) in 2016.

The Volpe Center was asked to support FAA's request for approval to use current 5 nautical mile (NM) separation procedures documented in [FAA Order 7110.65](#) for native WAM surveillance as an



input to the Micro-EARTS automation platform by demonstrating the accuracy, reliability, integrity, and availability are equivalent to or better than legacy radar systems. The Volpe team provided technical support to develop and perform the separation standards analysis of Micro-EARTS with native WAM.

FAA WeatherCams images show the challenging terrain in Juneau, AK, which is more easily surveilled with WAM surveillance in its native format. Source: FAA

Separation standards analyses generally evaluate a new system, in this case Micro-EARTS fusion with native WAM, against a legacy system to ensure the display of aircraft for air traffic control is as good or better than the legacy system. The Volpe Center coordinated with subject matter experts to test the software and collect recorded flight data to run TOOs, developed and ran simulation scenarios, and determined relevant parameters of the analysis.

The Volpe Center’s metric for analysis of TOO flight data was separation difference, calculated as the difference between the separation of real aircraft pairs (the TOOs) with the new system, and separation of the same aircraft pairs with the legacy system. The analysis of flight data shows the fusion output is equivalent to or better than the legacy results. The Volpe Center coordinated with the Separation Standards Working Group to document the analysis and write the performance evaluation for inclusion in a Safety Management System Safety Risk Management Document (SRMD), which informs the decision to utilize the full potential of native WAMs more frequent update rate and improved accuracy.

The Volpe team delivered the final separation standards report, “Performance Evaluation of Native WAM Integrated into the Microprocessor En Route Automated Radar Tracking System (Micro-EARTS) Fusion for 5 NM Separation,” to Surveillance and Broadcast Services management in June 2023 for inclusion in the SRMD. The SRMD supports the operational use of native WAM for 5 NM separation in Juneau, Alaska, as of August 2023, in order to increase safety and enhance efficiency. (Sponsor: FAA, Air Traffic Organization [ATO], Program Management Organization [PMO], AJM-42 - Surveillance and Broadcast Services [SBS], Systems Engineering, Separation Standards Working Group)

Enhancing the Aviation Sector's Resilience with Emerging Counter-Threat Cybersecurity Methods and Technologies

Cyberattacks in the aviation sector surged by 24 percent worldwide in the first half of 2023.¹¹ Data from 2021 shows that cyberattacks increased sharply in all threat categories, with a 530 percent increase year-to-year in reported incidents across the European aviation industry.¹² The aviation sector implements new systems and technology yearly, but as cyber threats evolve, the expertise and tools used to defend against these threats must change as well to better protect increasingly complex networks.

A primary objective of the U.S. DOT is to provide Air Traffic Organization (ATO) Cybersecurity Group (ACG) System Security Officers (SSOs) and cybersecurity subject matter experts (SMEs) to FAA. SSOs maintain the proper operational security posture to protect FAA information systems, programs, and designated information technology assets. They work closely with FAA's information systems owner and serve as a principal advisor on all matters, technical and otherwise. An SSO can be appointed for multiple information systems in an environment where personal computers, workstations, file servers, local area networks, or small systems are oriented toward the functional user as the operator. SMEs provide network and system security services which include performing system vulnerability and gap analysis, reviewing security assessment reports, audit artifacts, and briefings portraying the risks and system authorization recommendations up to the Air Traffic Organization Authorizing Official (ATO AO).

Attacks on critical infrastructure that are essential to the safe and efficient operation of the National Airspace System (NAS) continue to increase and have become more complex. In 2020, numerous cyberattacks occurred against critical infrastructure, including the supply-chain hack of the popular [SolarWinds](#) monitoring software, which culminated in cybersecurity threats spilling over from Russia's invasion of Ukraine. As a result, the Department of Homeland Security's Cybersecurity and Infrastructure Security Agency (CISA) initiated the [Shields Up](#) campaign for all government agencies.

During the Shields Up exercise, members of the U.S. DOT Volpe Center's Cybersecurity Team supporting the FAA ACG discovered a network vulnerability through an international air traffic control gateway. This discovery was reported to the FAA ATO AO and the gateway was prohibited from connecting to the network until the issue was resolved. The team noted, a simple change to a device can change the network and have far reaching effects that will impact everything else in the home network.

Supporting the ATO Cybersecurity Groups, a Volpe Center team reviewed sensitive NAS systems to ensure the security posture and cyber strength was enhanced. As a result, several undocumented remote connections to NAS systems were identified and disconnected. In early 2023, Volpe Center

11 TechForce (2023). Case Study: Cyberattacks in the Aviation Industry. [Online]. Available: <https://techforce.co.uk/blog/2023/case-study-cyberattacks-in-the-aviation-industry---risks-and-remedies>. September 19, 2023.

12 EUROCONTROL Think Paper #12-Aviation under attack from a wave of cybercrime. (2023). [Online]. Available: <https://www.eurocontrol.int/publication/eurocontrol-think-paper-12-aviation-under-attack-wave-cybercrime>. September 19, 2023.

cybersecurity SMEs proposed and initiated cyberattack desktop simulations to help FAA system developers visualize dependencies and key vulnerabilities requiring immediate attention. This endeavor had outstanding results, and the Volpe Center team’s sponsor satisfaction was recognized by FAA.

This work enhances the aviation sector’s resilience by implementing emerging counter-threat cybersecurity methods and technologies. It also aligns with the U.S. DOT strategic goal to invest in infrastructure to ensure mobility and accessibility and to stimulate economic growth, productivity, and competitiveness for American workers and businesses. This work will lead to the development and deployment of innovative practices and technologies that will improve the safety and performance of the nation’s transportation system. Recent funding for cyber programs from Congress—through the Infrastructure Investments and Jobs Act and 2022 Omnibus Appropriations Act—will help mitigate the risks due to emerging and new threats to the aviation sector, both on a national and global scale. *(Sponsor: FAA ATO Cybersecurity Group [ACG] AJW-B4; FAA Communications Information Network)*

MULTIMODAL

Strengthening the Resilience of Positioning, Navigation, and Timing Services

As the lead civil department for Positioning, Navigation, and Timing (PNT), the U.S. Department of Transportation (U.S. DOT) is responsible for driving user adoption of resilient PNT solutions across the nation’s transportation system and within other critical infrastructure sectors. A U.S. DOT Volpe Center project team supported the DOT Office of the Assistant Secretary for Research and Technology’s (OST-R) Office of PNT & Spectrum Management in developing a Complementary PNT (CPNT) Action Plan to increase utilization of PNT services and technology. The plan will support widespread use of CPNT technology by describing actions U.S. DOT will pursue over the next several years.

As identified in the CPNT Action Plan, U.S. DOT’s planned actions include engaging PNT stakeholders; monitoring and supporting the development of CPNT specifications and standards; establishing resources and procedures for CPNT testing and evaluation, including field test ranges; and creating a Federal PNT Services Clearinghouse. These initiatives, along with efforts of other federal partners, will strengthen the resilience of the nation’s PNT-dependent systems.

The CPNT Action Plan directly supports Executive Order 13905—Strengthening National Resilience through Responsible Use of PNT Services. Implementation of this plan will help raise awareness of the extent to which critical infrastructure depends on PNT services, ensure critical infrastructure can withstand disruption or manipulation of PNT services, and engage public and private sectors to promote responsible use of PNT services. Development of the CPNT Action Plan is one step toward



Goal of highly resilient/robust U.S. PNT Systems.
Source: OST-R

strengthening the resilience of the nation’s PNT-dependent systems, resulting in a safer, more secure critical infrastructure.

The CPNT Action Plan was approved by the Deputy Assistant Secretary (DAS) for Research and Technology and officially released to the public in September 2023. The DAS also delivered the keynote address at the Civil GPS Service Interface Committee (CGSIC) meeting in September 2023. In his remarks, the DAS highlighted the CPNT Action Plan in conjunction with other PNT initiatives underway at U.S. DOT. (*Sponsor: U.S. DOT/OST-R*)

Increasing GPS Resiliency to Bad-Actor Interference

The Global Positioning System (GPS) has become integral to everyday American life. Freely accessible by anyone with a GPS receiver, it has irreversibly changed the face of military operations, civilian navigation, and infrastructure, and is indispensable for today’s economy—not only for the safe and efficient use across all modes of transportation, but also for network synchronization, surveying, precision agriculture, machine control, earthquake detection, and scientific applications. Operated and maintained by the U.S. Space Force (USSF), GPS relies on signals broadcast from the GPS satellite constellation,¹³ which, along with other global navigation satellite systems (GNSS), circles the planet in medium earth orbit 12,550 miles above the earth.

GPS Interference and spoofing events are increasing at an exponential rate. The cost to the perpetrators has fallen, and web-downloadable, easy-to-use GPS simulators/spoofers, which take only minutes to get up and running, are now readily available for perhaps \$100. The asymmetry between those costs and the economic impact of such GPS interference can be massive, considering the cost of a single day’s loss of all non-military GPS services has been estimated at \$1 billion.¹⁴

Space Policy Directive 7 (SPD-7)¹⁵ establishes implementation actions and guidance for U.S. space-based positioning, navigation, and timing (PNT)¹⁶ programs and activities pursued for U.S. national and homeland security, civil, commercial, and scientific purposes. It directs U.S. DOT to develop and implement GPS signal authentication to increase the resiliency of PNT services for U.S. national critical infrastructure, and to provide interference protection to the GPS service that is used for safety systems and economic security.¹⁷ Since 2022, two U.S. DOT Volpe Center experts have represented the U.S. DOT Office of the Assistant Secretary for Research and Technology (OST-R) and the Federal Aviation Administration (FAA) as GPS liaisons to USSF, one for acquisitions and one for operations.

13 GPS.gov. (2023). Space Segment. [Online]. Available: <https://www.gps.gov/systems/gps/space/>. November 7, 2023.

14 A. C. O’Connor, et al., Economic Benefits of the Global Positioning System (GPS) Final Report, June 2019, p. E4.

15 Memorandum on Space Policy Directive 7, January 15, 2021. <https://trumpwhitehouse.archives.gov/presidential-actions/memorandum-space-policy-directive-7/>

16 GPS is the PNT system operated by the U.S. government.

17 This policy complements the guidance set forth in Executive Order 13905 of February 12, 2020 (Strengthening National Resilience through Responsible Use of Positioning, Navigation, and Timing Services), and the guidance for Global Navigation Satellite Systems (GNSS) included in the December 9, 2020, National Space Policy. See <https://trumpwhitehouse.archives.gov/wp-content/uploads/2020/12/National-Space-Policy.pdf>.

GPS Modernized Signal Authentication will mitigate intentional spoofing of GPS, which is a known and exploited threat to transportation safety systems and national critical infrastructure. In 2022, OST-R and FAA turned to the Volpe Center to lead the development of GPS Modernized Signal Authentication¹⁸ requirements and an implementation strategy through these liaisons and the OST-R Interagency Extended Positioning and Navigation Working Group. The Volpe Center is responsible for planning, coordinating, systems engineering, and evaluating operational suitability for GPS authentication. The result of this effort will be two products: at the receiver end, an out-of-band (OOB) data authentication service for existing GPS user equipment; and at the transmission end, a new, in-band signal+data authentication service that will be broadcast from GPS satellites.

This work is being performed in two phases. Phase I will develop OOB authentication and Phase II will create the new in-band authentication service. This phasing reflects a number of factors. OOB data authentication is accomplished by sending test signals to the user equipment through a communication link other than the GPS broadcast signal; in-band ranging+data authentication is accomplished by modifying the satellite GPS broadcast signals to include new navigation messages and ranging signals, some of which will be transmitted by satellites that have yet to be launched. This work will have significantly greater engineering, implementation, and funding challenges. Because development of the new OOB authentication system requirements and system can be accomplished without any dependency on the existing or future constellation, it can be achieved first.

The Volpe Center has led Phase I during FY2023 in partnership with USSF and the U.S. Coast Guard, expediting interagency coordination and acquisition support to obtain the necessary data from the operational space, control, and user operational segments of the GPS Enterprise. Implementing the public key infrastructure and distribution networks and testing the network are scheduled for FY2024; an operational OOB navigation message authentication service is targeted for mid-2025.

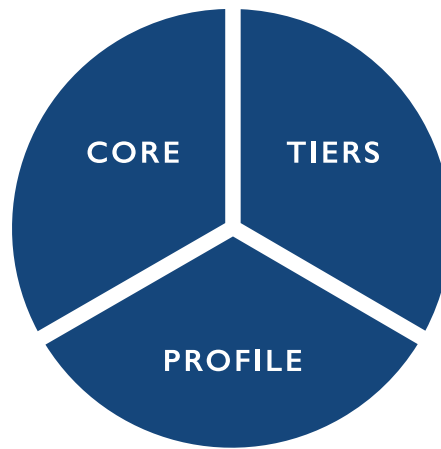
For Phase 2, development of the in-band authentication service, the Volpe Center will support the policy development, acquisition, and operational activities necessary for in-band authentication of the full GPS modernized signals transmitted from the enlarged constellation. System engineering is scheduled for FY2024. Implementation of the GPS changes is likely no earlier than FY2025, with completion sometime after 2028. (*Sponsor: OST-R, FAA, USCG, and USSF*)

Development of a National Institute of Standards and Technology Cybersecurity Profile for the ITS Ecosystem

The growing threat of cyber attacks and the resulting impact on the nation's highway system has highlighted safety and operational risks to our critical roadway infrastructure. Between June 2020

¹⁸ Authentication is the capability of a GPS receiver to verify the authenticity of both the incoming GPS information and the entity transmitting it, to ensure that it comes from a trusted source. Modernized GPS uses digital signature authentication technology as the mechanism to verify the authenticity of positioning signals.

CYBERSECURITY FRAMEWORK



The [National Institute of Standards and Technology \(NIST\) Cybersecurity Framework](#) consists of three main components: Framework Core, Implementation Tiers, and Profiles. Source: NIST

and June 2021, the transportation industry saw a 186-percent increase in weekly ransomware attacks.¹⁹ The U.S. Intelligent Transportation System (ITS) ecosystem faces the biggest challenge due to the value of ITS data and connectivity with other systems. Concerns about cybersecurity for ITS and advanced traffic management deployments are related to both current technologies as well as legacy systems, coupled with the growing trend to integrate ITS deployments with other computer and communications networks. This combination has introduced new hazards that have not been encountered in this domain.

Traffic management deployments oversee the movement of all types of vehicles, travelers, and pedestrians throughout the transportation network. These deployments include information collection, dissemination, and data processing that keep the surface transportation system moving efficiently. This application area covers both automated monitoring and control activities as well as decision-making processes (both automated and manual) that address real-time incidents and other disturbances on the transportation network, as well as managing travel demand as needed to maintain overall mobility.

In 2018, the U.S. DOT ITS Joint Program Office (JPO) sought the expertise of the U.S. DOT Volpe Center to create a cybersecurity profile and guidelines to support state and local DOT decision-making and strengthen activities to address cybersecurity issues for the ITS ecosystem. The Volpe Center provided overall program management to the ITS JPO, including oversight of contractors as well as leveraging its experience from developing the [Cybersecurity Framework \(CSF\) for the Connected Vehicle Environments](#) and other cybersecurity research. Volpe Center staff served as subject matter experts on cybersecurity issues and various transportation topics and conducted an analysis of the ITS architecture to define the scope of the profile, assisted stakeholders in developing mission objectives, and prioritized cyber risks and controls. The Volpe-led project team collaborated with the National Institute of Standards and Technology (NIST), National Cybersecurity Center of Excellence, and the MITRE Corporation and engaged stakeholders from public agencies across 20 states.

¹⁹ Check Point Software Technologies Ltd. (2023). Ransomware attacks continue to surge, hitting a 93% increase year over year: (June 14, 2021). [Online]. Available: <https://blog.checkpoint.com/2021/06/14/ransomware-attacks-continue-to-surge-hitting-a-93-increase-year-over-year/>. October 30, 2023.

The profile describes how state and local DOTs can implement cybersecurity controls for several service packages from the [Architecture Reference for Cooperative and Intelligent Transportation \(ARC-IT\)](#).

The Volpe team concluded its work in July 2023 and provided the following key deliverables to ITS JPO:

- An ITS Cybersecurity Framework Profile
- A Prototype ITS Security Controls Overlay and Reference Implementation
- Training modules, decision guidelines, and model templates that can support decision makers and project managers of ITS infrastructure, as well as help planners and financial programmers understand the scope of additional needed actions such as steps, processes, or mitigations.

This project supported efforts to ensure resilient transportation systems are designed, installed, operated, and maintained to prevent and survive a cyber incident while sustaining critical functions, consistent with the priorities outlined in the U.S. DOT Strategic Plan, which call for the “development of modal cyber threat models for transportation critical infrastructure to enhance integrated cybersecurity and safety research priorities.”²⁰

State and local agencies will implement the CSF profile to understand their baseline cybersecurity posture and develop an understanding of the priority measures they should take to improve it. In the longer term, all infrastructure owners/operators will have implemented the CSF profile and improved their cybersecurity posture such that their systems are resilient to cyber threats and vulnerabilities. (*Sponsor: ITS JPO and FHWA Office of Operations*)

INTERNATIONAL

Strengthening Safe Cross-Border Transportation between the U.S. and Southeast Asia

Disparities in safety requirements in cross-border transportation can impact the safe and efficient flow of goods between nations. As part of the U.S.–Association of Southeast Asian Nations (ASEAN) Transportation Dialogue Partnership, the U.S. and ASEAN have been cooperating on transportation-related programs, including a cross-border safety requirement initiative, to mitigate disparities across member state jurisdictions. The U.S. and ASEAN have conducted a series of two roundtable sessions, which leveraged lessons learned by U.S. DOT operating administrations such as the Federal Motor Carrier Safety Administration (FMCSA) and Federal Railroad Administration (FRA) and presented an overview and results of the roundtable sessions at the 46th annual Transportation Facilitation Working Group Meeting (TFWG) held by the ASEAN Secretariat.

20 U.S. Department of Transportation (2023). U.S. Department of Transportation Strategic Plan for FY 2018-2022. [Online]. Available: <https://www.transportation.gov/sites/dot.gov/files/docs/mission/administrations/office-policy/304866/dot-strategic-plan-fy2018-2022508.pdf>. October 30, 2023.

The roundtable sessions held in summer 2023 were attended by staff members from the Office of the Secretary, FMCSA, FRA, and the Commercial Vehicle Safety Alliance (CVSA), as well as ministers of transportation and relevant stakeholders from ASEAN member states: Brunei, Cambodia, Indonesia, Lao People’s Democratic Republic (PDR), Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. During the sessions, the U.S. shared the current process for a commercial motor vehicle and train to cross the Mexican and Canadian borders and enter the U.S., reviewed the history of cross-border transportation in the U.S., and the coordination between various state and federal agencies at the border crossings. Each participating ASEAN member state shared the current state of cross-border rail and land transportation in their country, reviewed various programs and policies that have been implemented to facilitate cross border transportation, and identified equivalencies and disparities in safety requirements across jurisdictions.

The ASEAN Secretariat provided an overview on the “Operationalization of ASEAN Transport Facilitation Agreements and ASEAN Goods and Vehicle Cross-Border (AGVCB) Permit at the regional level,” providing a better understanding of the multilateral agreements and permits that are already in place. The Thai Department of Transport presented a case study on the AGVCB permit and other cross-border permits to demonstrate how the permit is utilized. The ASEAN Cross-Border Safety Requirements project team provided an overview and results from the roundtable sessions during the 46th TFWG meeting in coordination with U.S. DOT Office of the Secretary (OST) and the ASEAN Secretariat.

The U.S. DOT Volpe Center supported FMCSA and OST in providing analytical research, facilitating the roundtables, and compiling information and meeting notes for post-meeting follow-up. The Volpe Center team will continue to assist and coordinate one-on-one interviews with specific member states to dive deeper into various topics and will assist in drafting a report to ASEAN member states to assist in better understanding how member states can align their standards to ensure seamless cross-border transportation.

With a focus on safety and an understanding of the holistic view of cross-border transportation in all activities, the ASEAN Cross-Border Safety Requirements project will ensure seamless and uninterrupted transportation between jurisdictions that may have different or equivalent safety requirements for land transportation. In addition to focusing on safety, the project will consider all aspects of cross-border transportation, including customs procedures and facilitation. The project will also enhance the U.S.–ASEAN partnership under projects such as the Master Plan on ASEAN Connectivity through policy recommendations on improving trade facilitation, boosting regional connectivity, and advancing strong supply chains. (*Sponsor: FMCSA*)

Supporting International Partnerships to Improve Grade Crossing Safety in the Mekong Region

In 2019, U.S. DOT partnered with the [Mekong-U.S. Partnership](#) to improve regional connectivity in the Mekong region through an East-West regional connectivity technical assistance and capacity building program. The Mekong-U.S. Partnership creates collaborative relationships between



Workshop participants observing an at-grade crossing. Source: U.S. DOT

Cambodia, Lao People's Democratic Republic (PDR), Myanmar, Thailand, and Vietnam with expertise provided by the United States. The East-West regional connectivity technical assistance and capacity building program is focused on regional corridor planning processes and aims to advance a more transparent, cohesive, and sustainable approach to localized transportation planning, infrastructure development, and maintenance through workshops and collaborative activities.

Thailand is a key partner in this effort due to its prominence in regional corridor networks and their strategic approach to shift freight traffic from road to rail. Aligning transportation needs to modes will better support key regional priorities by reducing wear on roadway networks, improving road safety, and streamlining cross-border commerce.

Under the East-West regional connectivity program, U.S. DOT and FRA experts conducted a rail grade crossing safety workshop in Thailand in March 2023, with more than 40 Thai officials from the Ministry of Transport (MOT), Department of Rail Transport (DRT), Rail Technology Research and Development Agency (RTRDA), Office of Transport and Traffic Policy and Planning (OTP), and the State Railway of Thailand (SRT). In cooperation with OST-X, Volpe Center staff developed the workshop agenda, collaborated with FRA experts to develop workshop content, provided on-the-ground logistical support, and facilitated workshop sessions. The workshop was part of a broader technical assistance and capacity building program the Volpe Center helped develop after a multiyear research, stakeholder engagement, and gap analysis effort. The Volpe Center was asked to support this work based on its expertise and knowledge of the overall program and the Mekong region. Additionally, OST-X partnered with FRA for this workshop, and FRA had previous experience working with Volpe Center staff on the selected topics.

The workshop included presentations on grade crossing safety countermeasures, data-driven decision-making, innovative research approaches, modeling and simulation, and education and outreach. Participants also visited five local grade crossings to observe safety challenges and discuss

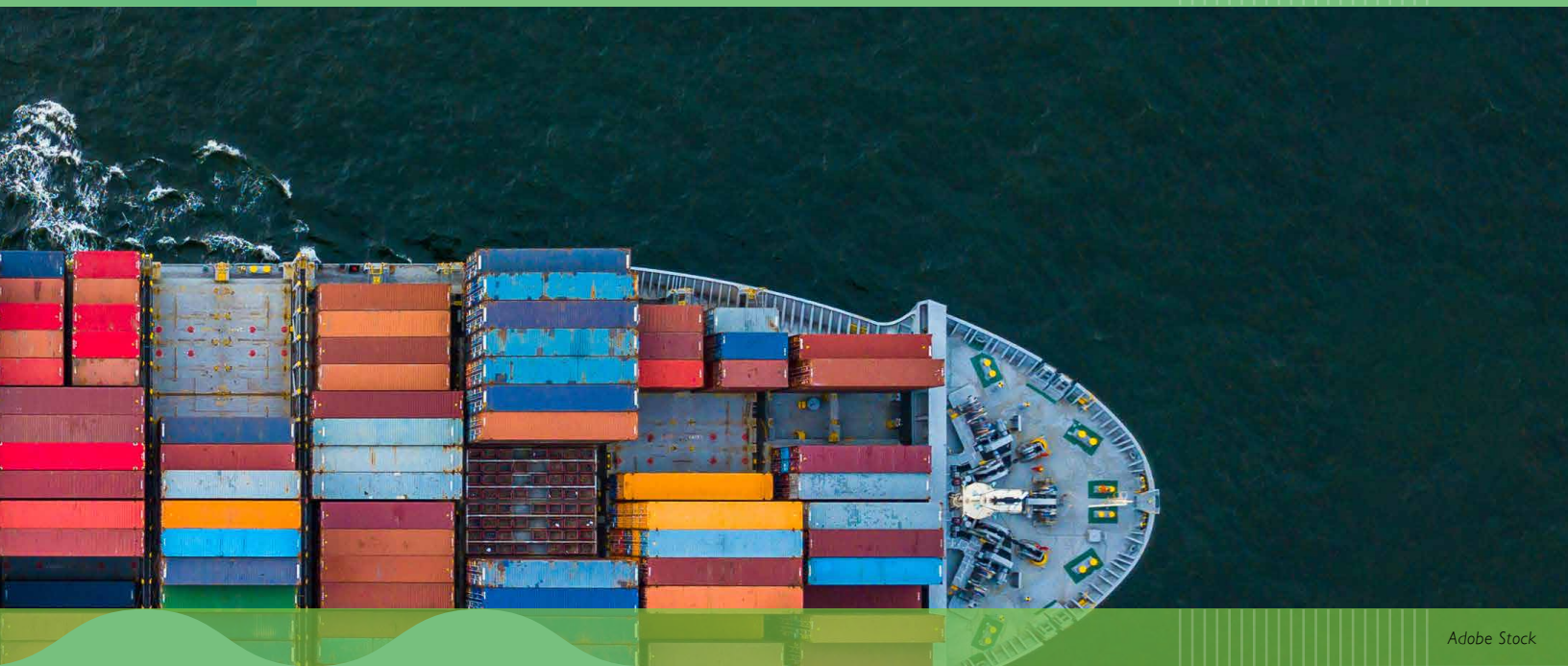
potential countermeasures to improve safety. The workshop set the groundwork for follow-on engagement with MOT, including virtual workshops and site visits to the United States.

With 2,975 railway crossings, including 626 illegal crossings and 1,510 at-grade crossings, Thailand was the primary benefactor of this workshop. From 2015–2021, 455 accidents occurred at railway crossings, resulting in 401 injuries and 163 fatalities. Workshop participants were able to apply safety countermeasures at existing and new railway crossings to reduce injuries and fatalities.

The workshop was just one component of a two-year technical assistance and capacity building program that runs through September 2024. Other recent activities included a two-day workshop held in June 2023 that focused on public-private partnerships and attracting foreign investment in Vientiane, Laos, as well as a webinar with Lao officials on strategies for promoting mode shift.

(Sponsor: Office of the Secretary of Transportation, Office of International Transportation and Trade)

Infrastructure, Economic Strength, and Global Competitiveness



Adobe Stock

With its broad range of multimodal, multidisciplinary expertise from engineering to economic analysis, the U.S. DOT Volpe Center works across all modes and federal agencies to support critical transportation modernization programs and initiatives focused on growing an inclusive and sustainable economy.

MULTIMODAL

Introducing the New U.S. DOT Project Delivery Center of Excellence

The Biden-Harris Administration's [Action Plan for Accelerating Infrastructure](#) outlines specific steps toward keeping infrastructure projects on time, on task, and on budget. One of the highlights of this plan included the announcement that U.S. DOT will launch a Project Delivery Center of Excellence (COE) at the U.S. DOT Volpe Center to support and educate recipients of federal funds—transportation infrastructure project managers in state, tribal, local, regional, and territorial governments—in delivering transportation infrastructure projects more efficiently and effectively from concept to completion.

In July 2023, U.S. Secretary of Transportation Pete Buttigieg launched the new U.S. DOT Project Delivery COE's thought leadership series on Delivering the Benefits of the Bipartisan Infrastructure Law (BIL). The series was designed for [BIL](#) project sponsors and other members of the transportation enterprise working hard to help deliver infrastructure projects. You can learn more about the series in the thought leadership chapter at the end of this publication.

At the same time, the new Project Delivery COE also launched a new online [Project Delivery Toolbox](#)—a collection of resources and best practices across U.S. DOT to help those delivering infrastructure projects to successfully implement their construction project—on time, on task, on budget. The toolbox is designed to help navigate the different components of project delivery including: public engagement, environmental considerations, equity considerations, project management, financing, and pre-construction considerations.

The BIL makes historic investments in transportation and infrastructure development to improve public safety and resilience, create jobs across the country, and deliver a more equitable future. The historic levels of investment require an equal investment of time and energy in ensuring efficient and effective project delivery.

Delivering transportation infrastructure projects on time and on budget requires keeping projects on task at the earliest phases, such as the permitting, design, and public engagement processes. Getting the pre-implementation phase right is essential to keeping projects on time and on budget, as resolving issues early prevents later—and more expensive—disruptions. It also presents the opportunity to create projects that reflect U.S. DOT's priorities, such as equity, resilience, and access to good jobs.

The new COE will serve as a central resource for innovative and effective practices and bring project managers together to enable knowledge sharing and peer-to-peer learning. The U.S. DOT Volpe Center is drawing upon its multimodal, multidisciplinary expertise to advance U.S. DOT's key



priorities to improve our transportation system. The Project Delivery COE will be uniquely informed by the U.S. DOT Volpe Center’s more than 50 years of advancing transportation innovation for the public good. (Sponsor: U.S. DOT/OST)

HIGHWAY

Bridge Investment Program Benefit-Cost Analysis Tool

The Infrastructure Investment and Jobs Act, commonly referred to as the Bipartisan Infrastructure Law (BIL), was signed into law by President Biden in November 2021. BIL provides \$550 billion in investment funding for infrastructure improvements, including roads, bridges, mass transit, water infrastructure, climate resilience, and expanded broadband. Many new competitive grant programs established by BIL require a benefit-cost analysis (BCA) for submitted infrastructure projects to help U.S. DOT determine which of them will be a cost-effective use of federal funding.

The Bridge Improvement Program (BIP) is a new federal initiative created under BIL, a discretionary grant program that provides competitive funding for replacement, rehabilitation, preservation, and protection of bridges. As with other programs, applications for BIP discretionary grant funding require a BCA.

The Federal Highway Administration (FHWA) asked a team of experienced Volpe Center economists to assist in developing a BIL-mandated spreadsheet template that would allow future applicants to

Table 1. Bridge Variables	
Bridge Variables	Bridge Values
State	mystate
County	mycounty
Structure Number	001
Inventory Route	00000
Feature Intersected	Example Roadway'
Facility Carried	Example Route'
Latitude	00° 00' 00.00"

The Bridge and Project Overview tab of the BIP BCA Excel workbook, which shows 1) macro buttons for adding a new bridge, and 2) Table 1 Bridge Variables of the workbook, which includes various National Bridge Inventory (NBI) data elements. Source: U.S. DOT Volpe Center

more easily submit BCAs for bridge rehabilitation and reconstruction projects. As specified in BIL, this template should provide applicants with a tool to summarize project needs and benefits and enable them to use data from the National Bridge Inventory.

The Volpe Center was the primary developer of all aspects of the Excel-based BIP Benefit-Cost Analysis Tool. The Volpe Center team leveraged its previous experience in developing decision support tools, as well as extensive experience as BCA reviewers to develop a new tool that will reduce the burden on both applicants and reviewers for the BIP.

A Volpe Center team designed the tool to allow applicants to complete an independent BCA for each bridge when projects are bundled. The tool provides a simple solution for agencies to leverage the BCA-relevant National Bridge Inventory data for their project bridges. Additionally, the tool gives them access to National Bridge Inventory Analysis System forecasts of condition rating and forecasts of load posting and closures.

This project aligns with DOT's priorities around safety and economic strength as the Excel tool supports applicants in securing funding to address safety and other issues for critical bridge infrastructure and improves economic strength by avoiding significant delays and other impacts due to disrepair.

Prior to its public release and as part of the development process, FHWA staff used the tool to review all applicant BCAs for the fiscal year (FY) 2022 BIP grant reviews. The tool was released publicly in conjunction with the opening of a rolling Notice of Funding Opportunity for the Large Bridge Project portion of the BIP on September 27, 2023. (*Sponsor: FHWA Office of Transportation Policy*)

AVIATION

Fire Protection and Life Safety System Infrastructure in National Airspace System Facilities

The Federal Aviation Administration's (FAA) Air Traffic Organization is responsible for the effective lifecycle management of the fire protection and life safety system infrastructure in National Airspace System (NAS) facilities.²¹ The ultimate goal of this partnership is to protect FAA employees and property, preserve the continuity of the NAS, and ensure the safety of the flying public. For more than 20 years, FAA has partnered with the U.S. DOT Volpe Center's engineering experts and their contractor specialists to assess existing facilities and their fire protection and life safety systems (FPLS) and improve their resiliency.

21 Fire protection systems involve fire sprinklers, fire alarms, smoke control systems, fire walls and barriers, and the like. Life safety systems are operational—for example, assurance of safe and appropriately sized egress paths, emergency evacuation protocols, and regular training drills.

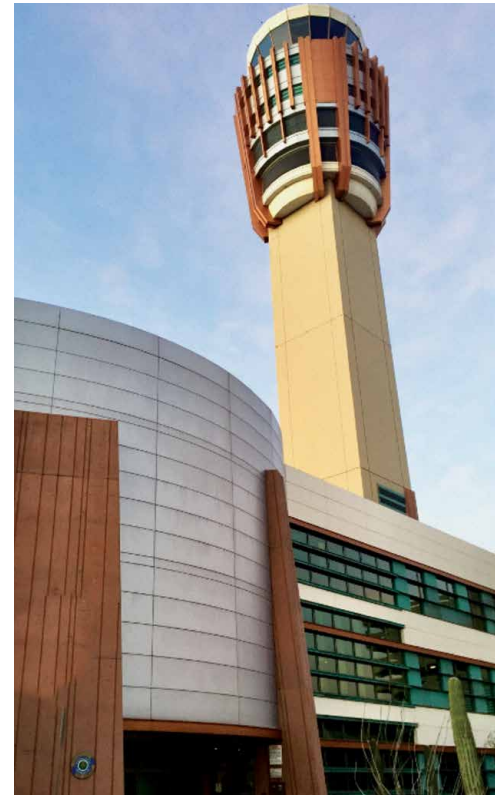
Since 2019, the Volpe Center has contributed to the upgrade and replacement of numerous NAS airport traffic control towers (ATCT), terminal radar approach control (TRACON) facilities, and air route traffic control centers (ARTCC). A Volpe team develops FPLS requirements and ensures compliance with codes and standards. Volpe provides technical expertise on the development and third-party review of fire protection and life safety system designs and upgrades; analyses of building and system codes; quality assurance and quality control services during installation; development of standard FPLS requirements for future facilities; and quick response when unexpected technical issues arise in the field.

The Volpe Center's work at the Phoenix Sky Harbor International Airport (PHX) is a good illustration of its upgrade capabilities. In 2018, FAA performed an investigation of the automatic fire sprinkler system at the PHX-P50 ATCT and TRACON facility. Site personnel described a history of water leaks from the automatic fire sprinkler system and unplanned failures as a result of corrosion within the piping system, in part due to the hard water quality in the Phoenix area.

Due to the facility's importance and the observed levels of piping corrosion, the Volpe Center and FAA agreed that complete replacement of the facility's fire sprinkler system, plus inclusion of corrosion protection measures, would offer the least risk over time. The project was split into two successive phases. In 2020, the Volpe team designed a sprinkler system replacement and fire/life safety upgrade package for the ATCT, now under construction.

In August 2023, the Volpe Center performed a 100 percent final verification site visit to confirm the design elements and details for the TRACON's sprinkler system replacement and fire/life safety upgrade. The 100 percent final engineering design package was completed in November 2023. When construction begins, the Volpe team will review contractor shop drawings and submittal packages, perform quality assurance/quality control during installation, and will participate in commissioning of the replacement system, bringing the new system into service, testing in accordance with all of the required codes and standards, and making sure everything works properly.

The Volpe Center is also providing FPLS subject matter expertise for the new ATCT to be built in Anchorage, Alaska; and for the new Sustainable Tower Design that is to be built at 30 locations as part of the Bipartition Infrastructure Law-funded ATCT replacement program. The Volpe team developed the Fire Protection and Life Safety chapter of the FAA Terminal Facilities Design Standard (TFDS), published internally in 2021. This standard "establishes design standards and technical criteria to be used in the programming, design, construction, measurement and verification, and documentation of new construction of ATCTs, TRACON facilities..., and associated structures. TFDS is the current mandatory standard for FAA ATCT and TRACON facility design, providing requirements that are above and beyond normal building codes. The Volpe Center also developed FAA-specific standard construction specifications for fire protection and life safety. Designs for new ATCTs are required to follow this standard, including the fire protection and life safety system requirements.



Phoenix Sky Harbor Airport Traffic Control Tower and Terminal Radar Approach Control facility. Source: U.S. DOT Volpe Center

The Anchorage ATCT design is currently at the 70-percent design review stage. The Sustainable Tower Design, as part of the Bipartisan Infrastructure Law-funded ATCT replacement program, is currently at the 45-percent design review stage; the Volpe Center will continue to provide FPLS input as the designs mature. The Volpe Center's involvement in these projects, and in the PHX-P50 TRACON sprinkler system replacement, will continue into 2024. (*Sponsor: FAA*)

MARITIME

Strengthening the Nation's Maritime Infrastructure

The nation's economy and security require a modern and fully integrated marine transportation system and shipbuilding industrial base to move freight quickly, efficiently, and safely. Modern port infrastructure, a solid U.S. shipbuilding and repair base, and an efficient network of accessible waterways are the underpinnings of that system. The U.S. DOT Volpe Center is supporting the Maritime Administration (MARAD) in its efforts to work with the nation's port operators, cargo carriers, shippers, and shipbuilders to ensure a functional, robust, and profitable maritime industry is available.

The Volpe Center assists MARAD in administering a number of discretionary grant programs for this purpose. Through the Port Infrastructure Development Program (PIDP), MARAD awards funds to projects that improve the safety, efficiency, or reliability of the movement of goods into, out of, around, or within a port.²² The America's Marine Highway (AMH) grant program under the U.S. Marine Highway Program (USMHP) makes grants available to previously designated Marine Highway Projects that support the development and expansion of documented vessels or port and landside infrastructure.²³ MARAD manages the maritime aspects of the following U.S. DOT grants:

- The Rebuilding American Infrastructure with Sustainability and Equity (RAISE) program, which enables U.S. DOT to invest in road, rail, transit, and port projects that promise to achieve national objectives.²⁴
- The Nationally Significant Multimodal Freight & Highway Projects (INFRA) program, which awards competitive grants for multimodal freight and highway projects of national or regional significance to improve the safety, efficiency, and reliability of the movement of freight and people in and across rural and urban areas.²⁵

Passage of the Bipartisan Infrastructure Law (BIL) greatly increased the number and size of MARAD grant awards to be made in fiscal years 2022 through 2026. For the PIDP, BIL appropriated \$2 billion over five years—roughly the same amount that was invested in ports by all U.S. DOT grant

22 U.S. DOT Maritime Administration. (2023). Port Infrastructure Development Program. [Online]. Available: <https://www.maritime.dot.gov/PIDPgrants>. October 30, 2023.

23 Federal Register. (2023). Notice of Funding Opportunity for America's Marine Highway Projects. [Online]. Available: <https://www.federal-register.gov/documents/2022/03/04/2022-04599/notice-of-funding-opportunity-for-americas-marine-highway-projects>. October 30, 2023.

24 The Better Utilizing Investments to Leverage Development (BUILD) and Transportation Investment Generating Economic Recovery (TIGER) Discretionary Grant programs have been merged into this new program. (See <https://www.transportation.gov/RAISEgrants/about>.)

25 U.S. DOT. (2023). The INFRA Grant Program. [Online]. Available: <https://www.transportation.gov/grants/infra-grant-program>. October 30, 2023.

programs since the U.S. DOT began the practice with the 2009 Recovery Act. From its establishment in 2010 through fiscal year 2022, USMHP awarded 56 grants totaling \$91 million to 32 projects; \$12.4 million is available for FY23, including \$10 million in FY23 appropriations and \$2.4 million from unexpended funds.²⁶ These expanded grant programs increased the managerial and administrative workload on MARAD. In spring 2022, MARAD turned to the Volpe Center for support in both grant application technical evaluation and administration of awarded grants. Because of the complexity of the grant-funded projects, the Volpe Center assembled a team consisting of engineering, project management, finance, and NEPA compliance specialists to support MARAD's programs and provide critical evaluation and oversight skills.

In fiscal year 2023, four Volpe Center specialists contributed to MARAD's PIDP evaluation team, reviewing more than 100 applications competing for up to \$662,203,512 in authorized funding. MARAD's desire for the Volpe Center's expertise in application evaluation is expected to continue in the coming years.

Grant monitoring regulations require grantees to submit financial reports, progress reports, and certification statements each quarter. Volpe Center grant management specialists and engineers support MARAD by providing the first level of review of these documents. Volpe Center support staff also review invoices, project reports, and engineering diagrams, and provide input to the responsible MARAD grant manager/engineer. Volpe engineers also perform on-site monitoring activities.

MARAD will continue to rely on the Volpe Center's expertise and skilled support for a subset of the many additional grant awards made in fiscal years 2021-2023, and those expected to be announced in future years. (*Sponsor: MARAD Office of Port Infrastructure Development*)

Expanding Panama's Maritime Domain Awareness to Increase Drug Interdiction Capability

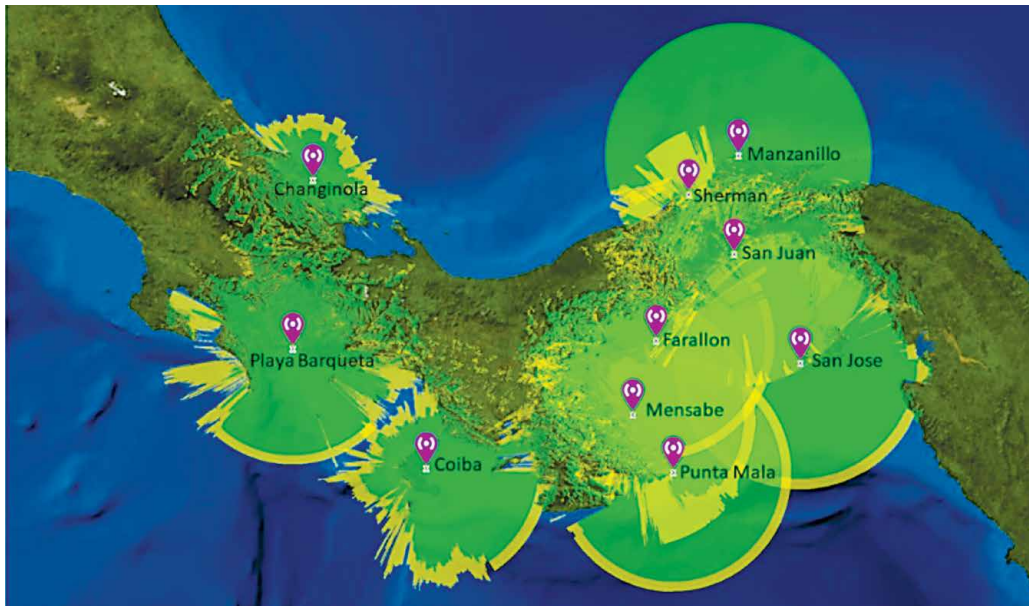
Panama is a major transit country for illicit contraband and narcotics destined for the United States, and is a geographic focal point for northward-bound cocaine from South America. Transnational criminal organizations use Panama's Caribbean and Pacific waters to traffic illegal drugs from South America to Central America, and ultimately to the United States. Criminal organizations from around the world also take advantage of the massive volume of shipping containers through the Panama Canal to smuggle drugs and contraband to destinations globally.²⁷

Since 2006, the U.S. DOT Volpe Center has supported the Department of Defense in improving global maritime domain awareness (MDA)²⁸ by developing, operating, and expanding the Maritime

26 U.S. DOT. (2023). USDOT Announces more than \$12 Million in Funding for the U.S. Marine Highway Program. [Online]. Available: <https://www.transportation.gov/briefing-room/usdot-announces-more-12-million-funding-us-marine-highway-program>. October 30, 2023.

27 U.S. Department of State. (2023). Bureau of International Narcotics and Law Enforcement Affairs: Panama Summary. [Online]. Available: <https://www.state.gov/bureau-of-international-narcotics-and-law-enforcement-affairs-work-by-country/panama-summary/>. October 31, 2023.

28 Maritime domain awareness is the effective understanding by a responsible national entity of anything associated with the global maritime domain that could impact that nation's security, safety, economy, or environment.



AIS station installations in Panama. Source: U.S. DOT Volpe Center

Safety and Security Information System (MSSIS) automatic identification system²⁹ (AIS) data-sharing network.³⁰ MDA is crucial to detecting illicit vessel activity within a nation’s territorial waters; historically, Panama’s MDA capability has been limited, and earlier attempts to improve it were unsuccessful. MSSIS is a low-cost, near-real-time application that relies on data from over 80 participating countries. It serves as an invaluable coastal surveillance tool in fighting drug smuggling, human trafficking, piracy, and global terrorism.

In January 2020, the Department of State Bureau of International Narcotics and Law Enforcement Affairs asked the Volpe Center to work with the Panama National Air and Naval Service (SENAN) to improve Panama’s MDA capabilities. The Volpe Center assessed prospective station sites for feasibility and maximum capability; installed AIS at 10 stations along Panama’s coasts; networked Panama into MSSIS; and enabled Panamanian access to SeaVision.

A team of Volpe Center engineers completed a project in 2023 to substantially expand Panama’s MDA capability, improving the country’s ability to interdict the transport of U.S.-bound narcotics. Despite the unexpected logistical constraints imposed by the COVID-19 pandemic, the Volpe Center completed the project with less than one year of delay due to agility in adapting plans to the unique conditions.

The Volpe team completed installation of temporary AIS equipment at Cerro San Juan, which immediately began transmitting data to the Regional Center for Aeronaval Operations located at SENAN’s General Command Base at Cocoli on the West Bank of the Panama Canal. This data is sent to MSSIS, giving SENAN access to SeaVision now that Panama is a member of the participant community.

29 AIS allows the automatic exchange of real-time vessel movement data, including static and voyage-related information, between ships and between ships and shore stations. When coupled with radar, AIS provides a near-complete operating picture of the maritime domain.

30 MSSIS integrates the AIS data from participating countries into a single data stream through secure, Internet-based servers. The Volpe Center provides Transview (TV32), a Microsoft Windows-based application, to access the MSSIS network. SeaVision, the U.S. Navy’s MDA web portal, visualizes MSSIS data and provides advanced capabilities for analysis of maritime traffic.

The Volpe team procured and readied equipment for remaining sites in Panama over the course of 2022. In January 2023, Volpe’s installation of AIS equipment and site augmentations brought Isla San Jose and Isla Coiba into the system.³¹ Finally, in spring 2023, the Volpe Center completed, tested, and performed final configurations for the last two AIS sites.

An early post-completion report from Panama’s National Intelligence Directorate conveys the evident promise of the improvement in MDA: “As of June 2023, using the AIS system, six missions have been carried out and 2,061 packages of illicit substances have been seized.”³² (*Sponsor: Department of State Bureau of International Narcotics and Law Enforcement Affairs*)

Evaluating the Availability of Federal Financial Assistance for Merchant Mariner Training

At the direction of Congress (P.L. 116–283, Section 3508(c)), the Maritime Administration (MARAD) undertook a study to assess the adequacy and accessibility of federal financial assistance available for the training of United States merchant mariners, including those seeking limited credentials. The work was to be performed in consultation with the Departments of Labor, Education, and Veterans Affairs. MARAD asked the Volpe Center to serve as the principal investigator and author of the study, because of its considerable experience and knowledge of the state of the U.S. Merchant Marine and of mariner training and education requirements.

In support of MARAD’s mandate, the U.S. DOT Volpe Center team conducted extensive research into federal financial assistance programs, as well as State programs funded through federal appropriations. First, the Volpe team identified federal programs available to fund education and training for a variety of U.S. Coast Guard-issued Merchant Mariner Credentials, including those for service in domestic waters and those for international service.³³

Second, the study investigated whether any inherent barriers limit certain individuals’ access to specific federal financial assistance programs for mariner education and training. Finally, the study considered whether the choice of a credentialing path—such as a four-year college program at a maritime academy or a part-time program at a career school or maritime training center—affected access to federal programs.

The report presented a detailed description of the various credentialing paths available to merchant mariners. An extensive inventory was created of over 300 public, private, and not-for-profit institutions offering mariner education and training, including four-year college-based programs, supplemental and refresher training programs, and institutions offering individual training courses.

31 Because of their offshore locations, San Jose needed a signal repeater; Coiba, which lacks the cell telephone service used at the other sites, required a microwave link to connect the NIU to the server at Cocoli.

32 Data from the National Intelligence Directorate.

33 House Report 116-452 Departments of Transportation, and Housing and Urban Development, and Related Agencies Appropriations Bill of 2021. July 16, 2020. Available: <https://www.congress.gov/congressional-report/116th-congress/house-report/452>.

The Volpe Center identified nearly 40 different federal aid programs, principally in the Departments of Labor, Education, and Veterans Affairs, that provide \$127 billion annually for education and training (not limited to mariners) through direct funding, grants, and/or loan subsidies. Other federal agencies, such as the Department of Defense and the Department of Transportation, offer programs that provide support specifically for mariner education.



The programs are variously available for college-level programs, career and technical schools, and other career paths. Veterans and their dependents, youth entering the workforce, displaced workers, and disadvantaged individuals or those eligible for and utilizing public assistance programs are included among eligible applicants.

U.S. Merchant Marine Academy students prepare for their annual U.S. Coast Guard exams. Source: U.S. Merchant Marine Academy

Overall, the study found that federal financial assistance for mariner education and training appears to be adequate for some credentialing paths but inadequate for others. Notably:

- There is limited access to federal financial assistance programs for individuals pursuing a maritime credential through a path other than a full-time college, university, or maritime academy program (e.g., pursuing a limited credential through a maritime training center or a proprietary nautical school).
- Federal financial assistance is generally not available for individuals who need education or training to renew or advance an existing mariner credential.

The study offers three principal recommendations:

1. Strengthen awareness and access to existing federal financial aid resources and career development programs through a better coordinated, all-of-government approach to integrating and sharing information.
2. Promote MARAD's Centers of Excellence for Domestic Maritime Workforce Training and Education program. Initiated in 2021, this program targets institutions that focus on the training and education of mariners for service in the domestic coastwise and inland maritime industry.
3. Promote and strengthen the Military to Mariner (M2M) program, a multi-agency effort initiated by the Committee on the Marine Transportation System in 2014, to facilitate the accession of military veterans into the merchant mariner profession. Many veterans have a wide range of maritime technical, logistical, and leadership experiences.

The study report was published on the MARAD website in February 2023.³⁴ (Sponsor: MARAD)

³⁴ U.S. DOT Maritime Administration. (2023). Evaluating the Availability of Federal Financial Assistance for Merchant Mariner Training. [Online] Available: <https://www.maritime.dot.gov/education/evaluating-availability-federal-financial-assistance-merchant-mariner-training>.

POSITIONING, NAVIGATION, AND TIMING

MARAD and FRA Pilot Projects Address Positioning, Navigation, and Timing (PNT) Resilience

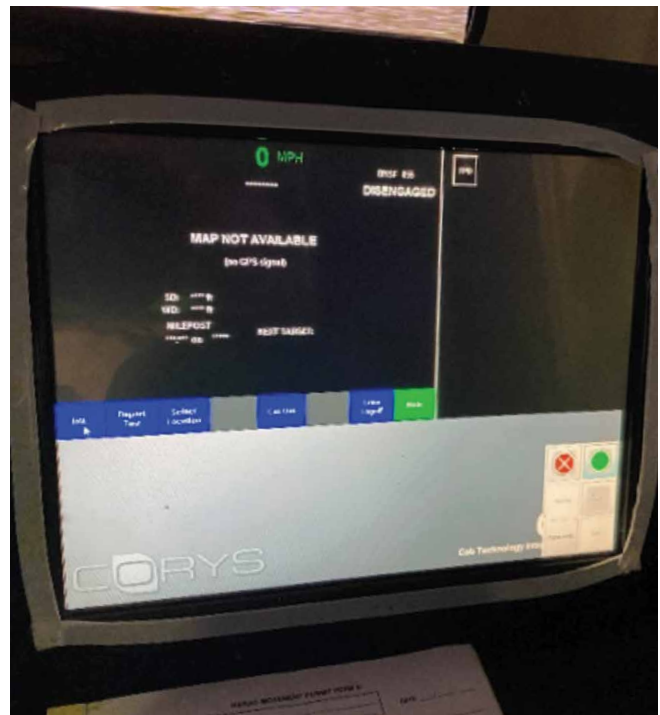
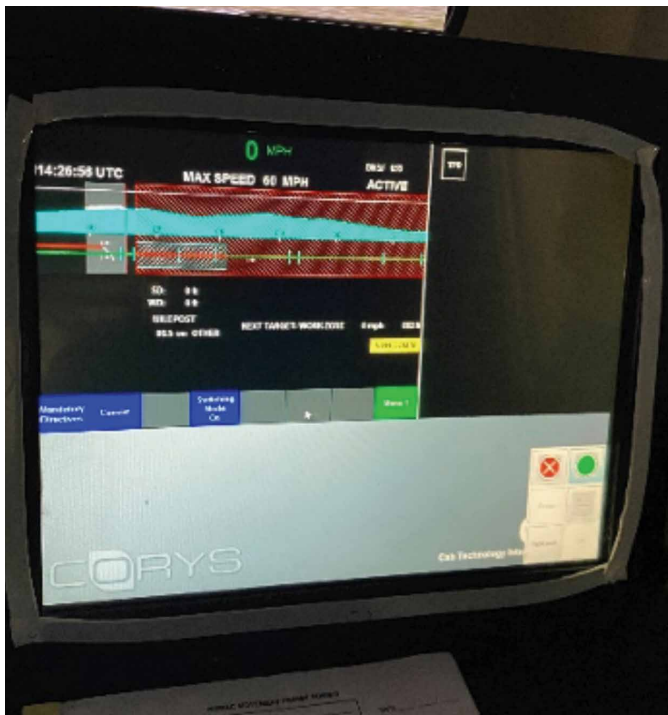
Positioning, Navigation, and Timing (PNT) services support critical infrastructure across the United States—communications, energy, finance, information systems, and transportation—to sustain national and economic security. The primary and most recognizable PNT service supporting critical infrastructure in the U.S. is the Global Positioning System (GPS). However, because GPS relies on signals broadcast from a constellation of satellites in medium Earth orbit, signal strength at the user receiver is low and vulnerable to intentional and unintentional disruptions.

Intentional and unintentional disruption across the globe continually threatens the civil and commercial use of GPS in various ways. In January 2022, the Denver, Colorado, metro area experienced widespread disruption of GPS signal reception that impacted multiple critical infrastructures, including rail PNT services, for a 33-hour period.³⁵ Reports of GPS radio frequency interference (jamming) from commercial air pilots flying into and out of airports in the Middle East have increased 2,000 percent since 2018.³⁶ From 2016–2018, GPS signals in 20 cargo ships navigating in the Black Sea

PTC in-cab display of track conditions ahead. Left: PTC in normal operation. The system is alerting the engineer of the need to slow down the train due to a work zone ahead. Right: PTC failure due to loss of GPS signal. Source: Volpe Center's CAB Technology Integration Laboratory (CTIL)

35 "Global Positioning System (GPS) Interference," CISA Insights, December 2022. https://www.cisa.gov/sites/default/files/publications/CI-SA-Insights_GPS-Interference_508.pdf

36 Ops Group. (2023). GPS Outages: The Hotspots. [Online]. Available: <https://ops.group/blog/gps-outages-the-hotspots/>. August 9, 2023.



were spoofed to show the ship's position as inland at a Russian airport.^{37,38} Further, natural and man-made obstructions to GPS signals, including urban canyons and mountainous terrain, impact the reliable operation of safety technology used for railroad, transit, and highway systems.

Per Executive Order 13905, Strengthening National Resilience Through Responsible Use of Positioning, Navigation, and Timing Services, "It is the policy of the United States to ensure that disruption or manipulation of PNT services does not undermine the reliable and efficient functioning of its critical infrastructure." U.S. DOT's Office of the Assistant Secretary for Research and Technology (OST-R) sponsored the U.S. DOT Volpe Center's PNT subject matter experts to undertake a pilot program to identify and recommend resilient PNT solutions for mitigating the impact of disruptions on civil and commercial sea and rail transportation. The Volpe team was asked to develop a risk management framework for systems, assets, and networks that depend on PNT service by:

- 1) Identifying equipment receiving or generating PNT data, and assets dependent on PNT services via stakeholder engagement and equipment inventories;
- 2) Detecting the disruption and manipulation of PNT services, in actual and simulated environments, through testing PNT system equipment;
- 3) Identifying protection equipment and complementary PNT technologies capable of mitigating risk to the modal systems; and
- 4) Sharing the framework with key stakeholders.

In Phase I of the U.S. DOT Maritime Administration (MARAD) pilot project, the Volpe team surveyed the radio frequency environment of a Ready Reserve Force (RRF) vessel during late summer 2021 to determine benign sources of GPS interference in port and at sea. The team later participated in a GPS-jamming and -spoofing exercise executed by the Department of Homeland Security. During this exercise, the vessel's GPS receiver was found to have dropped valid GPS signals and was captured by false signals, resulting in varying deviations between the vessel's reported position and its true position. The receiver provided little or no indication it had been captured by the spoofed signals. The Volpe team investigated the use of commercial off-the-shelf anti-jamming GPS antennas which, in the same exercise, greatly minimized the position deviation.

Additionally, a commercial satellite navigation source was tested as a complementary PNT service technology to assist with navigation in cases of GPS jamming and spoofing. The Volpe Center is now applying the lessons of Phase I to the second phase of this effort. The Volpe team installed protective equipment aboard a MARAD RRF vessel, which is currently on an operational deployment. This will allow the team to determine PNT performance in real-world conditions.

The maritime PNT pilot led to the initiation of a parallel effort in rail applications. Commercial freight rail safety relies on Positive Train Control (PTC) technology, which is designed to prevent train-to-train collisions, overspeed derailments, incursions into established work zones, and

37 GPS spoofing involves a radio transmitter near a target that interferes with the actual GPS signals being transmitted. GPS signals are often weak and transmitted through satellites. A stronger radio transmitter can be used to override the weaker signal and send illegitimate coordinates and information to the receiver. <https://www.okta.com/identity-101/gps-spoofing/#:~:text=GPS%20spoofing%20involves%20a%20radio,and%20information%20to%20the%20receiver>; accessed 07/03/2023, 3:13 p.m.

38 NewScientist. (2023). Ships fooled in GPS spoofing attack suggest Russian cyberweapon. [Online]. Available: <https://www.newscientist.com/article/2143499-ships-fooled-in-gps-spoofing-attack-suggest-russian-cyberweapon/>. August 9, 2023.

movements of trains through switches left in the wrong position.³⁹ The PTC system used by Amtrak and freight rail operators combines GPS and other data sources for the determination of a given train's precise location on a track. The dependence of PTC on GPS results in its vulnerability to jamming and spoofing events similar to those measured during the MARAD project.

Volpe Center engineers are presently engaged in the first step of the process to develop a Federal Railroad Administration (FRA) risk management framework by conferring with stakeholders from government, industry, and professional organizations to learn about rail-specific PTC vulnerabilities and identify potentially applicable solutions. Phase I of the FRA effort will work with an intercity passenger railroad to design and execute testing of PTC components and systems relating to GPS reliability and vulnerabilities (*Sponsor: OST-R*)

Ensuring a Smooth Civilian Transition to the GPS Next-Generation Operational Control System

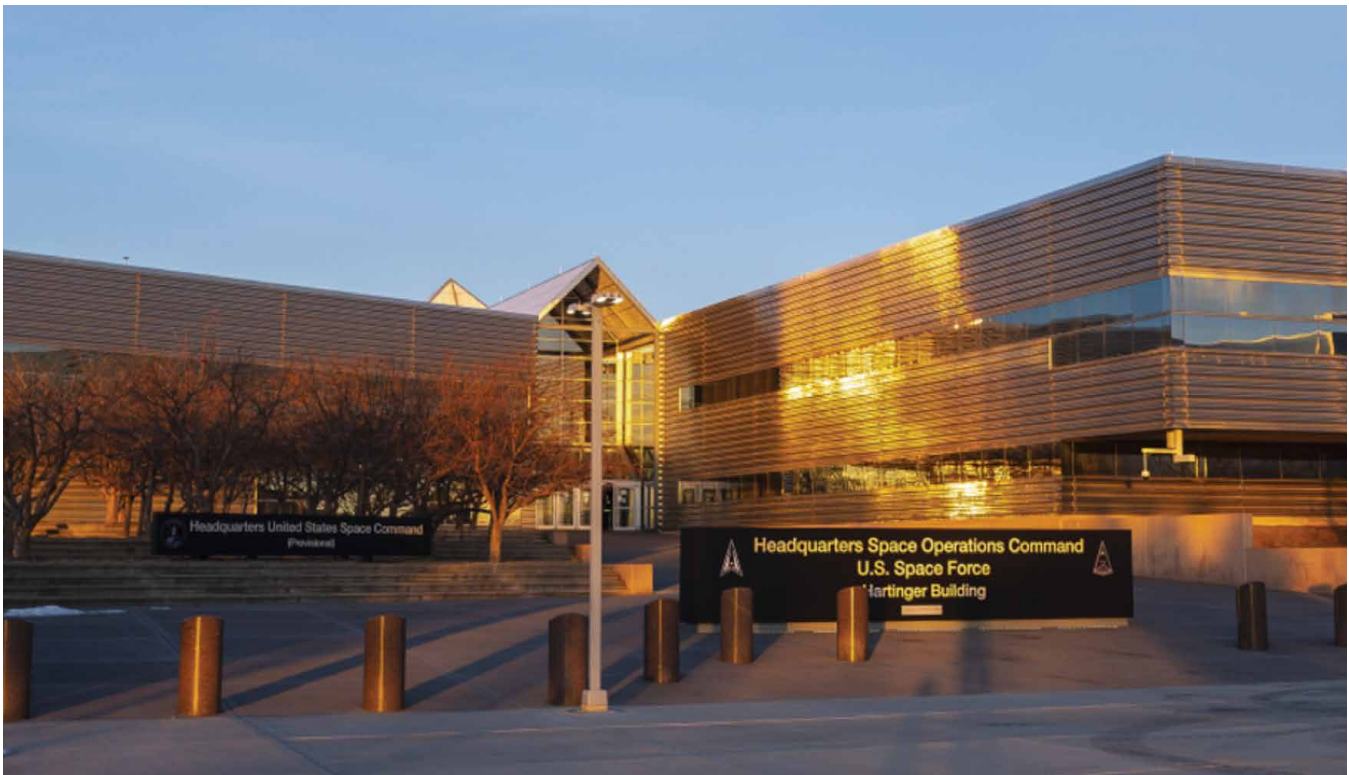
The Global Positioning System (GPS) is an integral part of everyday American life and is an essential element of the nation's economic infrastructure. Since 1986, the U.S. DOT has served as the lead agency within the U.S. government on issues of GPS-related civil (non-military) requirements and use. Because of the significance of the U.S. DOT's GPS responsibilities, the U.S. DOT Office of the Assistant Secretary for Research and Technology (OST-R) is directly responsible for interfacing with other federal agencies on their civil GPS needs.

Facilitating a mutual understanding of military and civilian requirements and applications is imperative and is being accomplished by building a relationship that improves daily. To fulfill this goal, the U.S. DOT and the U.S. Space Force (USSF) have a well-established working relationship to deliver space-based PNT services reliably to civil and military GPS users worldwide.

For operational communication and coordination, a U.S. DOT Volpe Center expert, in support of OST-R, serves as DOT's Space Operations Command (SpOC) Liaison, representing the needs and interests of all federal civilian agencies to the Department of Defense (DoD). This position is embedded with the USSF SpOC Command Staff, working with the Positioning, Navigation, and Timing Mission Area Team at Peterson Space Force Base in Colorado Springs, Colorado.

The Next Generation Operational Control System (OCX) is the future iteration of GPS command and control Architecture Evolution Plan (AEP). OCX will command all modernized and legacy GPS satellites, manage all civil and military navigation signals, and provide improved cybersecurity and resilience for the next generation of GPS operations. The OCX transition efforts are fielding the operational capability to control all legacy satellites and existing civil signals (L1, L2C and L5), as well as the GPS III satellites, the modernized civil signal (L1C), and the aviation safety-of-flight signal. In addition, these efforts will field the essential operational capability to control the globally compatible signal.

³⁹ "Positive Train Control (PTC) Study: An Analysis of PTC-Related Reports Submitted to the Confidential Close Call Reporting System (C3RS)." NASA/TM-20210021 | 39, August 2021.

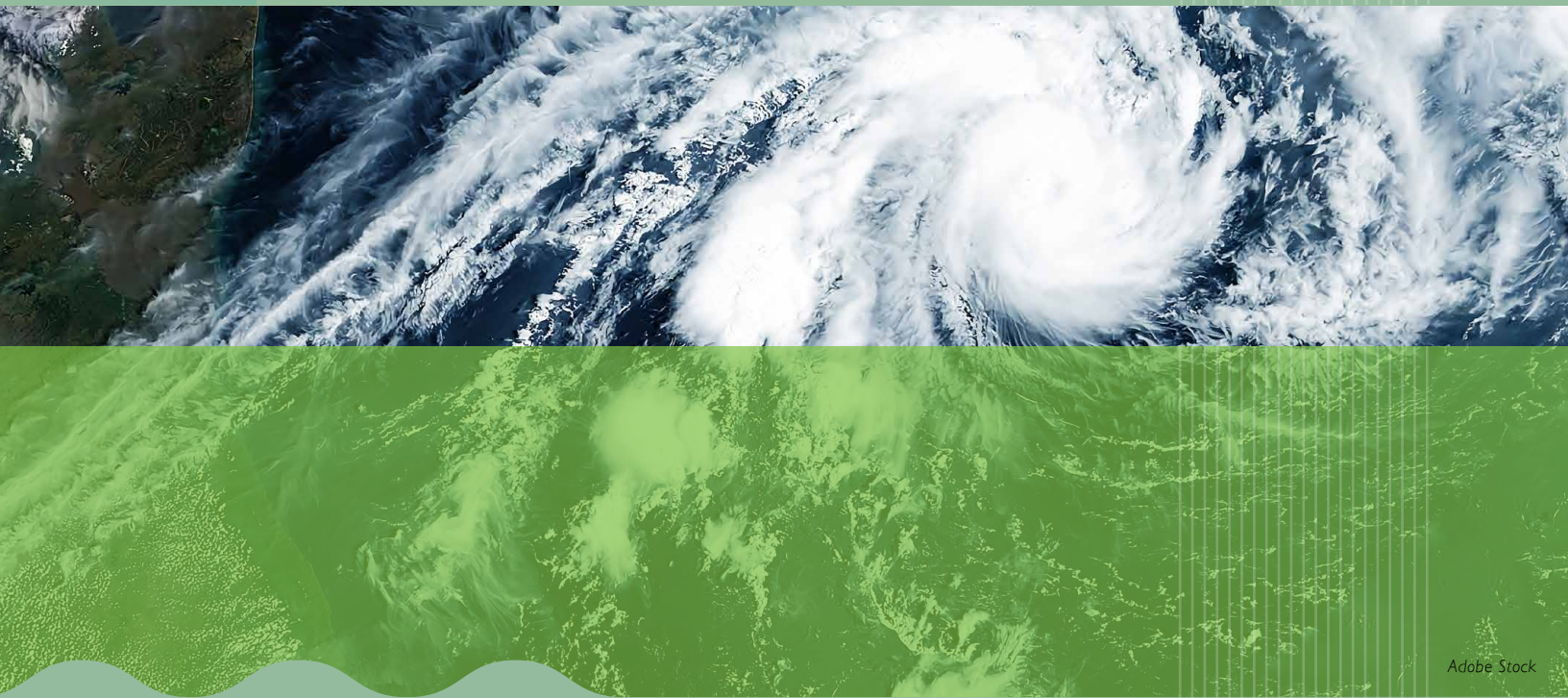


The OCX transition has presented unique hurdles to the civil community. The SpOC Liaison is working with various civilian agencies to identify challenges the civil community may face. The liaison plays a critical role in assuring the civil community is prepared for the transition with little to no impact on the current civil operating environment and that all required tests are completed and transparent to GPS users. The U.S. DOT is currently planning a preliminary 4 Satellite Vehicle (SV) test to help identify any erroneous operations the new OCX may inject into an operational satellite.

Headquarters Space Operations Command Building I located at Peterson Space Force Base, Colorado Springs, Colorado. Source: Headquarters Space Operations Command

Many unknowns and hurdles come with the operational acceptance of a completely new satellite control system. Several challenges have been identified by the U.S. Government Accountability Office's Report to Congressional Committees, including operational capability timelines relative to the current schedule, the operation and monitoring of new GPS civilian signals, and meeting reliability and mission assurance objectives. The U.S. DOT has held working groups to provide solutions to the DoD military community and civilian critical infrastructure agencies that rely on the timing signal from GPS satellites. OCX will provide new and groundbreaking technological advances to the GPS enterprise and much-needed security protocols. The U.S. DOT and its civil agency partners will coordinate with DoD to improve the transition from one system to another to ensure civilian and military users experience no interruptions or errors. (Sponsor: United States Space Force [USSF] HQ Space Operations Command [SpOC])

Resilience, Climate, and Sustainability



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Global transportation infrastructure today is confronted with the escalating threat of climate change. The U.S. DOT Volpe Center is lending key support to federal initiatives to reduce greenhouse gas emissions, build a more sustainable and resilient transportation system, and respond to the disruptive impacts of climate change.

HIGHWAYS

Updating Fuel Economy Standards to Secure Savings at the Pump

Rising fuel costs hurt the economy, disproportionately affecting low-income communities. The lowest-income households in the U.S. spend nearly 20 percent of their income on transportation fuels, which is three times the average U.S. household. Updating the fuel economy standards for passenger cars and light trucks would save Americans hundreds of dollars at the pump, all while making the nation more energy secure and less reliant on foreign oil. On July 28, 2023, the National Highway Traffic Safety Administration (NHTSA) released proposed fuel economy standards which set targets that are consistent with Congress' direction to conserve fuel and promote American energy independence.



The Corporate Average Fuel Economy (CAFE) Compliance and Effects Model, developed and maintained by the U.S. DOT Volpe Center to support NHTSA's rulemakings, calculates fuel savings, emission reductions, compliance costs, and consumer and societal benefits of potential new CAFE standards. NHTSA's proposal includes a 2 percent per year improvement in fuel efficiency for passenger cars, and a 4 percent per year improvement for light trucks, beginning in model year (MY) 2027 and ramping up through MY 2032, potentially reaching an average fleet fuel economy of 58 miles per gallon by 2032.⁴⁰ It also includes a 10 percent improvement per year for commercial pickup trucks and work vans beginning in MY 2030 and ramping up through MY 2035.

Volpe Center analysts were responsible for updating the CAFE Model, developing inputs, and then analyzing the potential regulatory alternatives and documenting the analysis as part of the rulemaking package (i.e., preamble, regulatory impact analysis, technical support document, and environmental impact statement). The Volpe Center, along with NHTSA, continues to coordinate with the Environmental Protection Agency to optimize the effectiveness of its standards while minimizing compliance costs, consistent with applicable statutory factors, and with the Department of Energy in preparation of the final analysis and final rule. A public hearing was held on September 28, 2023, to receive comments on NHTSA's proposal. The Volpe Center is supporting updates to the CAFE Model and analysis to reflect input received during the public comment period, which ended in October 2023.

If finalized, the proposal would provide critical savings at the gas pump for American consumers, while also supporting Congress' goals of conserving energy and promoting American energy independence. *(Sponsor: NHTSA)*

⁴⁰ This is based on preliminary data of a model year 2022 fleet.

RAIL

FRA Climate and Sustainability Program Strategic Plan and Roadmap

U.S. DOT set a target of economy-wide net-zero emissions by 2050 and identified specific research priorities in the areas of decarbonization and sustainable and resilient infrastructure. In alignment, Federal Railroad Administration (FRA) created a new Climate and Sustainability Program, with a key focus on reducing rail's carbon footprint by lowering greenhouse gas (GHG) emissions from the operation, construction, and maintenance of the rail system, and by supporting the expansion of zero-emission power sources for locomotives. FRA's Climate and Sustainability Program Strategic Plan and Roadmap presents FRA's climate and sustainability research strategies for fiscal years 2024 through 2028.

The U.S. DOT Volpe Center, which has supported FRA in the area of air quality for more than two decades, has been the lead drafter of the Strategic Plan and Roadmap, in collaboration with the agency's Office of Railroad Development.⁴¹

The new FRA Climate and Sustainability Program has three primary focus areas:

Focus Area I: Reduce Emissions centers on reducing GHG emissions from the rail sector. The focus is on locomotive emissions, but extends to reducing emissions from maintenance and construction, and to reducing the embodied carbon in materials used in the rail network. Modal shift efforts to increase freight and passenger trips on rail also fall under this program area.

Focus Area II: Resilient Infrastructure is intended to reduce the vulnerability of existing and new rail infrastructure to the impacts of extreme weather, sea-level rise, and natural disasters. The goal of this focus area is to integrate resilience into FRA's programs, including those that fund infrastructure, to ensure federal investment decisions incorporate mitigation of imminent and future climate change-related impacts. In addition, initiatives under this area will focus on developing more information on how the rail network can serve as a critical asset in emergency response, evacuation, and rebuilding activities from climate disasters.

Focus Area III: Sustainable Rail Network presents a variety of activities, including alternative uses for transportation rights-of-way, climate education and workforce development, and analysis of the environmental effects of FRA-funded projects. Additional initiatives include research activities and information gathering into the use of sustainable materials.

The Climate and Sustainability Program and the Strategic Plan and Roadmap originated from the FRA's work to support U.S. DOT's strategic goal of tackling and adapting to the climate crisis, requirements from Executive Orders, statutory requirements, and agency goals. The Volpe

⁴¹ A related project culminated in Volpe's December 2022 report Carbon Dioxide Emissions from Four Real World Inter-City Passenger Trips: A Comparison of Rail, Air, and Road Travel Modes by City Pair (https://railroads.dot.gov/sites/fra.dot.gov/files/2022_12/CO2EmissionsByMode_FinalReport_FRA_12.2.22_PDFa.pdf). The project, a collaboration between Volpe and FRA, highlighted the role that passenger rail can contribute now toward the U.S. DOT reaching its target of economy-wide net-zero emissions by 2050.

Reducing Rail's Carbon Footprint

THE TARGET IS ECONOMY-WIDE NET-ZERO EMISSIONS BY 2050.

The **FRA** has established a new **Climate and Sustainability Program** focused on lowering greenhouse gas (GHG) emissions from the operation, construction, and maintenance of the rail system. A U.S. DOT Volpe Center team has been working in collaboration with FRA to draft FRA's *Climate and Sustainability Plan and Roadmap*.

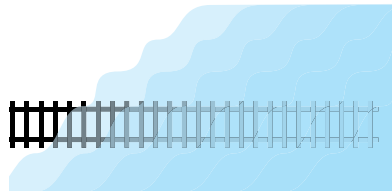
There are **three primary focus areas:**



REDUCE EMISSIONS:

Reduce GHG emissions from the rail sector. Examples:

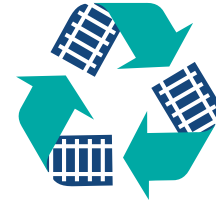
- Locomotives
- Maintenance and Construction
- Embodied Carbon



RESILIENT INFRASTRUCTURE:

Reduce vulnerability of rail infrastructure to the impacts of:

- Extreme Weather
- Sea-Level Rise
- Other Natural Disasters



SUSTAINABLE RAIL NETWORK:

Lessen the rail industry's impact on the environment. Examples:

- Alternative Uses for Rights-of-Way
- Climate Education
- Research and Use Sustainable Materials

01/2024



Center performed a literature review to understand the current state of the rail industry as related to sustainability and resiliency and to catalog related current and proposed research activities. As the information was compared with actions FRA was already taking, new research ideas and potential initiatives began to emerge. Discussion finally centered on how the potential research and new initiatives should be organized strategically within the focus areas and assigned relative priority.

The Volpe Center drew upon its expertise in environmental science and engineering, and knowledge base in the areas of climate change and emissions, to produce a first draft of the Strategic Plan. It provides additional detail on each of the focus areas and its associated initiatives. Under each focus area, the plan describes the state of the practice, identifies actions FRA has already taken to support relevant research activities across FRA offices, and details potential additional actions FRA could take to support the focus area's goals. The Strategic Plan concludes with a roadmap representing FRA's prioritized activities over the near term, and goals for the next five years and beyond. This roadmap will be periodically updated to align with any changes in FRA priorities and as projects are completed or new projects are identified.

The FRA's Climate and Sustainability Program Strategic Plan and Roadmap is under agency review and slated to be completed in January 2024. (*Sponsor: FRA*)



Bicyclists on the Harlem Valley Rail Trail in New York. Source: Amy Plovnick/U.S. DOT Volpe Center

FEDERAL LANDS

Filling the Gap in Trail Climate Resilience Research

Shared-use paths and other trails are key pieces of transportation infrastructure that can provide recreational opportunities, improve health and wellbeing, and become critical infrastructure during an emergency when other transportation facilities are inaccessible. Trails are often vulnerable to impacts from climate change and extreme weather.

Trails are also often overlooked as elements of essential infrastructure for a resilient transportation system. In an internal Federal Highway Administration (FHWA) review of state bicycle and pedestrian plans from October 2021 through March 2022, 24 FHWA Division Offices responded that state plans addressed climate resilience, emissions reduction, or energy use. However, not all of these states provided details about how their plans specifically address climate resilience.

To address this gap, the Volpe Center, in support of the FHWA Recreational Trails Program, conducted a literature review on resilience and emergency response on trails. The Volpe Center team also conducted eight interviews with national trail organizations including the Rails-to-Trails Conservancy, the East Coast Greenway Alliance, the International Mountain Bicycling Association, the Professional TrailBuilders Association, American Trails, and others. The resulting [white paper](#) explores existing research, highlights project examples, and identifies research gaps in connection to climate resilience, emergency response, and public health emergencies. FHWA published the white paper in April 2023.⁴²

Through the literature review and interviews, the Volpe Center discovered there is a lack of information on the topics of climate resilience and emergency response that is specifically geared toward trail

⁴² U.S. DOT FHWA. (2023). Trails and Resilience: Review of the Role of Trails in Climate Resilience and Emergency Response. [Online] Available: https://www.fhwa.dot.gov/environment/recreational_trails/publications/fhwahep23017.pdf. [August 16, 2023].

planners, designers, and managers. The study recommended future research investigating techniques to design for, plan, and manage trails to be resilient to climate change, as well as strategies to incorporate trails into larger resilience-focused efforts. Future research could also focus on innovative finance strategies to leverage existing funding for trail resilience.

Based on these identified research gaps, FHWA is developing a guidebook on trails as resilient infrastructure that covers both climate resilience and emergency response. The guidebook will provide actionable information to transportation and trail planners, designers, and managers on how trails can be designed to be both accessible for users and resilient to natural hazards, as well as how trails can be designed to support emergency response and recovery efforts. Additionally, the guidebook will help planners, designers, and managers identify strategies for improving infrastructure resilience and emergency response and preparedness by integrating shared-use paths and recreational trails into the transportation network. *(Sponsor: FHWA Office of Human Environment)*

Helping Federal Land Management Agencies Transition to Electric Vehicle Fleets

New electric vehicle (EV) sales nearly doubled in the United States in 2021 compared to sales in any previous year and grew by another two-thirds in 2022. EV sales will likely reach 30 percent of all new U.S. car sales in 2030 from a roughly 3.5 percent share of new car sales in 2021.

The U.S. Department of the Interior, National Park Service (NPS), U.S. Forest Service (USFS), U.S. Fish and Wildlife Service (USFWS), Bureau of Reclamation, Bureau of Land Management (BLM), and U.S. Army Corps of Engineers (USACE) are working to attain the goals set forth in President Biden’s Executive Order 14057, which calls for government agencies to transition to 100 percent zero-emission EVs by 2035, and 100 percent zero-emission light-duty EVs by 2027. This work will enable the nation’s federal lands management agencies to transition their vehicle fleets to EVs while providing needed electric vehicle supply equipment (EVSE) to the visiting public.



New 40-foot electric shuttle bus at Zion National Park in Utah. Source: NPS

These agencies asked for the U.S. DOT Volpe Center's support in this area because of its depth of knowledge of transportation electrification, public lands planning, and geospatial analysis. The Volpe Center has provided expertise at the juncture of these areas for years, including development of a precursor gap analysis on EVSE access for the NPS.

To support these federal land management agencies, the Volpe team planned, convened, and facilitated meetings with each of the federal land management agencies to understand and address their current issues and needs; conducted high-level mapping, programming, analysis, and research to develop stakeholder meetings; and worked iteratively with agencies to revise and refine deliverables. This work impacts the entire nation as every state contains federal land management agencies that oversee roughly 640 million acres (28 percent of the land in the U.S.).

The team completed a report on [Electric Vehicle Supply Equipment Gap Analysis for Federal Land Management Agencies](#), and a [National Park Service Electric Vehicle Transition Plan](#), both published in February 2023. Ongoing projects include development of a web-based mapping tool to illustrate priority locations for investing in EVSE for the USFS, and support for USFWS and the Bureau of Reclamation to identify and address EV and EVSE needs.

The Volpe Center will continue to support NPS in implementing the National Park Service Electric Vehicle Transition Plan and will convert the Electric Vehicle Supply Equipment Gap Analysis for Federal Land Management Agencies into a web tool and perform future updates to the analysis. The Volpe team will also finalize the USFS web-mapping tool and provide support on related items; help develop and implement the USFWS's Five-Year Electric Vehicle Plan; and work with the Bureau of Reclamation to help launch a program to transition its fleet to EVs. This work will entail planning; site assessment, design, and installation of EVSE; and an overall program assessment. The Bureau of Reclamation will use the assessment as a foundation for subsequent efforts to electrify its entire fleet at additional sites. *(Sponsor: U.S. Department of the Interior, National Park Service, U.S. Forest Service, U.S. Fish and Wildlife Service, Bureau of Reclamation, Bureau of Land Management, and U.S. Army Corps of Engineers)*

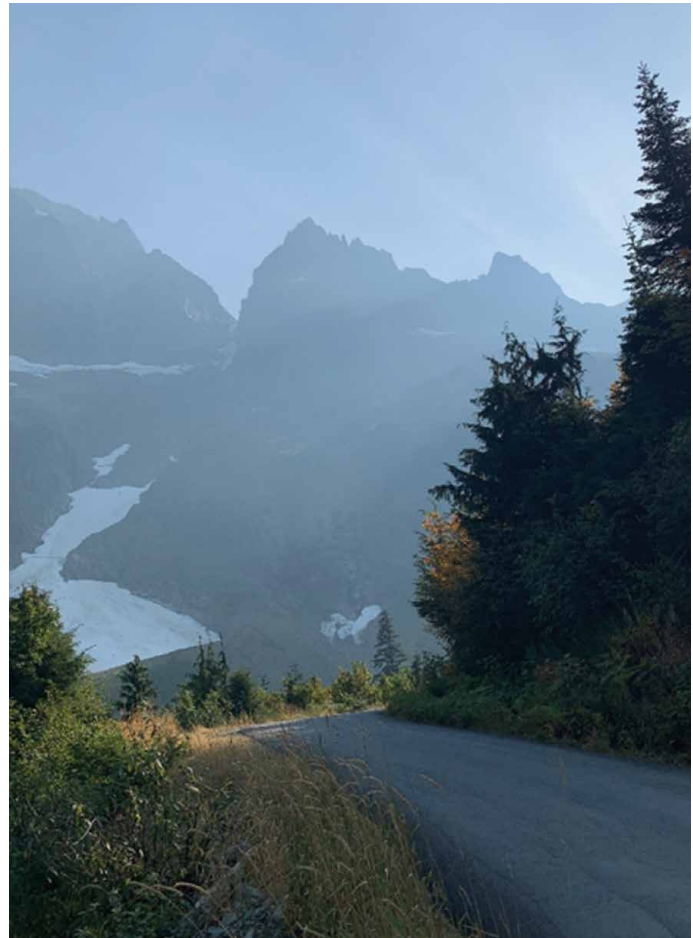
Addressing Climate Impacts in Our National Parks

Extreme weather events across the United States have caused sections of national parks to close for extended periods of time, limiting public and administrative access, and occasionally stranding visitors. In June 2022, Yellowstone National Park experienced a 500-year flooding event with northern areas of the park receiving a combined 7.5 to 9.5 inches of rain and snowmelt in a 24-hour period. The resulting flood destroyed several sections of the North Entrance Road between Mammoth Hot Springs, Wyoming, and Gardiner, Montana, and three sections of the Northeast Entrance Road between Lamar Valley and Cooke City/Silver Gate, Montana.⁴³ Parts of Mount Rainier National Park were closed indefinitely in 2020 due to flooding and mudslides that shut down access points and covered forest service roads with thick mud and storm debris.

⁴³ Yellowstone National Park (2023). Flood Recovery and Operations. [Online]. Available: Flood Recovery and Operations - Yellowstone National Park (U.S. National Park Service) (nps.gov). September 13, 2023.

Weather events like this are especially persistent in the Pacific Northwest where parks such as North Cascades National Park in Washington have experienced severe climate change impacts, including more frequent and destructive flooding, wildfires, slope instability, and erosion damage to roads, trails, and other transportation assets. Repairing transportation assets and restoring access is costly, time-intensive, and, in many cases, unsustainable, given the limited resources available to national parks.

To mitigate the effects of severe weather in North Cascades National Park, the National Park Service (NPS) sought to identify road corridors in the park where an updated strategy to address climate change impacts is needed and to identify the actions necessary to achieve a resilient transportation system. Four corridors in the park were identified which have experienced recurring erosion and slope instability based on the park's existing scientific, asset management, and anecdotal data. The U.S. DOT Volpe Center worked with North Cascades National Park to develop a Long-Term Access and Resilience Strategy, which includes a 10-year action plan the park intends to pursue in the coming years. The goal of the effort is to help the park establish a clear action plan that considers the likelihood of continued and increasing impacts from a changing and unstable climate and the park's resource capacity.



The Volpe Center team held a kick-off meeting in August 2022 with NPS staff to identify key issues and conducted a site visit in October 2022 to observe the areas of concern first-hand. The team reviewed the data and documents provided by the park, as well as resources on climate trends and projections. With this information, the Volpe Center team developed access scenarios and alternatives for each of the four road corridors. Volpe experts used GIS capabilities to map previous resilience challenges and infrastructure improvements along the corridors. Through presentations to and feedback from park staff and NPS leadership, the Volpe Center team updated the access scenarios and alternatives, and developed an action plan to outline a long-term access and resilience strategy.

The Volpe Center team presented its findings to park leadership in June 2023 and provided a draft report—which included the action plan—for park leadership review in July 2023. With the action plan, the park will be better suited to address climate impacts and avoid extended closures. Though the project is focused on North Cascades National Park, it is a pilot project for a strategy and methodology that will inform a more general framework for pursuing long-term infrastructure resilience and access planning in other park units. *(Sponsor: National Park Service, including the Transportation Planning Program and North Cascades)*

Transportation corridor in North Cascades National Park. Source: Scott Gilman/ U.S. DOT Volpe Center

Transformation



Adobe Stock

The U.S. DOT Volpe Center works in collaboration with the Office of the Secretary, departmental operating administrations and offices, other federal agencies, and the broader transportation community to advance transportation innovation for the public good. By developing fresh approaches and new solutions, Volpe works to ensure innovation and technology create a safer, more efficient, sustainable, and equitable transportation future.



ENERGY TRANSFORMATION

Working with States and Communities to Build a Convenient, Reliable National EV Charging Network

The transportation sector is the largest source of greenhouse gas (GHG) emissions in the United States, responsible for one third of all emissions. To address the growing climate crisis and meet President Biden’s goal of a net-zero emissions economy by 2050, it is critical to decarbonize transportation by eliminating nearly all GHG emissions from the sector. A decarbonized transportation system can mobilize a sustainable economy that benefits everyone.

Electrifying the nation’s transportation sector requires bold action to ensure the necessary infrastructure is in place for Americans to be able to ride and drive electric vehicles (EVs). According to a recent study from the National Renewable Energy Laboratory, 1.2 million public charging stations will be needed to support 33 million light-duty vehicles by 2030. The Infrastructure Investment and Jobs Act, also known as the Bipartisan Infrastructure Law (BIL), has invested \$7.5 billion to build a national EV charging network and created the Joint Office of Energy and Transportation (Joint Office) to study, plan, coordinate, and implement issues of joint concern between the U.S. DOT and Department of Energy.

One of the goals of BIL is to invest in EV charging infrastructure, and a large portion of BIL funding is dedicated to making EVs accessible to all Americans for both local and long-distance trips. The U.S. DOT Volpe Center supports the development of new EV charging infrastructure by providing expertise to the Joint Office and through support to the Federal Highway Administration (FHWA).

Since the inception of BIL’s National Electric Vehicle Infrastructure (NEVI) formula program in 2022, the Volpe Center has supported the Joint Office in working with federal, state, and local officials, as well as private industry, to plan and promote a national network of charging/fueling stations with a focus on filling gaps in rural, disadvantaged, and hard-to-reach locations. This work expanded with BIL’s [Charging and Fueling Infrastructure \(CFI\)](#) competitive grant program launch in March 2023, and FHWA’s [Electric Vehicle Charger Reliability and Accessibility Accelerator](#) grant program in September 2023.

The Volpe Center supports the Joint Office’s work related to the NEVI and CFI programs through strategic planning; program guidance development; state plan and proposal reviews/evaluations; stakeholder coordination, outreach, and resource development; technical assistance for state DOTs, communities, and tribal nations; program evaluations; and coordination efforts with Justice40 and labor and equity workforce initiatives. In addition, the Volpe Center facilitates coordination between FHWA and the Joint Office.



A motorcade EV charges at a charging station in South Carolina during the Secretary of Energy's People Powered EV Summer Road Trip in June 2023. Source: Heather Richardson/U.S. DOT Volpe Center

During 2023, the Volpe Center provided dedicated staff support for the Technical Assistance Team, which focused on technical assistance to state DOTs and other key state agencies, for the implementation activities of NEVI. In addition, the Volpe Center developed and released [Charging Forward: A Toolkit for Planning and Funding Urban Electric Mobility Infrastructure](#) in August 2023. The toolkit serves as a one-stop resource to help urban communities scope, plan, and identify ways to fund EV charging infrastructure, and complements the [Rural Electric Mobility Toolkit](#) the Volpe Center developed in 2022 and updated in 2023.

Other key Volpe Center support related to this transformational initiative include:

- Participating in the reviews of the NEVI EV Infrastructure Deployment Plan updates for \$885 million in fiscal year 2024 funding. Volpe Center staff led review teams and consensus meetings which provided recommendations for approval to Joint Office and FHWA leadership.
- Providing technical and policy support for standing up the CFI Discretionary Grant Program and developing the CFI Notice of Funding Opportunity.
- Providing assistance in standing up the Electric Vehicle Working Group (EVWG) which consists of 25 stakeholders that will provide recommendations to the Secretaries of Energy and Transportation on the development, adoption, and integration of EVs into the energy and transportation systems of the U.S.
- Developing a series of briefings for Joint Office leadership on various EV charging solutions for multifamily housing residents. Volpe Center staff also developed [public resources](#) categorizing and summarizing different solution types.
- Developing [cybersecurity procurement language](#) for state NEVI plans. Volpe Center staff coordinated federal cybersecurity research to reduce NEVI cyber risks, as well as hosted public and private sector stakeholders for a workshop on EV charging cybersecurity.

These activities directly support the Biden Administration's vision of creating a convenient, reliable, and Made-in-America EV charging network so the great American road trip can be electrified. These steps will help the U.S. meet President Biden's ambitious goals to confront the climate crisis by building a national network of 500,000 EV chargers along America's highways and in our communities. It is estimated that EV sales will make up at least 50 percent of new passenger car sales by 2030, which underscores the industrial strategy to boost domestic EV and EV charging production. The path to net-zero emissions by 2050 will create good-paying manufacturing and installation jobs for the nation. *(Sponsor: Joint Office of Energy and Transportation and FHWA)*

BUILDING DATA AND TECHNOLOGY CAPACITY

Funding Innovation through the SMART Grants Program

New technologies and innovative approaches can benefit communities if they are used to improve local transportation efficiency and safety. The Bipartisan Infrastructure Law (BIL) established the Strengthening Mobility and Revolutionizing Transportation (SMART) Grants Program, which provides grants to eligible public sector agencies to conduct demonstration projects focused on advanced smart community technologies and systems. Funded projects must leverage at least one of eight technology domains identified in BIL: connected vehicles, coordinated automation, delivery/logistics, innovative aviation, sensors, smart grids, systems integrations, and traffic signals.

The SMART Grants Program's guiding principles focus on purpose-driven innovation and building data and technology capacity for state, local, and tribal governments. OST-R and the U.S. DOT Volpe Center applied these principles as they developed program priorities and merit criteria and crafted an initial Notice of Funding Opportunity (NOFO). The program received 392 applications. In March 2023, it was announced that 59 projects across 33 states were selected for funding—the first round granting over \$94 million.

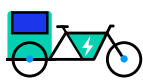
In addition to helping establish the SMART Grants Program and drafting the NOFO language, the Volpe SMART team managed the application evaluation process through the [Valid Eval](#) web application. This included training evaluators, facilitating meetings to arrive at a consensus rating, and developing materials for the senior review team. Eighteen Volpe Center staff members also served as application evaluators. The Volpe team worked on communications content for the SMART Grants Program website as well. Volpe Center technical advisors will provide ongoing subject matter expertise to grantees based on the technologies to be deployed.

The selected projects will address immediate local challenges, using technology to improve curb management, pedestrian safety, transit reliability, package delivery, traffic efficiency, and more, while also demonstrating the safety, equity, climate, and efficiency benefits of innovative technologies to other communities across the country. Eventually, the grantees' reports and a program evaluation will be incorporated into a report to Congress with the Volpe Center team's help. The team also supported planning and programming efforts for an in-person SMART Grantee Summit in September 2023 that allowed grantees to network with other SMART grant project teams. Looking toward the future, the Volpe Center and OST-R are preparing additional SMART NOFOs and planning for the coming years of the program. (*Sponsor: U.S. DOT/OST-R*)

The eight BIL technology domains, which all SMART projects leverage one or more of. Source: [SMART Grants Program](#)



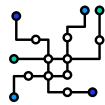
CONNECTED VEHICLES



DELIVERY/ LOGISTICS



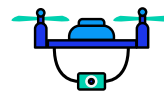
SENSORS



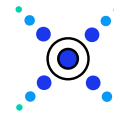
SYSTEMS INTEGRATION



COORDINATED AUTOMATION



INNOVATIVE AVIATION



SMART GRID



TRAFFIC SIGNALS

The Flight Information Exchange Model (FIXM) 4.3.0 Overview

FIXM APPLICATIONS	FIXM CORE	FIXM EXTENSIONS
<p>Contain metadata about the message exchange in addition to guidance for constructing messages, such as XML templates.</p> <p>Site as a layer above Core.</p>	<p>Contain basic flight data that are globally applicable and which are endorsed by the FIXM Change Control Board (CCB).</p>	<p>Support localized requirements from particular communities of interest.</p> <p>Extends basic flight data and/or applications.</p>

- Aligns with the Air Traffic Management Requirements and Performance Panel's (ATMRPP) Manual on Flight and Flow Information for a Collaborative Environment (FF-ICE) Implementation Guidance (FF-ICE IG) v0.99
- Incorporates recent non-FF-ICE International Civil Aviation Organization (ICAO) requirements
- Incorporates general improvements based on FIXM 4.2.0 feedback and lessons learned
- Both CCB-maintained FIXM Applications were updated to work with the new Core
 - FF-ICE Message 1.1.0
 - Basic Message 1.1.0

Source: FAA

Breaking Down Barriers in Flight Data Exchange

Many flight management systems produce data in custom formats tailored to system-specific needs, making it difficult to exchange that information with external systems. This language barrier impedes data exchange, efficiency, and innovation. The Flight Information Exchange Model (FIXM) was developed by the Federal Aviation Administration (FAA) and EUROCONTROL, the European air traffic organization, to reduce this barrier and improve the quality and consistency of data. FIXM provides a common flight language across the global aerospace community by utilizing a standardized format for flight data exchange. The U.S. DOT Volpe Center has been supporting FAA on the FIXM program for over a decade.

The FIXM project directly supports the International Civil Aviation Organization (ICAO) Air Traffic Management Requirements and Performance Panel (ATMRPP) Flight and Flow Information for a Collaborative Environment (FF-ICE) project. FF-ICE was developed to address the limitations of current flight planning mechanisms and to enable the transition to a fully collaborative environment. FIXM consists of three main components: Core, Applications, and Extensions. The Core component provides globally harmonized flight data structures within a hierarchical structure for organizing flight information. The Applications component supports message standardization, and the Extensions component supports localized requirements, such as those for domestic flights.

A Volpe team provides subject matter expertise and program management, leads the development and maintenance of the FIXM data model, and supports the full spectrum of services in support of the FAA and FIXM global community. In February 2023, the latest version of FIXM Core was released to the public for operational use. This version was published on the refreshed FIXM

website along with the Basic Message and FF-ICE Message applications. The website was also modernized to improve usability and support a variety of mobile devices.

As of today, FIXM is used by multiple FAA programs and in multiple international activities. Embracing FIXM as a common flight language comes with many benefits, such as improving access to data, reducing data redundancy, reducing risk, and lowering costs. FIXM will be used across the international community to exchange flight information. For example, EUROCONTROL has committed to full adoption of FIXM by 2025. The international community of users drive the evolution of FIXM through submittal and review of change requests to the FIXM Change Control Board (CCB), participation in virtual Technical Interchange Meetings, discussions in the online FIXM Work Area, and supporting CCB's approval. With these chances to drive its evolution and more time to work with data instead of translating, FIXM provides more opportunity for innovation in flight data exchange. *(Sponsor: FAA)*

AUTOMATION

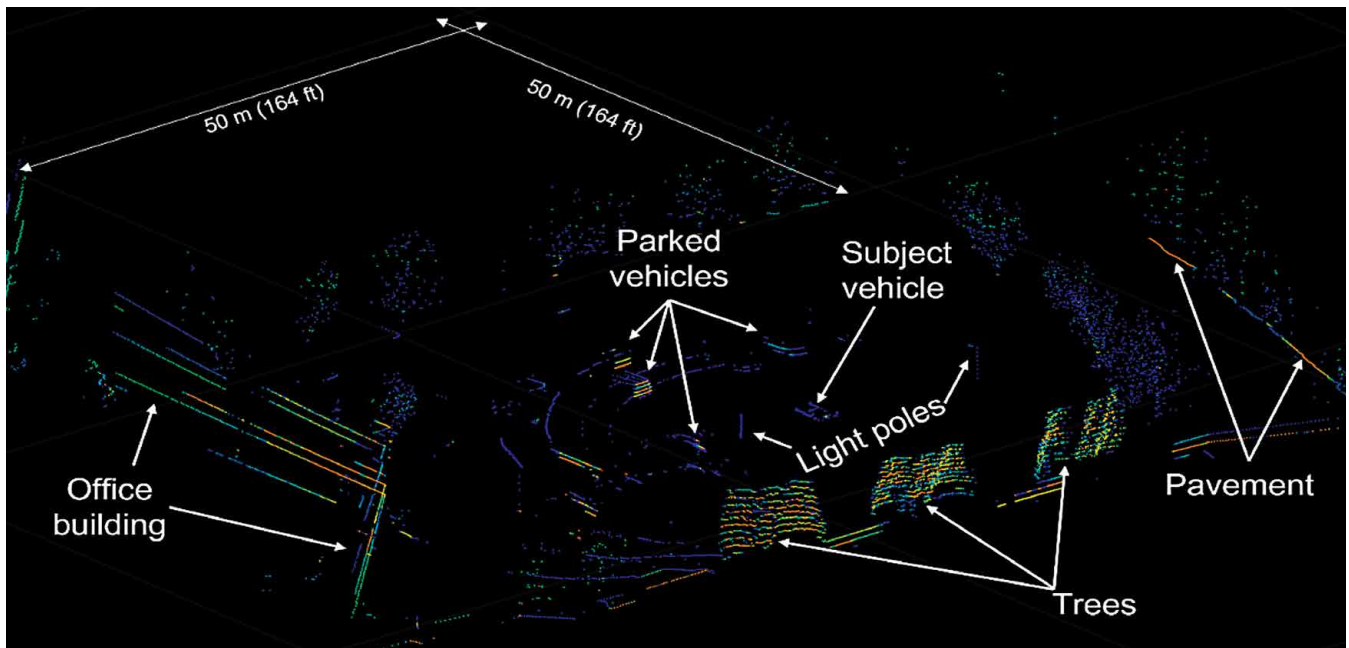
Positioning, Navigation, and Timing Technology Readiness for Safe Automated Vehicle Operations

The Highly Automated Vehicle (HAV) sector is evolving at a fast rate, and testing HAVs in controlled environments, as well as limited on-road deployments, has also increased in recent years across the United States and internationally. The advancement of HAV systems is being propelled by the research and development of cutting-edge enabling technologies across many disciplines including robotics, communications, perception, and navigation.

HAV systems that consist of remote sensors such as cameras and Light Detection and Ranging (LiDAR) rely on sophisticated artificial intelligence (AI) algorithms to perform the perception tasks and aid navigation functions. While such technology has the potential to allow a human driver to off-load dynamic driving tasks to HAV systems, no robust approach that is generally accepted is available yet. Such an approach is needed to demonstrate the safe transfer of dynamic driving tasks under nominal conditions, during unexpected driving situations, as well as under cybersecurity attacks including jamming and spoofing of navigation and perception signals.

Recognizing the magnitude and importance of this challenge, and given the critical role Positioning, Navigation, and Timing (PNT) plays in the safety of HAV operations, the Office of the Assistant Secretary for Research and Technology (OST-R) Intelligent Transportation Systems (ITS) Joint Program Office (JPO) and the Office of PNT and Spectrum Management jointly sponsored the U.S. DOT Volpe Center to develop and apply innovative methodologies to define a set of PNT requirements that support and enhance the safe operation of an HAV. The Volpe team also researched and tested current and emerging technologies and their potential to meet these requirements.

The Volpe Center is the leading technical organization in this area and is conducting the AV PNT technology assessment framework development and implementation. The Volpe Center's current



technical experience with the Global Navigation Satellite System (GNSS) and other PNT technologies—signal and image processing, data analysis, remote sensors analysis and simulations, fusion, and navigation filters, as well as requirements development and verification for multimodal applications—enabled the team to meet U.S. DOT’s needs.

LiDAR point cloud captured in a parking lot as a part of suburban environment data collection effort representing typical ODD conditions.

The Volpe team outlined a framework to assess PNT sensor performance—identified requirements and developed scenarios to evaluate PNT sensor suite performance and resiliency under nominal and challenged PNT environments. PNT resiliency enhancements gained from sensor fusion for scenarios with environmental challenges (i.e., adverse weather, dense environments, and covered roads) and man-made challenges (i.e., spoofing and jamming attacks) were also assessed by the Volpe Center team.

Volpe Center staff prepared and delivered an internal final report to OST-R in April 2023, which discussed five major focus areas:

1. Developing HAV/ADS use cases that describe Operational Design Domains (ODDs) where HAV systems are expected to operate routinely.
2. Developing HAV/ADS Target Levels of Safety (TLS): integrity, continuity, availability, accuracy, and resiliency.
3. Developing a multisensor fusion algorithm and assessment of PNT benefits gained and pitfalls incurred.
4. Surveying candidate HAV/ADS technologies for AV PNT solutions.
5. Assessing PNT sensor performance in driving scenarios representative of use-cases developed in the first task, against HAV/ADS TLS developed in the second task.

The HAV/ADS PNT technology readiness project began its second phase at the start of 2023 and includes the following work:

- Improving PNT sensor technology including augmenting the ODD with PNT aids and other complementary PNT sources. This includes smart repurposing of perception and other onboard systems such as cameras and radars as additional PNT sources.
- Fusing multiple sources including additional onboard PNT sources and the use of performance monitors with upgraded and improved systems for robust unintentional and intentional fault detection.
- Designing use cases for SAE level 4 operations that allow for capacity and alert limit tradeoffs resulting in TLS that can be met with current and emerging technologies. (*Sponsor: OST-R, ITS-JPO, and PNT and Spectrum Management Program*)

Developing a Human-Centered Approach to Automation

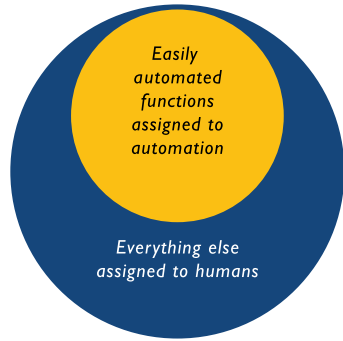
Automated technologies can improve the efficiency and effectiveness of the track inspection process. Automation-aided inspections and increased availability of track condition data may improve railroads' ability to detect and address defects in the short-term and facilitate more effective long-term planning for proactive maintenance activities. However, the most prevalent approach to designing and adopting new automation may make it more challenging to achieve those goals. The current technology-centered approach is primarily focused on exploiting the capabilities of automation, while relying on humans to manage the limitations of the technology and perform any tasks that cannot be easily automated. A technology-centered approach can introduce challenges such as skill degradation and unpredictable workload. Conversely, a human-centered approach can mitigate many of these challenges by identifying a better balance between the human's tasks and automated tasks and ways they can work together more effectively, whether in track inspection or other transportation processes.

The U.S. DOT Volpe Center provided a foundational overview to the Federal Railroad Administration (FRA) on how the rail industry can approach the design of human-automation teams (HATs), with the objective of improving the safety and efficiency of the overall track inspection process. A Volpe Center team explored how a human-centered design approach can support more effective track inspections. This approach involves carefully considering how tasks and responsibilities should be allocated to humans and automation technologies, and taking into consideration the roles, abilities, and limitations of each, as well as the potential interactions.

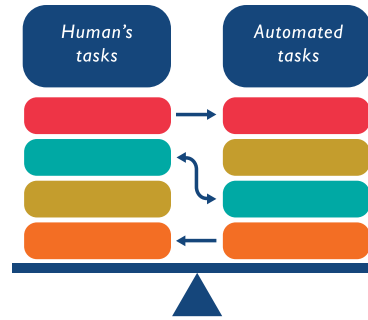
The Volpe Center team identified a five-step process for designing HATs based on existing literature:

1. Examine process requirements and system-level goals.
2. Explore possible roles for humans and automation.
3. Consider tradeoffs and challenges.
4. Develop detailed design requirements.
5. Implement and assess HATs.

TECHNOLOGY-CENTERED



HUMAN-CENTERED



Moving from a technology-centered approach to a human-centered approach allows designers to structure tasks based on the capabilities and limitations of both humans and automation and to consider the interactions between them. *Source: U.S. DOT*

To demonstrate this process at a high level, the Volpe Center team then applied the first three steps in this process to track inspection activities, informed by prior work with FRA and interviews with subject matter experts. The team examined requirements for four inspection tasks (data collection, data analysis, decision-making, and action), considered both current and future uses of technology, and discussed tradeoffs and challenges associated with various roles for humans and automation. System designers can use the Volpe Center's work as a starting point to apply these steps to develop HAT requirements for specific track inspection technologies. Though the Volpe Center's work focused on track inspection, this human-centered design approach can also be applied more broadly to other rail processes.

This work was presented at FRA's Rail Share Conference in November 2022 and at the Transportation Research Board 2023 Annual Meeting in March 2023. Follow-on work is ongoing and focuses on the application of HAT principles to support the design and implementation of Automated Track Change Detection technology.

New and innovative technologies can lead to increased safety in the rail industry, including how railroads monitor and maintain their track infrastructure—but to use these technologies to their full potential and realize their safety benefits requires consideration of how employees and automation can work together. The work conducted by the Volpe Center team can help stakeholders adopt a more human-centered approach. If applied by the railroad industry, this approach has the potential to positively impact the use of automation across the U.S., particularly with respect to automation in track inspection. *(Sponsor: FRA)*

Interactive Training to Improve Safety Driver Awareness for Transit Vehicles with Automated Driving Features

As automated features are added to transit vehicles, the role of the operator will shift from actively piloting the vehicle to monitoring onboard systems and the roadway ahead. Drivers may require additional training to adjust to this new role and avoid certain human factors issues that may arise from this shift.

The Federal Transit Administration (FTA) asked the U.S. DOT Volpe Center to identify potential human factors concerns that could be introduced by the inclusion of automated features. With decades of human factors expertise, a Volpe team developed an interactive PowerPoint training using the proven 3M training method.⁴⁴ 3M training allows participants to make Mistakes, be Mentored about the correct choice, and Master the correct response. 3M training is easily adaptable to other operational settings or levels of automation and is designed to improve driver safety and efficiency.

The Volpe Center research team completed a pilot test of this training to determine if the 3M method had the potential to improve a driver's ability to identify latent hazards, mitigate those hazards, and maintain attention on the roadway. The pilot test showed that participants who received the training improved measures of situational awareness from 41 percent to 94 percent accuracy, while the control group who received a placebo training improved only slightly.

The Volpe Center's Transportation Human Factors Division worked with FTA and a transit agency to develop training materials to educate drivers on the parameters of newly automated systems. The human factors team pilot tested a customizable PowerPoint-based training that allows a transit agency to provide supplemental guidance to help drivers make this adjustment. The training can be customized to transit agency needs and uses a proven training technique to help improve hazard anticipation, hazard mitigation, and driver situational awareness maintenance.

During the course of this project, the Volpe team met with sponsors and stakeholders to understand transit agency training needs and narrowed in on specific human factors needs to develop the

44 AAA Foundation for Traffic Safety. (2023) Accelerating Teen Driver Learning: Anywhere, Anytime Training. [Online]. Available: <https://aaafoundation.org/accelerating-teen-driver-learning-anywhere-anytime-training/#>. October 24, 2023.



Bus at a station stop along the CTfastrak guideway in central Connecticut. Source: U.S. DOT Volpe Center

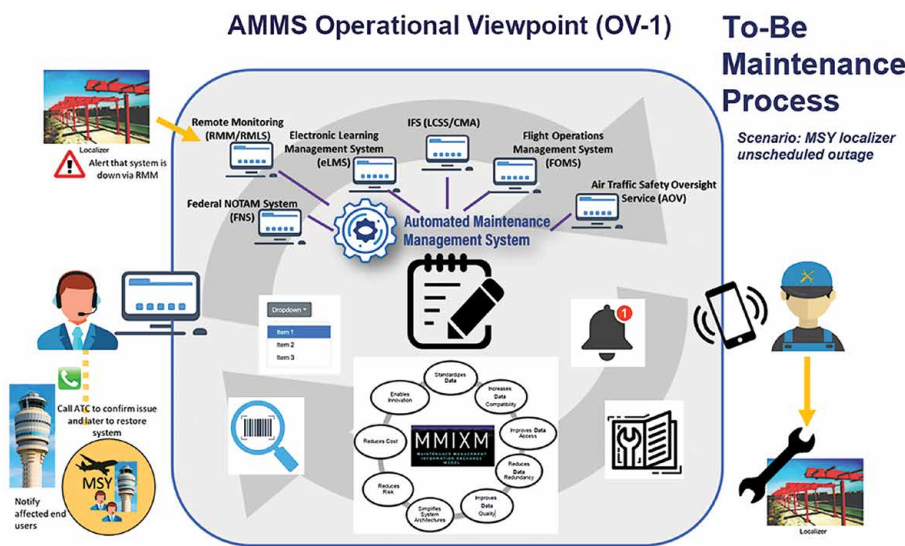
training. The Volpe team worked with stakeholders to develop a set of realistic training modules and gathered data on the effectiveness of the proposed training.

This effort could have significant impacts nationwide, as any transit agency considering adopting advanced automation features in transit vehicles will be able to utilize this training method to educate their workforce. By using commonly available software, transit agencies can adapt the training to meet the needs of different levels of automation and different operational conditions. FTA published a final report on the pilot test in June 2023 titled [Interactive PowerPoint Training to Improve Safety Driver Awareness while Operating a Transit Vehicle Equipped with Driving Automation Features](#). (Sponsor: Federal Transit Administration)

Providing Configuration, Logistics, and Maintenance Resource Solutions to the FAA

The Federal Aviation Administration (FAA) is responsible for the configuration management, logistics center support, and maintenance automation of the National Airspace System (NAS) facilities, equipment, and systems. In 2019, the FAA grouped several functions and programs under one Configuration, Logistics, and Maintenance Resource Solutions (CLMRS) program office team, including the following programs: Logistics Center Support System (LCSS), Automated Maintenance Management System (AMMS), and Configuration Management Automation (CMA). The CLMRS team allows for integration and maturation of existing, functional elements that are executed today to implement data-driven decisions for the agency. This creates a holistic view to harmonize and reduce duplicate policies, processes, and tools across organizations.

The Volpe Center primarily supports the AMMS program within the CLMRS portfolio to a) lead development of requirements and engineering artifacts through the FAA’s investment analysis phase, and b) support data standardization efforts for each new AMMS interface. In 2022, the AMMS



AMMS high-level operational concept diagram. Source: FAA CLMRS Program Office. Source: FAA CLMRS Program Office

program achieved final investment decision (FID) and began developing a new tool, the TechOps Activities Portal (TAP). TAP is a modern desktop and mobile tool for technicians to perform maintenance on assets that keep the NAS technology available. AMMS provides improvements to maintenance recording, event coordination, and scheduling functionality. The U.S. DOT Volpe Center has experience with FAA's Tech Ops maintenance systems and data modeling efforts and possesses directly applicable engineering experience within the AMMS program.

The figure displays the AMMS high-level operational concept diagram, or OV-1, which illustrates the interaction of AMMS with en route and terminal automation facilities, the flight inspection and Notice to Air Missions (NOTAMs) interfaces, and NAS equipment.

The Volpe Center works closely with the FAA's Air Traffic Systems group (AJM-2330) to develop functional and automation enhancements for logistics, maintenance, and configuration-support systems and capabilities through a variety of systems engineering and development activities. For AMMS, the Volpe Center leads the requirement mapping and program interface coordination, acts as system engineering subject matter experts, and provides model-based systems engineering support, including the hosting and operations of engineering and CLMRS software applications within the Volpe Center's NextGen Innovation lab.

Since the new TechOps Activities Portal was initially deployed in 2022, 79 percent of FAA maintenance users have been using the new tool instead of the existing tools for maintenance logging. The Volpe Center has also supported AMMS with its Maintenance Management Information eXchange Model (MMIXM). The beta of MMIXM v3.0.0 was released in December 2022 and the final version was released in August 2023. The Volpe Center leads the development of model updates and enhancements of the MMIXM website.

The AMMS program moved to the next phase of the FAA Acquisition Management System, Solution Implementation, which is scheduled for completion in 2028. The integration of maintenance recording, event coordination data, Flight Check scheduling data, and NOTAMs data will be achieved. Additional capabilities, such as asset ordering and barcode scanning, will also be available within the new tools provided by AMMS. (*Sponsor: FAA PMO: AJM-2330*)

MOBILITY

National Parks Michigan Mobility Challenge Project Launch

The National Parks Michigan Mobility Challenge (NPMMC) launched a collaborative effort in August 2023 between the National Park Service (NPS) and the state of Michigan. NPMMC is an industry challenge aimed at identifying and deploying emerging mobility and electrification pilots in a recreational environment in and around NPS units in Michigan. The U.S. DOT Volpe Center is assisting NPS and Michigan with project management and the development of the challenge and review process.

The near-term goal of the NPMMC is to use emerging mobility and electrification pilots to provide new mobility options for NPS visitors through technology demonstrations and evaluations. The challenge invites mobility companies, local governments, and partners to propose solutions to one or more of the three “Areas of Innovation” identified by NPS and the state of Michigan through engagement with the parks and partners, including:

1. Multimodal electric community charging hubs to create electric vehicle charging hubs at community locations that will be among the first to provide multimodal charging for recreational visitors to NPS sites.
2. Micromobility concepts to identify innovative micromobility technologies and business models that can be deployed in and around NPS units in Michigan.
3. Small-scale electric shuttles and automated driving systems (ADS) to learn how the next generation of these technologies may perform in a park setting—connecting visitors to park destinations and surrounding communities, reducing the environmental impact of visitation, alleviating parking and roadway congestion in busy areas, and improving access for persons with disabilities.

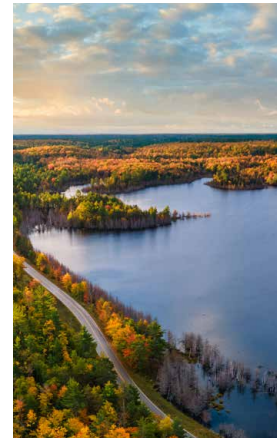
The Volpe Center’s work builds upon the November 2021 [Memorandum of Understanding](#) between U.S. DOT and the Department of the Interior on Transportation Innovation in the National Park System, by providing expertise to NPS and the state of Michigan to develop a strategy that will help national parks adapt to and proactively address emerging mobility trends. Over the course of the project, the Volpe Center has:

- Supported project discussions with NPS park units, the state of Michigan, and other NPMMC project partners.
- Developed challenge statements for each of the three Areas of Innovation.
- Developed the NPMMC submittal and review processes.
- Reviewed and provided preliminary evaluations of challenge submissions.

Located at four of Michigan’s five National Park units—Sleeping Bear Dunes National Lakeshore, Pictured Rocks National Lakeshore, Keweenaw National Historical Park, and River Raisin National Battlefield Park—this project will likely result in the implementation of emerging mobility and electrification projects in an outdoor recreation environment, and will inform the development of similar projects in the state of Michigan and throughout the U.S. The Volpe Center will provide ongoing support to NPS and the state of Michigan by evaluating proposals and implementing successful submissions. *(Sponsor: The National Park Service (NPS); The State of Michigan’s (SOM) Office of Future Mobility and Electrification)*

Ranger IV Design for Isle Royale National Park

Isle Royale National Park (ISRO), one of only three island national parks, is situated off the northern shore of Lake Superior. With 165 miles of trails, 36 campgrounds, and 337 miles of shoreline, the park offers visitors the experience of hiking, backpacking, and boating through rugged, unspoiled



Sunrise on Kingston Lake (top) near Pictured Rocks National Lakeshore in the Michigan Upper Peninsula. Bottom photo: Sleeping Bear Dunes National Lakeshore. Source: Terry Reimink/Adobe Stock

North American wilderness. The park is open from April 15 to October 31 due to harsh weather conditions much of the year. ISRO is only accessible by boat and seaplane, with no wheeled vehicle access.

At 165 feet long and 34 feet wide, the ISRO-operated *Ranger III* is the largest passenger ferry providing service to and from the park, as well as the largest moving piece of equipment owned and operated by the National Park Service (NPS).⁴⁵ Trips run between Houghton, Michigan and the park, with park stops at Rock Harbor, Mott Island, and Washington Harbor. The journey across Lake Superior takes six hours. During the first hour of the trip, *Ranger III* navigates the scenic Keweenaw Waterway, passing under the world's largest lift bridge. In addition to transporting visitors, NPS personnel, and concessionaire staff, *Ranger III* provides cargo services, replenishing the park's food supply twice a week, bringing fuel for generator systems and motorboats, and conveying construction materials, along with whatever else is needed to ensure visitors have a safe and enjoyable experience. It is not an exaggeration to say that *Ranger III* is the lifeline to the park.

Constructed in 1958, *Ranger III* is nearing the end of its useful life. Additionally, replacement parts for the ship's internal components are becoming increasingly difficult to procure; eventually parts may have to be reengineered, which is very expensive.

Meanwhile, park operations have changed and grown since 1958, expanding services, increasing housing and adding amenities for park staff and visitors, generating more power to meet increased demand, creating greater capacity across fuel storage facilities, and more. Environmental regulation and stewardship have changed greatly since the 1950s, as well. The combined result is ISRO's need for a modernized vessel.⁴⁶

The U.S. DOT Volpe Center is supporting the NPS to develop a replacement ferry, *Ranger IV*. The new vessel will modernize the park's transportation system by carrying passengers, heavier cargo, and additional types of cargo for decades to come. *Ranger IV* will meet all current EPA engine emissions criteria (resulting in lower emissions than *Ranger III*). It will also have a double hull for all fuel tanks, and a ballast water treatment system.

Previously, the Volpe Center performed a transportation study for NPS to analyze current and future transportation system needs at ISRO, and to identify measures to streamline and reduce the cost of park operations. The Volpe Center also collaborated with regional and headquarters NPS staff, ISRO, the Denver Service Center, and with other contractor subject matter experts to develop a value analysis weighing four of the alternative transportation solutions identified in the transportation study.⁴⁷ The *Ranger IV* alternative scored the highest Cost and Importance Value scores.

45 Isle Royale National Park. (2023). Ranger III Specs. [Online] Available: <https://www.nps.gov/isro/planyourvisit/ranger-iii-specs.htm>. September 12, 2023.

46 Safety of *Ranger III* is not a concern; the vessel is inspected annually by the Coast Guard, meets all CFR requirements, and has a valid certificate of inspection. Were the vessel unable to meet those requirements because of an unscheduled maintenance/repair or some other reason, it would not be allowed to operate.

47 The alternatives were 1) rehabilitate *Ranger III*; 2) design and build a new *Ranger IV*; 3) build a new NPS-operated tug and barge to transport cargo, and a new concessionaire-operated ferry to transport visitors and staff; and 4) build a new NPS-owned and -operated tug and barge to transport cargo, and a new NPS-owned and -operated ferry to transport visitors and staff.



Ranger III docks in Rock Harbor, Isle Royale National Park. Source: NPS

The Volpe Center’s naval architects developed the basis of design in close coordination with ISRO staff, including the *Ranger III* Captain and Chief Engineer. The basis of design discusses the goals of the new vessel, describing its missions and operational modes. The design lays out in detail the Volpe-identified target requirements for the hull, propulsion plant, maneuverability, electric plant, vessel endurance, cargo storage and passenger/crew areas and amenities, and cites regulations the vessel must conform with.

The Volpe Center then developed a solicitation for the preliminary design of the *Ranger IV*, awarding the contract to a naval architecture firm in December 2022. Work started on this contract in March 2023. This preliminary design, reflecting the basis of design requirements, will provide the drawings (e.g., arrangements, layouts, furnishings, internal components) and design specifications for the vessel. The Volpe Center’s naval architects are managing the contract and will perform design reviews throughout the process. Approval of the completed preliminary design is due in April 2024.

The final design, construction, and outfitting will be accomplished by the ship builder. The goal is to have *Ranger IV* ready for service before the scheduled dry docking of *Ranger III* in 2027.
(Sponsor: NPS)

DEFENSE MODERNIZATION

U.S. DOT Volpe Center Modernizes Locomotives and Railway Rolling Stock for the Department of Defense

The Department of Defense (DoD) is modernizing outdated railroad equipment to provide quieter and more efficient locomotives, reduce harmful greenhouse gas (GHG) emissions, and increase operational capabilities and safety. The DoD faces a dilemma as new railroad locomotives and rolling

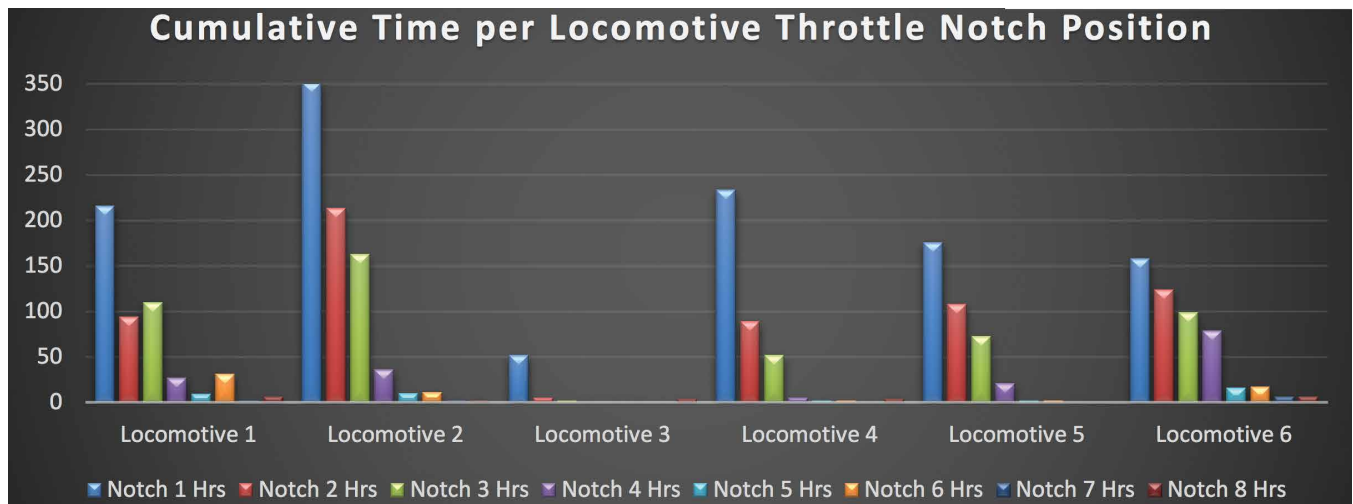
stock have increased in size and overall capacity and some military rail installations cannot accommodate newer and larger equipment. Retrofitting existing railroad technology and infrastructure will require innovative solutions to design and manufacture new rolling stock and equipment.

The U.S. DOT Volpe Center has supported the DoD’s high priority modernization efforts for over 30 years and has replaced obsolete units with modern engines to reduce the age of the rail fleet and provide greener solutions. Volpe Center engineers assess current conditions related to DoD rail infrastructure and provide information for DoD decisionmakers that enables better management of modernization strategies, lowers the age of locomotive and railway rolling stock fleets, reduces harmful GHG emissions, and assists with creating safer, more efficient, modern, and manageable assets that strengthen DoD mission capabilities.

During 2023, the Volpe Center was actively involved with replacing outdated Air Force and Army diesel locomotives that have unregulated emissions with modern locomotives that provide ultra-low emitting technology. To increase DoD’s safety and mission capability, the Volpe Center is currently involved with replacing smaller Navy industrial-sized locomotives with new motive power technology that offers right type/right size units, reduced exhaust gas emissions, and enhanced operator visibility. For each locomotive the Volpe Center replaces, particulate matter is reduced by 94 percent; hydrocarbons by 96 percent; and oxides of nitrogen by 94 percent. To date, the Volpe Center has replaced 35 locomotives and is currently assessing the remaining locomotives in the DoD fleet to determine the best strategy for moving forward.

This modernization effort has positively affected DoD military sites in 12 states across the U.S., and future efforts will have positive impacts in 22 additional states. *(Sponsor: U.S. Army Tank-Automotive and Armaments Command [TACOM]; U.S. Navy Facilities Engineering and Expeditionary Warfare Center [NAFVAC EXWC]; U.S. Air Force Life Cycle Management Center, Support Equipment and Vehicles)*

To evaluate conditions for determining the most efficient and viable replacement technologies, Volpe Center engineers analyze locomotive power versus time information. The plot shown here consists of a locomotive sample size of six and displays the time spent in each throttle notch position of operating locomotives. *Source: Barry Mickela/U.S. DOT Volpe Center*

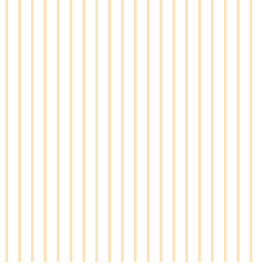


Equity



Adobe Stock

In support of U.S. DOT's Equity strategic goal, the U.S. DOT Volpe Center is supporting programs and initiatives aimed at reducing inequities across our transportation systems and the communities they affect.



JUSTICE40 INITIATIVE

Educating Communities on Transportation Equity Initiatives

As part of the [Justice40 Initiative](#), created by the Biden-Harris Administration, U.S. DOT is developing tools to help communities understand the cumulative impacts that result from a lack of affordable, safe, multimodal transportation options, and how to connect communities to the benefits U.S. DOT's projects are expected to deliver.

The Office of the Secretary of Transportation for Policy (OST-P) asked the U.S. DOT Volpe Center to assist in developing an ArcGIS StoryMap on the Justice40 Initiative. The StoryMap illustrates U.S. DOT's approach to the initiative and includes three case studies that use the agency's newly released ETC Explorer to demonstrate the connection between the components of disadvantage and project benefits that may help reverse or mitigate how a community experiences disadvantage.

The Volpe Center staff's experience in crafting highly visible and notable StoryMaps on behalf of the U.S. DOT and prior support to the Department's equity portfolio positioned them to assist OST-P with this project. Volpe Center staff helped outline and construct the StoryMap, and developed dynamic and interactive representations of the ETC Explorer results that were embedded in the StoryMap's case studies. Volpe Center staff were responsible for the visual aesthetic and flow of the story, crafting custom themes of fonts, colors, section separators, and other formatting features.

The Justice40 StoryMap was released to the public in May 2023. In the first month of its release, the StoryMap garnered more than 3,100 views, averaging about 90 views per day. Though this component of the Justice40 Initiative is complete, the Volpe Center will continue to support the initiative in other ways, as well as other equity initiatives for OST-P. Through the Justice40 Initiative and ETC Explorer, U.S. DOT is providing metropolitan planning organizations, state DOTs, and local decision makers with the tools to help select projects that meet the transportation needs of areas, which in turn will help strengthen communities and create more equitable opportunities to improve daily life.
(Sponsor: OST-P)

ACCESSIBILITY

Final Regulatory Impact Analysis for Public Rights-of-Way Accessibility Guidelines

Over 20 million Americans have a vision- or mobility-related disability that can affect their access to the transportation system, and it is estimated that Americans with a travel-limiting disability make 7 million or more pedestrian trips per day. The Americans with Disabilities Act (ADA) recognizes and

protects the civil rights of people with disabilities and is modeled after earlier landmark laws prohibiting discrimination on the basis of race and gender. To ensure buildings and facilities are accessible to and usable by people with disabilities, the ADA establishes accessibility requirements for state and

Ensuring the Accessibility of Pedestrian Facilities in the Public Right-of-Way

WHAT WILL IT TAKE TO CREATE A MORE ACCESSIBLE TRANSPORTATION SYSTEM?

Over 20 million Americans

have a vision- or mobility-related disability that affects their ability to use the transportation system.

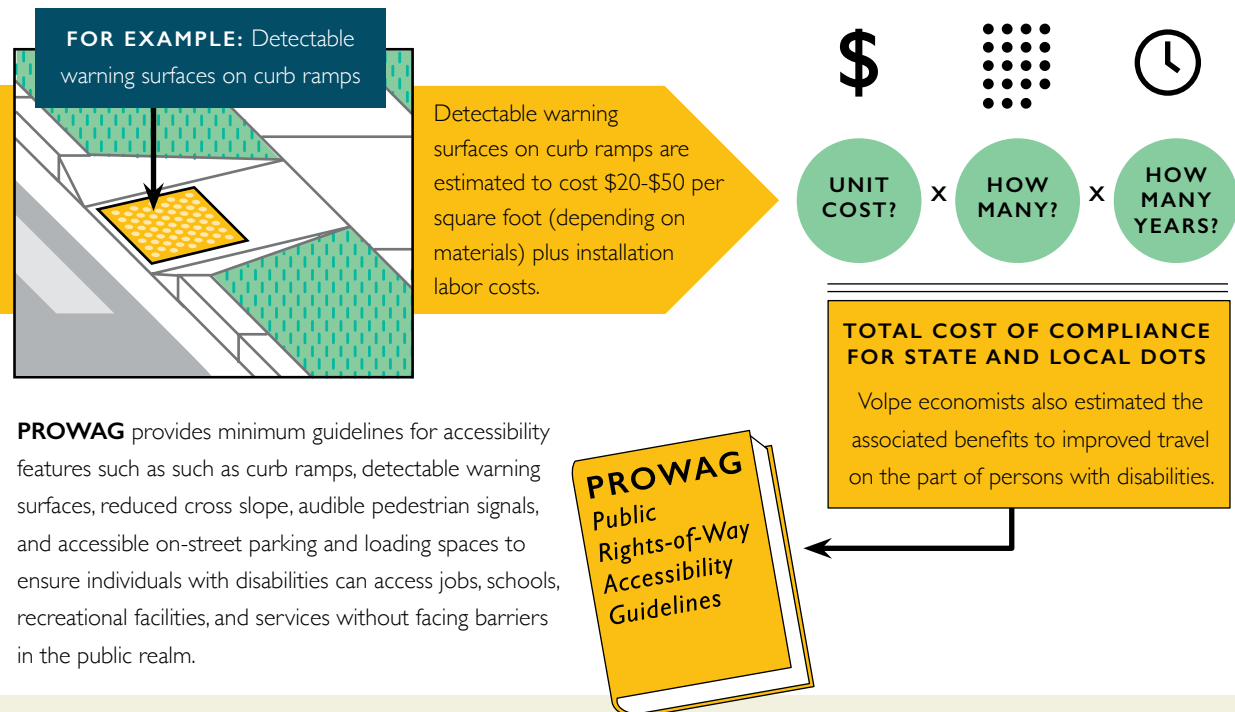


7 million pedestrian trips

per day are made by Americans with a travel-limiting disability. ([U.S. Census Bureau](https://www.census.gov)*)

In 2023, the U.S. DOT Volpe Center delivered a regulatory impact analysis (RIA) for the U.S. Access Board's **Public Rights-of-Way Accessibility Guidelines (PROWAG)**.**

A Volpe team performed a literature review and economic analysis of each major PROWAG provision, compiled the results in a RIA, and responded to comments from the **Office of Management and Budget** and other stakeholders. The U.S. DOT Volpe Center has supported this work since 2010, as PROWAG has been refined over time.



PROWAG provides minimum guidelines for accessibility features such as such as curb ramps, detectable warning surfaces, reduced cross slope, audible pedestrian signals, and accessible on-street parking and loading spaces to ensure individuals with disabilities can access jobs, schools, recreational facilities, and services without facing barriers in the public realm.

The [final rule](#) was published by the Architectural and Transportation Barriers Compliance Board on August 8, 2023.



01/2024

* <https://www.census.gov/newsroom/facts-for-features/2021/disabilities-act.html>

** <https://www.access-board.gov/prowag/>

local government facilities, places of public accommodation, and commercial facilities. Additionally, the Architectural Barriers Act (ABA) requires access to certain facilities designed, built, altered, or leased with federal funds.

The U.S. Access Board issued its final rule on the Public Right-of-Way Accessibility Guidelines (PROWAG) for public rights-of-way and shared use paths under the ADA and ABA in August 2023. The Board has extensively coordinated with the Department of Justice and Department of Transportation, both of which will eventually adopt enforceable standards that meet or exceed the level of accessibility as stated in the guidelines. Although much progress has already been made in accommodating the needs of the mobility-disabled, final adoption of these standards will create a significant improvement in pedestrian accessibility for these Americans.

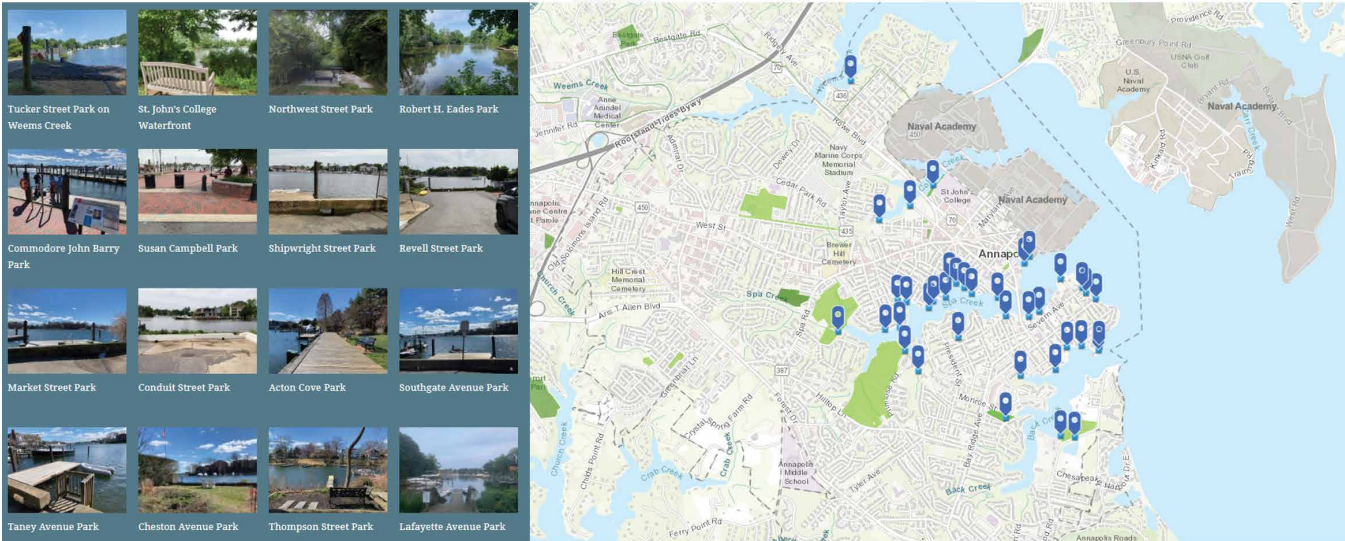
Applicable to both newly built pedestrian facilities and alterations of existing facilities, PROWAG will address access to sidewalks and streets, crosswalks, curb ramps, pedestrian signals, on-street parking, and other components of public rights-of-way. These guidelines also review shared-use paths, which are designed primarily for use by bicyclists and pedestrians for transportation and recreation purposes. Provisions such as curb ramps, detectable warning surfaces, reduced cross-slope, accessible (audible) pedestrian signals, and accessible on-street parking and loading spaces will help ensure Americans with disabilities can access jobs, schools, recreational facilities, and services without facing barriers in the public realm.

At the U.S. Access Board's request, the Volpe Center developed, performed, and finalized the regulatory impact analysis (RIA) that provides estimates of the compliance costs of PROWAG and the expected benefits required for approval of new regulations. The Volpe Center has assisted the U.S. Access Board with continued refinement of the PROWAG proposal. Following a literature review, the Volpe team conducted an economic analysis of each major PROWAG provision. A draft regulatory impact document presenting the compiled results was submitted for review by the Office of Management and Budget and stakeholders, and the Volpe Center responded to their respective comments.

A [final rule](#) on the Public Right-of-Way Accessibility Guidelines was issued by the U.S. Access Board on August 8, 2023. (*Sponsor: U.S. Access Board*)

Using GIS and ArcGIS StoryMap to Help the City of Annapolis Improve Access to Public Water Parks

The U.S. DOT Volpe Center entered into an Interagency Agreement with the National Park Service (NPS) Chesapeake Gateways Office (NPS Chesapeake Gateways) to provide multimodal transportation and access consultations and technical assistance to Chesapeake Gateways places, communities, and partners. The Volpe Center's work helps to improve equitable, multimodal, public access to the Chesapeake Bay and its watershed.



The City of Annapolis, Maryland was identified by NPS Chesapeake Gateways as a [Gateways partner](#) to help conserve and provide access to the cultural, natural, and recreational resources of the Chesapeake Bay. The Volpe Center team was asked by the NPS Chesapeake Gateways to provide technical expertise to the city to expand public water access citywide and support the implementation of NPS Chesapeake Gateways’ Strategic Plan. Beginning in September 2021, the Volpe Center supported the City of Annapolis by facilitating a planning process to develop the Annapolis Equitable Public Water Access Plan and ArcGIS StoryMap. A StoryMap is a web-based application that includes an interactive map as well as descriptive text and multimedia content. The ArcGIS StoryMap was completed and delivered to the City of Annapolis in April 2023.

Annapolis Public Water Access Parks StoryMap and Collection. Source: City of Annapolis.

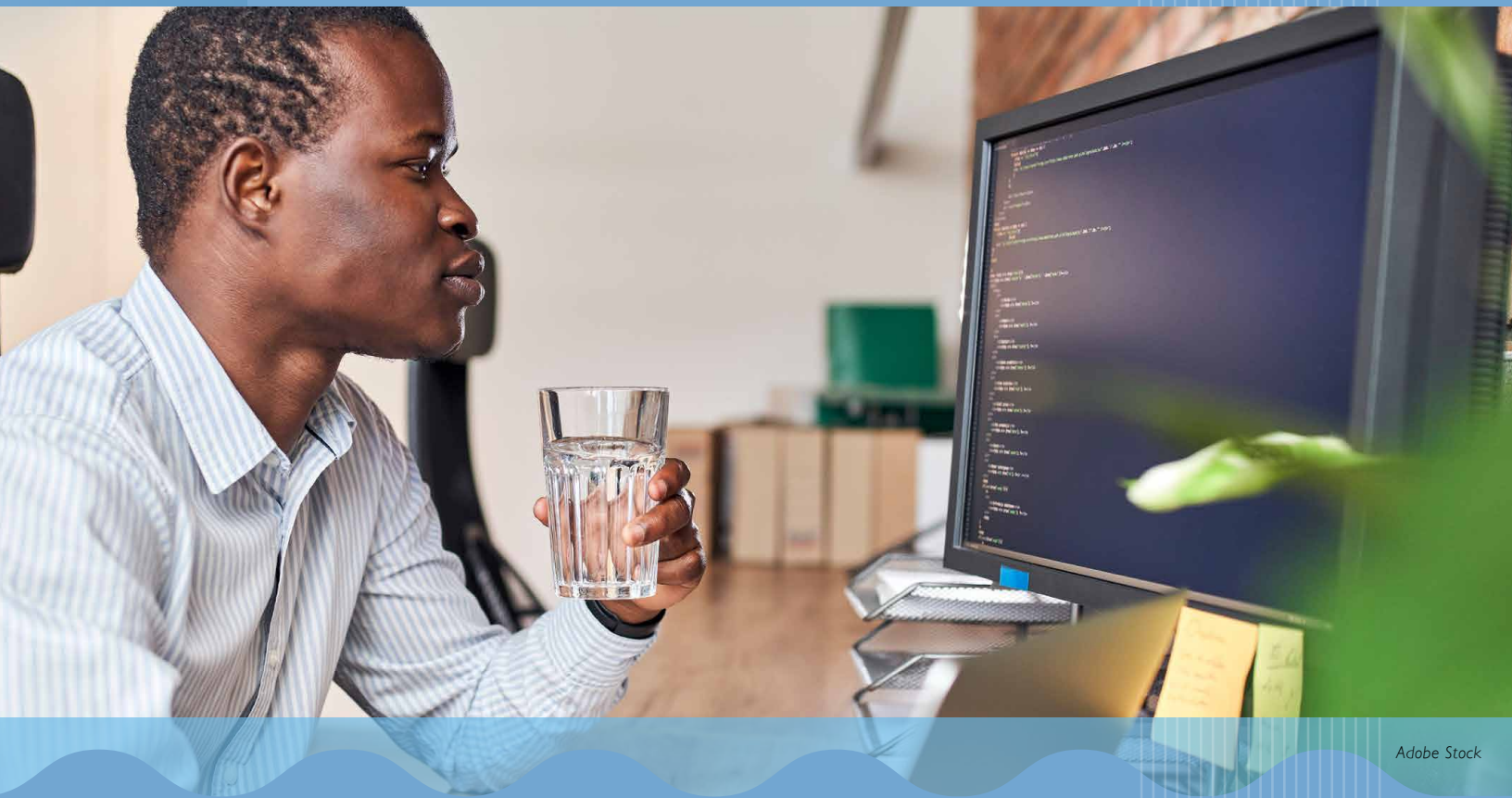
The Volpe Center provided GIS expertise to the Annapolis Equitable Public Water Access Plan that consisted of the following: 1) Creating a GIS point layer of existing public water access parks located in the City of Annapolis; 2) Creating a set of static maps of Annapolis’ existing public water access parks; and 3) Designing a StoryMap of these existing public water access parks for integration with the City of Annapolis’ public website as a public tool to help promote the city’s network of public water access parks. To create the GIS point layer of existing public water access parks, the Volpe Center team utilized several resources, including existing Annapolis data layers with several parks already geolocated, descriptions of street end park locations supplied by the City of Annapolis, a survey of parks supervised by the Volpe Center team, and verification of park locations by City of Annapolis staff. The resulting point layer of water access parks was joined with survey data of park characteristics and used for display and information in the static maps and StoryMaps.

To create static maps of Annapolis’ existing public water access park locations, the Volpe team produced a set of maps of different extents and sizes. The maps included small-scale maps of the City of Annapolis, a regional map of the city and surrounding areas, and large-scale maps of four individual Annapolis subwatersheds. These maps were used for publications and large-scale presentations at public meetings.

The City of Annapolis requested an ESRI ArcGIS StoryMap for public use that displays the city's existing public water access parks with a description of each park. The city also requested the design of several StoryMaps based on different activities, such as fishing, swimming, and watercraft launch access. Since several StoryMaps would be created, a collaborative decision was made between the Volpe Center and the City of Annapolis to create an ArcGIS StoryMap Collection that would best suit this purpose. A StoryMap Collection is a group of ArcGIS StoryMaps accessed from the same web page, which allows easy navigation between StoryMaps. The Annapolis collection includes a total of six StoryMaps: a StoryMap of all of the existing public water access parks and five activity based StoryMaps. A link to the City of Annapolis' current Park Locator Web Application is also included on the StoryMap Collection web page.

An individual StoryMap can be accessed by clicking on the desired StoryMap picture on the collection web page. The user is then taken to the selected StoryMap, which includes a picture of each water access park in a grid layout, as well as a map of the parks' locations. When an individual park picture or a point on the map is selected, the map zooms in to the selected park's location and a description of the park is displayed. When the map is zoomed in, other layers such as bicycle facilities, bus routes, and bus stops are displayed to assist the user with more local context. Other StoryMaps are also listed at the top of each web page so the user can easily switch between StoryMaps. The Annapolis StoryMaps will be made available on the city's website in early 2024 for the public to use for locating public water access sites and identifying each site's amenities. *(Sponsor: City of Annapolis, MD / National Park Service Office of the Chesapeake Bay [CHBA])*

Small Business Innovation Research



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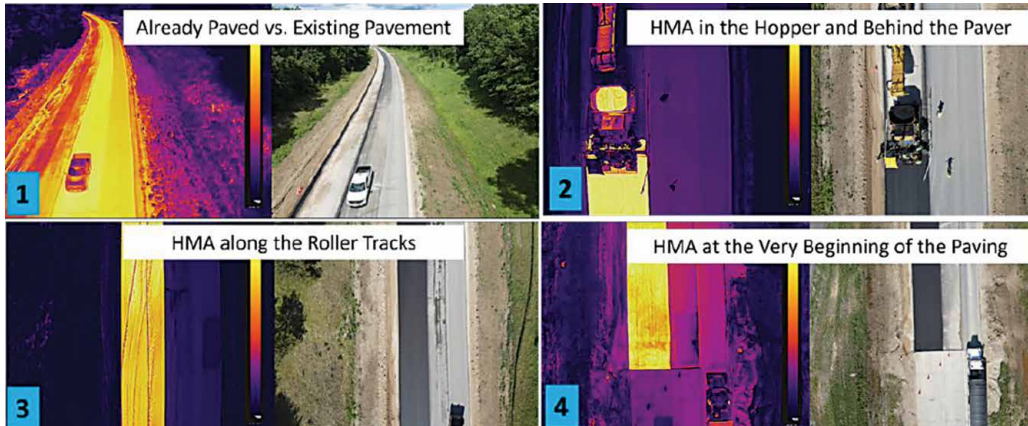
The U.S. DOT Volpe Center administers the Department's Small Business Innovation Research (SBIR) Program on behalf of the Office of the Secretary of Transportation. Small businesses that participate in the Department's SBIR Program have developed many new and innovative technologies that have benefited the Department and the public and have helped small businesses grow.

EMPOWERING INNOVATIVE SOLUTIONS

Using Unmanned Aircraft Systems to Remotely Inspect Tracks and Highway-Rail Grade Crossings

The U.S. DOT's Small Business Innovation Research (SBIR) program awards over \$10 million annually to small businesses to enable research on and development of innovative solutions to our nation's transportation challenges. The highly competitive program encourages small businesses to explore their technological potential and provides the incentive to profit from its commercialization. Small businesses that participate in the SBIR program have developed numerous new and innovative technologies that have benefited the U.S. DOT and the public, while providing a basis for growth for small businesses. The U.S. DOT Volpe Center administers the SBIR program on behalf of the U.S. DOT and partners with funding operating administrations and small businesses alike in working toward a successful outcome that can benefit the nation's transportation system.

One highlight stemming from the U.S. DOT's 2023 SBIR program was seeing the transferability of research applications from one mode to another. In 2023, two FTA-sponsored SBIR Phase III



Drone thermal image of an asphalt paving project taken by PI Brooks, showing how this sensor solution can find thermal anomaly hot spots. This capability will be helpful in finding safety problems such as electrical arcing locations in confined space tunnel environments. Bright yellow areas are the warmest; coolest areas are dark purple. *Source: MTRI*

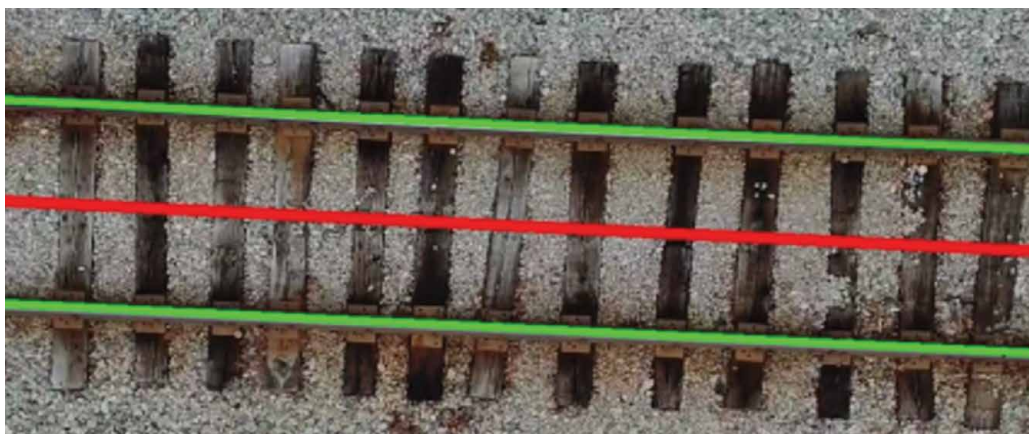


Example of using the Flyability Elios "drone in a cage" solution for Dr. Brooks' research on drone-assisted bridge inspection for Michigan DOT. A similar capability will be evaluated for use in confined space transit tunnel situations for this Phase III effort. *Source: MTRI*



During this task, the project team will add the ability for users to capture photos or videos through the mobile application during an inspection. This feature will provide users with a photo and video log to review after an inspection flight is completed. This task will require integrating commands from DJI's mobile SDK to control the primary camera payload.

Source: VisioStack



Track Centerline Detection.

Source: VisioStack

projects were initiated that iterate on previous FRA-funded Phase II research focused on unmanned aircraft systems (UAS) for highway-rail grade crossing data collection, now applying the technology to the inspection of transit rail systems, especially tracks. This mutual interest in UAS across two modes showcases how the SBIR program's research can benefit the greater transportation industry. With this new FTA-funded work, previous FRA-funded applications using the Crossing-I SBIR project by the Michigan Tech Research Institute (MTRI) and the Aerial Crossing Inspection System (AXIS) project by VisioStack will partner with public transit agencies, such as Chicago Transit Authority, in their respective areas in Michigan and Chicago to develop use-cases for their inspection systems.

Both projects aim to develop robust, drone-based inspection systems for transit agencies. Specific results include enhanced flight navigation capabilities for GPS-denied regions, integration of a spotlight payload for low-light and tunnel inspections, and a mobile app to control the system and view feedback from onboard payloads. The project addresses the challenge of ensuring safety at highway-rail grade crossings and in transit rail systems, where incidents between trains, vehicles, and pedestrians can occur. While both programs are working on adapting their technologies to public transit environments and using artificial intelligence to analyze imagery, they each have different aspects to address. VisioStack's AXIS research is currently targeting flight capabilities in GPS-denied locations, low-light conditions, conducting track and assist operations when transit cars catch fire,

and improving its mobile application. MTRI Crossing-I focuses on automated monitoring and developing sensors that work in conjunction with traditional optical sensors.

These efforts will enable transit agencies to perform safer and more efficient inspections, especially in challenging environments. This innovative work will enhance response capabilities during emergencies, such as transit car fires, leading to improved safety and potentially preventing accidents.

Bridging the gap between research and practical application, the SBIR program empowers innovative solutions to improve safety, efficiency, and overall performance across various transportation sectors, thus making a lasting impact on the industry and the public at large. *(Sponsor: FTA)*



Autonomous Inspection System. Source: VisioStack

Thought Leadership



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The U.S. DOT Volpe Center looks beyond the horizon to anticipate future issues and discuss fresh approaches to emerging transportation challenges.

Delivering the Benefits of the Bipartisan Infrastructure Law Thought Leadership Series

The U.S. DOT's new Project Delivery Center of Excellence at the U.S. DOT Volpe Center sponsored the Delivering the Benefits of the Bipartisan Infrastructure Law (BIL) thought leadership series. As part of the Center of Excellence's charge to help support the delivery of transportation infrastructure projects more efficiently and effectively from concept to completion, the virtual series was designed to enable BIL project sponsors and other members of the transportation community to learn from and engage with transportation project delivery experts.

The series ran from July to November 2023. Over 20 expert speakers provided perspectives on best practices for project delivery and successful projects that make the transportation system safer, usher in a new era of clean energy and sustainable transportation, promote equity, connect communities, create good-paying jobs, and boost American manufacturing.

Key series themes included:

- Best practices in project delivery and lessons learned
- Identifying and managing common project delivery risks
- Embedding equity in project delivery
- Using National Environmental Policy Act (NEPA) review to define and shape better projects
- Innovative approaches to finance and project delivery

The following provides a brief overview of the eight-part series.

ON TIME, ON TASK, ON BUDGET

July 26, 2023

U.S. Transportation Secretary Pete Buttigieg launched the new U.S. DOT Project Delivery Center of Excellence and delivered keynote remarks at the kickoff of the thought leadership series. Professor Bent Flyvbjerg, the author of *How Big Things Get Done* and *Megaprojects and Risk*, joined the Secretary in the July 26 conversation about the importance of transportation infrastructure project delivery.

Secretary Buttigieg noted that many of the event's almost 800 attendees across the transportation enterprise were a part of the story of the passage of the monumental BIL, and now it's time to be part of the story of "how we make good on its potential."



Secretary Buttigieg emphasized the need for timely, on-budget delivery, stressing the responsibility of non-federal entities to ensure success. He highlighted U.S. DOT's commitment to partnering with project sponsors, leveraging tools like the Project Delivery Center of Excellence to bridge gaps between practitioners and thought leaders. The Secretary urged thorough planning before project initiation, citing Professor Bent Flyvbjerg's advice on "slow thinking" to enable faster, well-informed execution.



Pete Buttigieg, U.S. Transportation Secretary

“We are optimistic about what can be done, but we also know that it won’t happen on its own. The Volpe Center is such a great place to host this thought leadership [as] thought leaders for our Department and an extraordinary global hub for transportation expertise.”

“Now is the best chance probably in our lifetimes in the United States to transform our transportation systems for the better, to make communities safer, to make transportation cleaner, to advance equity, and to connect people to the resources, opportunities, and jobs that are going to shape their lives.”

Secretary Pete Buttigieg



Bent Flyvbjerg, First BT Professor and Inaugural Chair of Major Programme Management, Oxford University's Saïd Business School and Villum Kann Rasmussen Professor and Chair of Major Program Management, IT University of Copenhagen

Professor Flyvbjerg shared insights on starting projects the right way, long before construction begins, and “slow thinking” prior to acting fast and delivering. He emphasized the importance of learning from both project failures and successes, warning against the uniqueness bias and advocating for leveraging shared experiences across similar project types. The discussion also stressed managing risks comprehensively and engaging communities meaningfully.

“It sounds like a paradox. But if you want to go fast, you’ve got to go slow first.”

“You’re increasing the risk that your project is going to fail enormously if you don’t benefit from all the learning that is out there.”

Bent Flyvbjerg

THINKING OUTSIDE THE BOX: INNOVATING FOR BETTER PROJECT DELIVERY

August 3, 2023

Carlos Braceras emphasized the critical role of speed in project delivery and the significance of alternative delivery methods such as design-build and progressive design-build. Drawing from his experience at UDOT, Braceras recommended aligning project goals with the appropriate delivery tool. He also stressed the importance of building strong relationships between owners and contractors, focusing on listening, learning, and making decisions together for the project's success.



Carlos M. Braceras, Executive Director, Utah Department of Transportation (UDOT)

“If a project is worth doing, it’s worth delivering fast.”

Carlos M. Braceras

Paula Hammond underscored the significance of timely infrastructure funding to improve the transportation system and ultimately benefit communities. She stressed the importance of partnerships and collaboration among various stakeholders, particularly emphasizing early engagement with local governments and communities for successful project outcomes. She noted their partnership and collaboration are essential throughout planning, designing, and building projects.

“Our transportation system is badly in need of investment, and we’ve got a real shot in the arm and opportunity with the Bipartisan Infrastructure Law.”

Paula Hammond



Paula Hammond, Chair, American Road and Transport Builders Association and Senior Vice President, WSP USA

HOW CITIES ARE REINVENTING PROJECT DELIVERY

August 10, 2023

Highlighting the findings from the nonprofit City Thread, Kyle Wagenschutz discussed how cities and municipalities across the country can accelerate building and completing mobility networks. He highlighted traffic congestion, climate change, and economic development among the shared challenges that U.S. communities face.

“One of the joys that we have in working with local communities is that we get to meet and work with people on the ground who are trying to tackle really big challenges. And those challenges sometimes are the challenges that many cities across the country and around the world face every single day.”

Kyle Wagenschutz

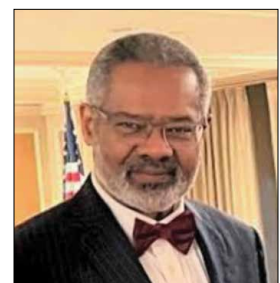


Kyle Wagenschutz, Urban Mobility Planner, City Thread

Eric Macfarlane focused on DDC’s efforts to secure federal funding for various capital projects across city agencies. He shared insights from the formation of a Federal Infrastructure Funding Task Force to help standardize funding requests and manage the multitude of projects from different agencies in preparation for New York City’s planned request of \$2.5 billion by the year’s end.

“We have a continuous focus on planning better, designing better, and building better,” said Macfarlane, noting DDC’s efforts to improve the capital project delivery process through better planning, designing, and building.”

Eric C. Macfarlane



Eric C. Macfarlane, First Deputy Commissioner, New York City Department of Design and Construction (DDC)

San Diego Mayor Gloria discussed the city’s dedication to leveraging the historic opportunities presented by the BIL to create a more equitable and transformed urban landscape. He stressed the importance of efficiently utilizing federal funding for projects and highlighted several reform initiatives aimed at optimizing project delivery processes and maximizing external funding, particularly in historically disadvantaged neighborhoods.



Todd Gloria, Mayor,
San Diego, CA

“Now that the federal government has stepped up to provide communities with the funding to build these projects, we need to make sure that we’re set up at the local level to successfully deploy that funding effectively and equitably.”

Mayor Todd Gloria

EMBEDDING EQUITY IN PROJECT DELIVERY

September 7, 2023

Emmanuella Myrthil’s discussion focused on the need to embed equity in the strategic foundation of projects from the outset. She highlighted the importance of explicit equity goals, multifaceted impact assessments, and the necessity of empathetic approaches to infrastructure projects, encouraging open dialogues and psychological safety for all involved. She advocated for moving beyond traditional stakeholder engagement toward active enrollment and fostering a culture of continuous learning and improvement, focusing on mentorship for creativity alongside compliance.



Emmanuella Myrthil, Chief
Equity and Inclusion Officer,
Southeastern Pennsylvania
Transportation Authority

“We don’t want to just monitor for compliance. We want to mentor for creativity.”

Emmanuella Myrthil

LA Metro CEO Wiggins shared insights on how one of the largest transit agencies in the nation is actively putting equity into action in a diverse and dynamic Los Angeles County community. She emphasized the importance of equity in transit and infrastructure projects, highlighting the challenges faced by the region, as well as the agency’s commitment to inclusive and intentional actions.



Stephanie Wiggins,
Chief Executive Officer,
Los Angeles
County Metropolitan
Transportation Authority

Wiggins noted the role of the BIL and the Justice40 Initiative in helping to ensure equity in project construction.

“I believe the most effective way to incorporate equity in the construction part of the project delivery process is through the procurement actions.”

“Now, we’re in an era where the gap between rich and poor has never been greater, and we’re headed into an era where we know climate change is going to affect the poorest the most. We got here because of intentional policy choices, many of which ignored or concealed the impact on communities at the lowest rungs of the income distribution. Intentionality got us here, and intentionality is the only thing that can help lead us toward a brighter, cleaner, and more equitable future.”

Stephanie Wiggins

USING NEPA REVIEW TO DEFINE AND SHAPE BETTER PROJECTS

September 27, 2023

Nancy Daubenberger shed light on Minnesota’s approach to NEPA, showcasing key projects that highlight the state’s commitment to meaningful public engagement and community-centric decision-making. She stressed early and continued engagement with citizens, public officials, and stakeholders at key milestones as crucial in reducing project risks, costs, and delays while building public trust. She also noted the importance of focusing on understanding community needs and aspirations and aligning project goals accordingly.



Nancy Daubenberger,
Transportation
Commissioner, Minnesota

“It’s not about better environmental documents or processes, but better engagement and decision-making in the project development process.”

Nancy Daubenberger

Kammy Horne shared how NEPA plays a pivotal role in shaping successful projects in San Antonio. She highlighted Via Metropolitan Transit’s focus on early coordination, deliberate outreach, and creative tools to define and refine projects for the benefit of the community, such as tele-town hall presentations, panel discussions, an informative website, and a public outreach office.



Kammy Horne, Senior Vice
President of Development
and Planning, Via
Metropolitan Transit,
San Antonio, TX

“We were deliberate in asking questions from the public, and also our other stakeholders, in terms of what are your concerns?”

Kammy Horne

Megan Blum stressed that NEPA is not just a set of regulations but a roadmap to better decision-making. She shared how NEPA can be harnessed effectively to drive better outcomes for projects and the environment. By embracing its principles, incorporating diverse perspectives, planning early, and utilizing tools like annotated outlines and graphics, project teams can streamline their NEPA journey.



Megan Blum, Director for
the Office of Environmental
Programs, Federal Transit
Administration (FTA)

“Sometimes going back to the basics is the way to go. It’s the best way to move forward, and by having these conversations early in the process, the team should experience an expedited environmental review and document development.”

Megan Blum

Emily Biondi provided insight into FHWA’s role in utilizing NEPA to streamline decision-making processes and achieve better outcomes for communities across the United States. She emphasized the need for the NEPA process to be open and collaborative, stressing the importance of extensive public involvement and community engagement.



Emily Biondi, Associate
Administrator for Planning,
Environment, and Realty,
Federal Highway
Administration (FHWA)

“Federal Highway Administration has long been a leader in improving the environmental review and permitting process.”

Emily Biondi

ACCELERATING PROJECT DELIVERY THROUGH INNOVATIVE PROCUREMENT, PARTNERSHIPS, AND FINANCING METHODS: PART I

October 12, 2023

Dr. Farajian highlighted the U.S. DOT Build America Bureau's role as a consolidated resource, offering various funding programs, flexible financing options, and technical support to make projects more cost-effective. He noted that the Bureau is more than just a funding source; it also encourages projects that align with the U.S. DOT's strategic goals. He shared a few initiatives that stimulate project development and provide options for critical infrastructure improvements such as TIFIA 49, Transit-Oriented Development, and the Rural Project Initiative.



Morteza Farajian, PhD,
Executive Director, U.S. DOT
Build America Bureau

“Project sponsors who are trying to learn a little bit more about innovative project delivery, innovative funding, and financing options don't have to go to different operating administrators...They can come to us, and we'll be able to help them.”

Morteza Farajian, PhD

Maria Lehman discussed the importance of addressing workforce challenges that affect everything from planning and design to construction and long-term maintenance, investing in infrastructure, and ensuring resiliency in infrastructure. She stressed the need to leverage all available tools to achieve infrastructure goals, specifically recommending use of parallel processes, senior advisory teams that meet regularly, and extensive and transparent stakeholder engagement. She also highlighted ASCE's commitment to timely project delivery through development of technical and financial capabilities, such as the Engineers Joint Contract Documents Committee (EJCDC) templates that help to significantly expedite project delivery and facilitate efficient contracting processes, especially for the vast number of entities eligible for grant funding under the BIL.



Maria C. Lehman, PE, ENV SP,
F.ASCE, President, American
Society of Civil Engineers

“These fill-in-the-blank resources help communities that don't have the knowledge and provide that extra help that they need without having a whole lot of extra people involved.”

Maria C. Lehman, PE, ENV SP, F.ASCE

Adie Tomer shared insights on the current state of infrastructure investment and the challenges facing transportation projects in the United States. He offered a high-level perspective from a research institution, focusing on the macro-level fiscal environment, core challenges in project delivery, and ongoing innovations and gaps in the transportation sector. He recommended aligning projects with societal values, ensuring accurate asset inventories, addressing workforce gaps, and using innovative approaches to transform the transportation landscape.



Adie Tomer, Senior Fellow,
Brookings Institute

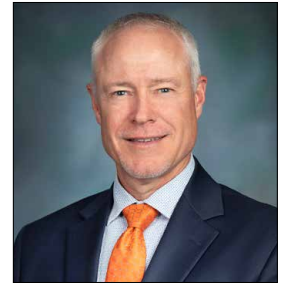
“There are a ton of opportunities and innovations underway, but there are still some kind of root and core challenges we need to think differently about if we want to actually deliver the kinds of projects that set up America for long-term success in the transportation space.”

Adie Tomer

ACCELERATING PROJECT DELIVERY THROUGH INNOVATIVE PROCUREMENT, PARTNERSHIPS, AND FINANCING METHODS: PART 2

October 26, 2023

Brad Wieferich shared insights from Michigan’s innovative infrastructure projects and progressive approach to transportation development. He highlighted the I-375 Reconnecting Community Project in Detroit and the I-75 Modernization in Oakland County as examples of Michigan’s commitment to community engagement, resilience, and efficient project delivery. He focused on their approaches to address historical injustices, promote equity, and minimize project durations and costs while maximizing efficiency.



Brad Wieferich, Acting Director and Chief Operations Officer, Michigan Department of Transportation

“We’ll never be able to right a wrong, but we know that we have some work to do to make sure that we’re acknowledging some of the social and environmental justice issues here.”

Brad Wieferich

Susan Shaw discussed her experience and perspectives from an owner’s standpoint in project delivery. Focusing on her years of experience with the Virginia Department of Transportation, Shaw highlighted the significance of effective partnerships throughout the project lifecycle. Whether in project development, procurement, or design and construction, she asserted that collaboration with internal teams, external agencies, and the public is vital for successful infrastructure projects. She offered Virginia’s I-66 Express Lanes network serves as an example of how strategic partnerships can lead to innovative and efficient project delivery, ultimately benefiting the public and stakeholders. She also highlighted multimodal integration and innovative procurement approaches as essential components for successful infrastructure initiatives.



Susan Shaw, PE, DBIA, CCM, Vice President, Subject Matter Expert – Major Program Development, ATCS

“One of the important things was to have as a goal of the project to move more people, not to move more vehicles.”

Susan Shaw, PE, DBIA, CCM

Mike Johnson shared insights on the challenges and opportunities associated with modern infrastructure development. He focused on the importance of aligning delivery methods with the complexities of projects, managing risks, and ensuring transparency and collaboration at every stage. He also highlighted adaptability to the ever-changing demands of infrastructure development; a commitment to addressing the needs of communities and stakeholders; and utilization of diverse delivery methods as keys to success.



Mike Johnson, Senior Vice President – Infrastructure Market & Strategy, Kiewit

“I think the main word in all these projects that drive success is transparency, transparency with the clients, and transparency with the design builder alike are going to bring project success.”

Mike Johnson

SERIES FINALE: COMMEMORATING THE SECOND ANNIVERSARY OF THE BIPARTISAN INFRASTRUCTURE LAW (BIL)

November 15, 2023

Deputy Secretary Polly Trottenberg delivered the opening message for the finale of the thought leadership series. Reflecting on the signing of the Infrastructure Investment and Jobs Act, she emphasized the importance of utilizing resources effectively for lasting community impact and highlighted successful projects, like the 14th Street Bridge in Washington DC, that were funded by such investments. She stressed the challenge of timely and budget-friendly project delivery, praising the Project Delivery Center of Excellence for promoting successful models.



Polly Trottenberg, Deputy Secretary, U.S. Department of Transportation

“Two years ago today, President Biden signed the Infrastructure Investment and Jobs Act into law. That by itself is a historic accomplishment...And yet passing the law is just the beginning. The even harder part is ensuring that those resources are put to the best possible use, so they make a meaningful and lasting difference in people’s lives and communities.”

Polly Trottenberg

Governor Moore focused on the significance of the Biden-Harris Administration’s support for Maryland, particularly Baltimore, highlighting recent projects funded by the BIL. He discussed job creation, economic progress, and the transformative impact of partnerships between the state and federal government.



Wes Moore, Governor, Maryland

“It’s not enough to create good jobs. We need to create good-paying union jobs with high labor standards and that actually support job training.”

“The only way you’re going to get big things done is by listening and by collaborating. And you really don’t need to look any further than the Bipartisan Infrastructure Law to see what that actually looks like in practice.”

Governor Wes Moore

Thomas Nissalke shared his experience with Hartsfield-Jackson Atlanta International Airport’s Concourse D widening project, made possible through a \$40 million grant from the U.S. DOT and the Federal Aviation Administration. He highlighted the project’s innovative modular construction approach and its commitment to involving minority and female-owned businesses, targeting approximately 40 percent of the project opportunities for these enterprises.



Thomas Nissalke, PhD, Assistant General Manager of Planning and Development, Hartsfield-Jackson Atlanta International Airport

“That will translate to something on the order of about 500 million dollars going to small minority and female business enterprises. And we’re very, very excited about that.”

Thomas Nissalke, PhD

Christopher Puchalsky shared insights from the city of Philadelphia’s approach to revitalizing Roosevelt Boulevard, a major thoroughfare in Philadelphia carrying significant traffic and transit ridership. He emphasized the importance of an extensive planning study, as well as a focus on safety, community engagement, job creation, and economic empowerment as integral parts of the transformative project.



Christopher Puchalsky, PhD, Director of Policy and Strategic Initiatives, city of Philadelphia, Office of Transportation, Infrastructure, and Sustainability

“It was really this planning study that allowed us to win the federal grant, and it’s this work that we did ahead of time, not when the NOFO came out, not a few weeks ahead of time, but for an extended period ahead of time that really set us up for success.”

Christopher Puchalsky, PhD

Engagement and Outreach

The Delivering the Benefits of the BIL thought leadership series engaged over **2,600 stakeholders** from the federal government, state and local agencies, tribal governments and organizations, the private sector; MPOs, nonprofit organizations, academia, and international organizations.

Question and answer periods were held during each event and provided attendees with the opportunity to pose questions to speakers. The series enabled broad discussions and offered diverse insights on themes central to ensuring successful project delivery.

Those working hard to deliver BIL projects and others joined the conversation about delivering infrastructure projects **on time, on task, and on budget.**

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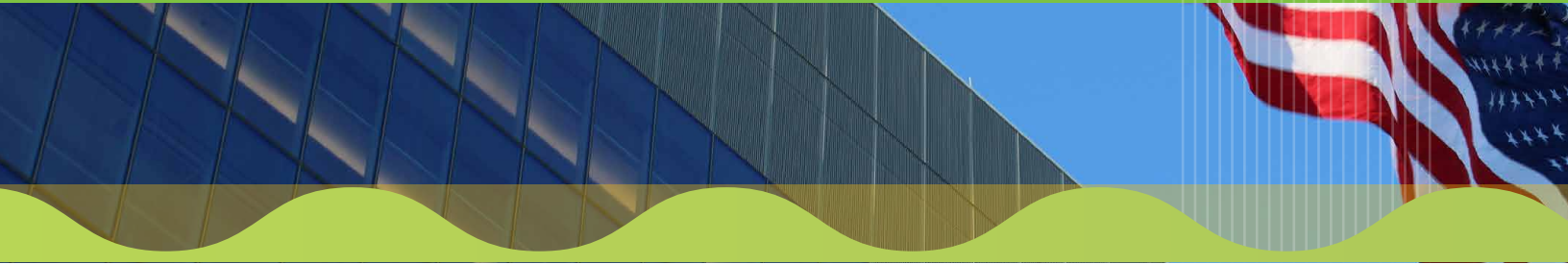
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