The **U.S. Department of Transportation's Volpe Center**
and the **U.S. Department of Defense**

A Successful Partnership

U.S. Department of Transportation

50 YEARS | **Volpe Center**
1970 – 2020
TRANSPORTATION INNOVATION
FOR THE PUBLIC GOOD

The Volpe Center has provided essential support to the DoD for **50 years.**

The U.S. Department of Transportation's (U.S. DOT's) Volpe National Transportation Systems Center (**Volpe Center**) and the U.S. Department of Defense (**DoD**) have had a long-standing **memorandum of understanding** that encourages all DoD commands and organizations to leverage the Volpe Center's world-renowned, multidisciplinary expertise in all modes of transportation.

The agreement was updated in September 2019 and reinforces the U.S. DOT's critical support of DoD's important transportation and logistics-related mission.

Cover: The U.S. DOT Volpe Center helped develop SeaVision, a web-based vessel tracking system that assists countries in combating piracy. Pictured is a U.S. Navy helicopter disrupting an attack on a Philippine-flagged merchant vessel. (Photo: U.S. Navy photo Mass Communication Specialist 3rd Class Robert Guerra)
Below: Locomotive USAX 6518 is one of four EPA Tier 4, Ultra-Low Emitting Locomotives located at Fort Hood Texas. (Photo: U.S. DOT/Volpe Center)

Working Collaboratively in Support of National Objectives

Multimodal Infrastructure Modernization and Planning

Rail

The Volpe Center has provided long-standing technical expertise to the DoD to modernize locomotives and rail infrastructure critical to the U.S. Army's mission. To increase the efficiency, reliability, and safety of operations on U.S. Army installations, the Volpe Center provides engineering expertise, technical specifications, and procures new equipment to service aging railway infrastructure.

Volpe Center engineers perform equipment inspections and assessments, and provide efficient solutions that meet the requirements of specific locations. The U.S. Army has added several highly efficient GenSet Road-Switcher locomotives to its rail fleet.

Aviation

The DoD continues to replace its outdated equipment in control towers and at radar approach control facilities across the globe. The Volpe Center continues to support life-cycle upgrades—including conducting system-level and site engineering activities—to the U.S. Air Force's (USAF's) worldwide air traffic control (ATC) communication, surveillance, and automation infrastructure. The Volpe Center routinely and on an as-needed basis optimizes all of the USAF's Digital Airport Surveillance Radars (DASRs) and the Standard Terminal Automation Replacement System (STARS) using a systems approach.

Volpe Center engineers currently provide requirements development support to the massive, multi-agency, Spectrum Efficient National Surveillance Radar (SENSR) program, which will replace a number of surveillance capabilities, including those for ATC and homeland defense.

The Volpe Center played an important role in the DoD National Airspace System (NAS) Deployable Radar Approach Control (D-RAPCON), an ATC system that can be deployed worldwide in support of U.S. Armed Forces and humanitarian operations. A Volpe Center team recently established the D-RAPCON system performance baseline and verified that it was acceptable for use in the NAS.

Infrastructure Planning and Development

The Volpe Center performs infrastructure planning and development for several branches of the U.S. military.

Volpe experts worked on a program jointly funded and managed by the U.S. Navy and USAF that

constructed the world's most powerful and versatile ionospheric research facility in Gakona, Alaska. Research at the facility was used to analyze basic ionospheric properties and assess the potential for developing ionospheric enhancement technology.

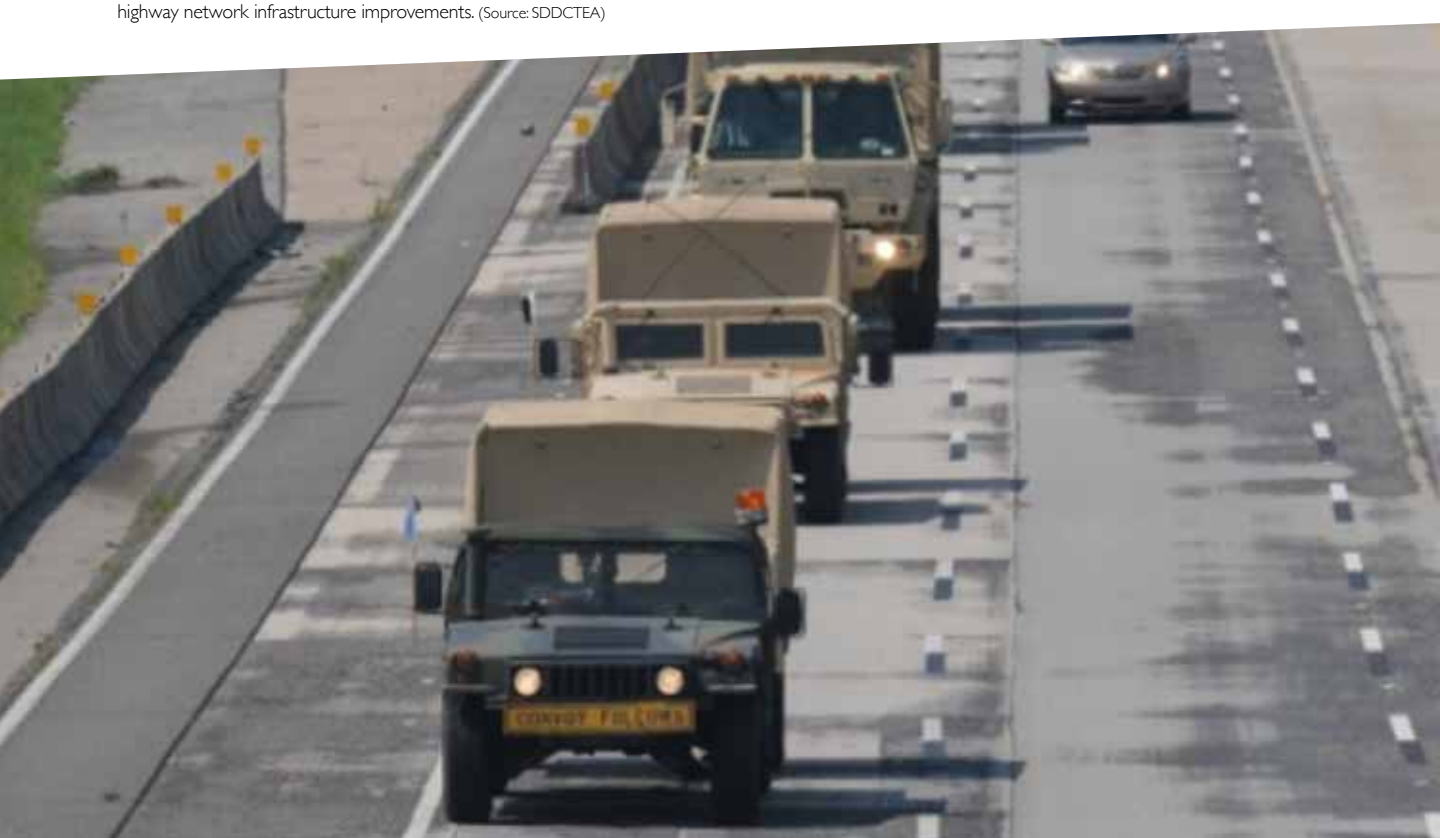
Military Strategic Transportation Program

Volpe Center transportation planners and data scientists are working collaboratively with the Military Surface Deployment and Distribution Command Transportation Engineering Agency (SDDCTEA) and the Federal Highway Administration (FHWA) to develop and implement a Military Strategic Transportation Program. The purpose of the Military Strategic Transportation Program is to improve national security by creating a renewed and dedicated focus on strategic highway network infrastructure improvements, which will allow the military to better meet its deployment and distribution requirements.

Volpe delivered a Surface Transportation Reauthorization Resource Paper (Paper) to SDDCTEA and FHWA in March 2020. The Paper described military transportation needs and proposed statutory recommendations for improving strategic highway network infrastructure conditions and performance. To better characterize military movement challenges and requirements, Volpe data scientists and planners are currently performing a comprehensive analysis of infrastructure conditions, performance, and investment needs on Power Projection Platform routes, which are the highest-priority segments of the strategic highway network. The results of this analysis will be used to better characterize military deployment infrastructure challenges and needs, and will inform refinements to the proposed statutory recommendations.

The Paper also recommended a series of collaboration strategies to FHWA and SDDCTEA for improving conditions and performance on the strategic highway network. The proposed Military Strategic Transportation Program will serve the DoD's broader mission of providing military forces needed to deter war and to protect the security of our nation, and will also support the U.S. DOT's infrastructure, safety, and security-related goals. ■

The Military Strategic Transportation Program focuses on strategic highway network infrastructure improvements. (Source: SDDCTEA)



A rocket successfully launches the Global Positioning System (GPS) IIF-5 satellite for the U.S. Air Force. (Source: United Launch Alliance/Ben Cooper)

Resilience

Global Positioning System

The U.S. DOT is the civil lead for the Global Positioning System (GPS) and works closely with the DoD in the development, acquisition, management, and operation of the GPS. The Volpe Center supports this mission by working with the USAF to provide both systems engineering expertise on implementation of GPS civil signal performance monitoring within the Next Generation GPS Operational Control System and systems support in developing Global Navigation Satellite System (GNSS) capabilities for the GPS Enterprise.

The Volpe Center was instrumental in conducting a GPS Adjacent Band Compatibility Assessment in conjunction with the USAF and other interagency partners. This effort established the technical basis for the executive branch position on the power levels that can be tolerated in the adjacent radio-frequency bands by existing and evolving GPS and GNSS receivers.

The Volpe Center works closely with the DoD and the Department of Homeland Security (DHS) to increase awareness of GPS vulnerabilities, evaluate the impact of the vulnerabilities, and research complementary sources of positioning, navigation, and timing. These efforts increase resiliency for safety-critical transportation applications and make intentional jamming and spoofing of GPS by subversives less desirable.

Minimizing Network Disruptions and Infrastructure Resilience Investment Tools

Various U.S. DOT agencies, including the Office of Intelligence, Security, and Emergency Response (S-60), expressed a need for a nationally applicable modeling tool to calculate regional-scale, all-hazard, disaster impacts on the transportation system to reduce uncertainty and to enhance pre-event planning and after-event recovery capabilities.

The objective is to create a tool that allows Federal and non-Federal partners to determine whether the infrastructure has the ability to withstand, and recover from, extreme weather events and to accurately assess the value of resilience in future infrastructure investments. To achieve this objective, the Volpe Center is developing a novel prototype model—the Benefit Cost Analysis Under Uncertainty—to understand and incorporate resilience into the transportation system's decision-making process. The model will include information for prioritizing projects, weighing trade-offs, and making informed decisions on future infrastructure investments. Objective, performance-based testing of the model will occur during a pilot

project in Hampton Roads, Virginia, home to the world's largest naval base.

Volpe has also worked with the FAA, the Department of Energy's Office of Policy, and the Office of Naval Research to develop the Freight and Fuel Transportation Optimization Tool (FTOT), a scenario-testing tool for evaluating optimal routing and flow of goods and fuels over the transportation network and assessing options for enhancing supply chain performance. The FTOT also enables the exploration of implications of network infrastructure changes due to planned modifications (e.g., investment in network assets) or disruption (e.g., loss of network links or facilities due to hazards such as floods).

Resilient Energy Partnerships

The USAF brought together the Volpe Center, RAND Corporation, the National Renewable Energy Laboratory, the Massachusetts Institute of Technology Lincoln Laboratory, and the Air Force Research Laboratory to develop a comprehensive energy resilience strategy in response to the challenges arising from the USAF's energy vulnerabilities. Beale Air Force Base (AFB) served as the pilot site for the Resilient Energy Demonstration Initiative.

The Volpe Center applied its novel Resilience Toolkit, which provides decision support for future cost-effective energy architecture selections, to the demonstration. The Volpe team created a detailed energy resilience analysis based on Beale AFB data and documented Beale AFB's best resiliency practices for use by the USAF at bases across the globe.

Separately, the Volpe Center partnered with the Advanced Research Projects Agency–Energy (ARPA-E) to assess novel renewable energy technologies for funded projects. The Volpe Center also collaborated with Brown University to assess potential environmental effects of a new tidal energy technology, and with the Naval Research Laboratory and Pennsylvania State University to assess promising transportation applications of their advanced concentrated solar photovoltaic systems for greater distributed power availability and reliability.

Complementary Positioning, Navigation, and Timing Demonstration

The 2018 National Defense Authorization Act (NDAA) directed the U.S. DOT, the DoD, and the DHS to conduct demonstrations of mature technology that increase the resilience of positioning, timing, and navigation (PNT) services serving critical infrastructure and reduce the risks associated with overdependence on GPS.

The Volpe Center is supporting work with U.S. DOT's Office of the Assistant Secretary for Research and Technology and the U.S. Space Force's Space and Missile Systems Command in a partnership to conduct multiple two-week demonstrations in spring 2020 at Joint Base Cape Cod and at National Aeronautics and Space Administration's (NASA's) Langley Research Center. During these demonstrations, Volpe Center staff will field a wide array of PNT technology from 11 vendors at the two demonstration sites to collect positioning and timing data under various scenarios. The effort will include analysis within a framework for applying measures of effectiveness across the scenarios and technologies.

These demonstrations will inform a strategic roadmap for developing a more resilient PNT service to support safety and automation initiatives for aviation, maritime, rail, and surface transportation, and will result in the development of a recommended national PNT decision framework. ■

Cybersecurity

Testing, Awareness, and Collaboration

The Volpe Center's auto cybersecurity lab tests vulnerabilities and the efficacy of cyber intrusion detection devices for vehicle telematics and wireless systems. Volpe engineers and information technology specialists developed guidance for government fleet managers on selecting cybersecurity mitigation solutions, including those for nontactical DoD vehicles for the U.S. Army, U.S. Marine Corps, U.S. Navy, and USAF.

In addition, the Volpe Center provided government fleet managers with a cybersecurity primer to raise their awareness of the responsibility for managing risk related to cybersecurity when selecting and implementing a fleet efficiency management tool. Volpe Center specialists also perform aftermarket device testing on diagnostic tools, fleet management devices, and aftermarket cybersecurity solutions.

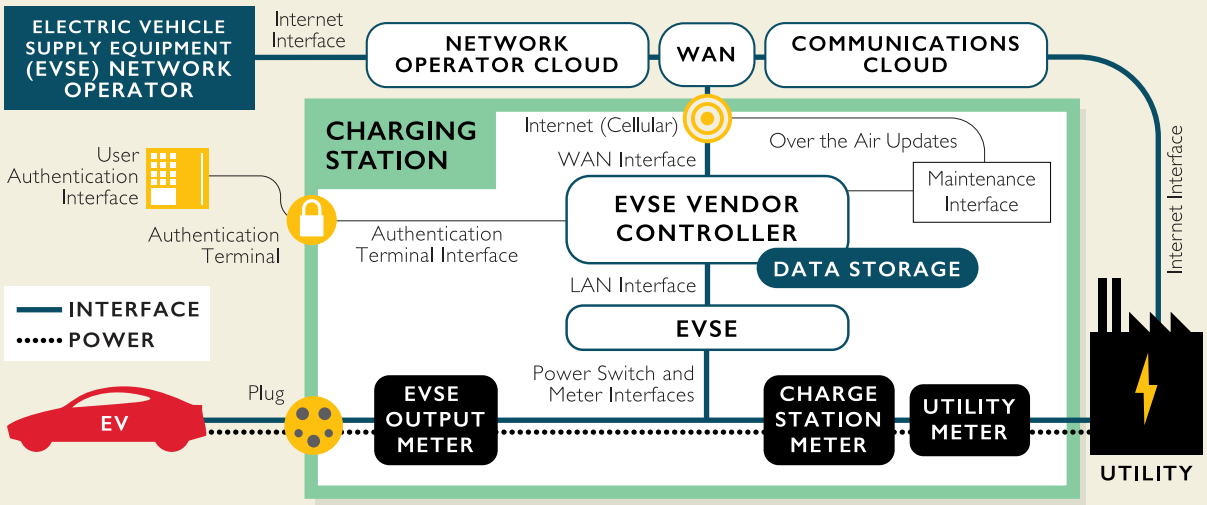
The Volpe Center also participates in FAA's multi-agency work group, providing a path forward for interagency aviation cybersecurity. The FAA-led effort brings together USAF, NASA, and DHS to establish a sustainable foundation for multi-agency collaboration on NextGen cybersecurity.

Electric Vehicle and Supply Equipment Procurements

The increasing number of electric vehicles (EVs) and electric vehicle supply equipment (EVSE) across the automotive space is creating potential cybersecurity risks for connected systems due to the connectivity of EVSE with EVs, the electric grid, and network components. To inform DoD personnel about the importance of integrating cybersecurity into EVSE systems at the design phase, the Volpe Center developed the *2019 Government Fleet and Public Sector Electric Vehicle Supply Equipment (EVSE) Cybersecurity Best Practices and Procurement Language Report.*

This document defines baseline EVSE cybersecurity requirements and procurement language in a clear manner for use by asset

Complex systems bring power to electric vehicles. (Source: U.S. DOT/Volpe Center)



owners, operators, integrators, and suppliers during the EVSE procurement process. Implementing the recommended practices will assist the DoD in deploying and integrating reliable, innovative, energy-efficient EVSE technologies into its transportation systems while reducing cybersecurity risks from connected systems. ■

Automation and Advanced Technology

Unmanned Aircraft Systems

Volpe Center experts are working collaboratively with the DoD, FAA, NASA, other Federal agencies, industry, and academia on challenges and opportunities related to unmanned aircraft systems (UAS).

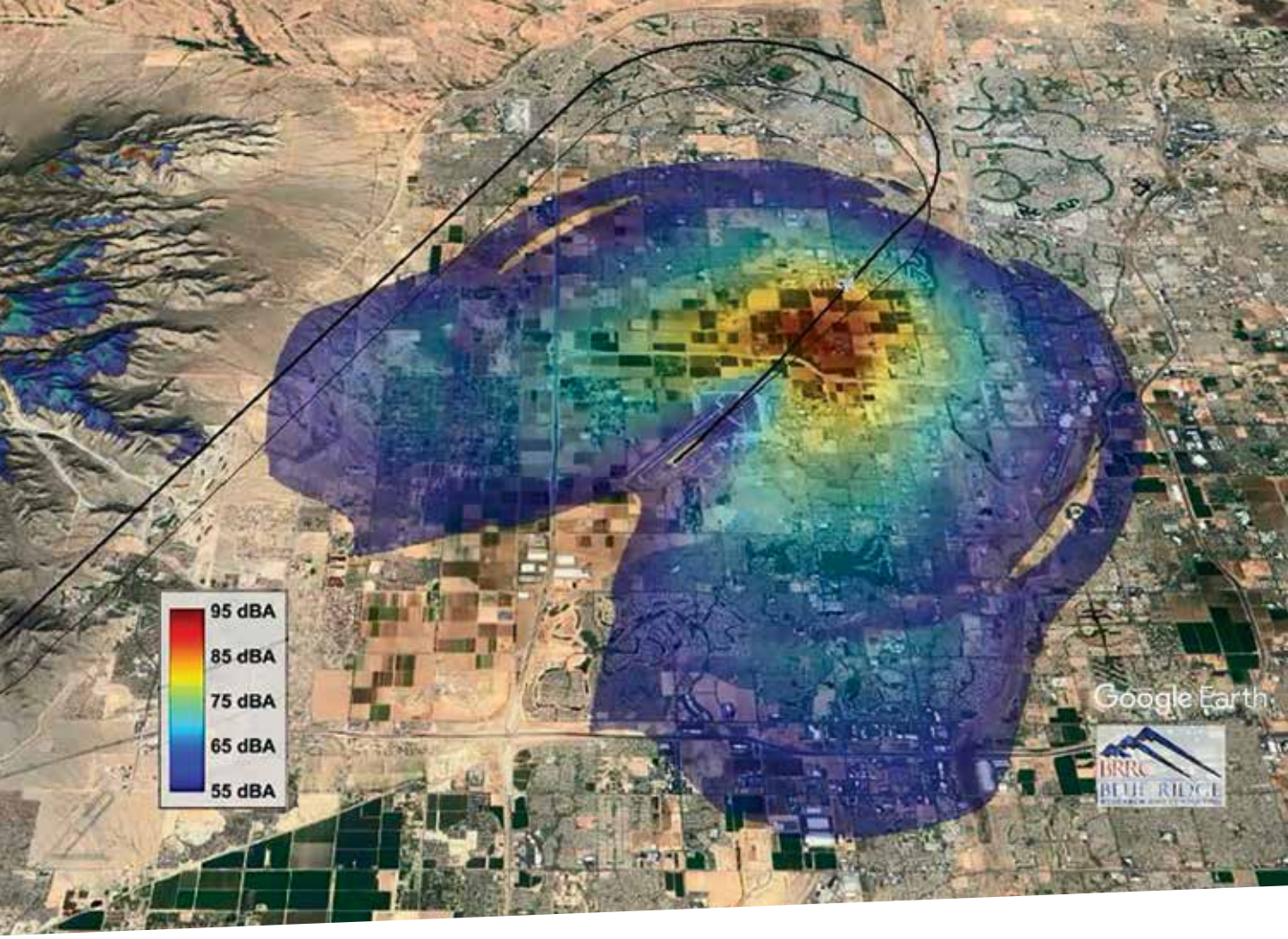
The USAF increasingly uses UAS for critical missions, and is focused on finding ways to safely operate alongside manned aircraft in the NAS.

The Volpe Center worked in partnership with Hanscom Air Force Base, Air Force Research Laboratory, Raytheon, and the MITRE Corporation on the Ground-Based Detect and Avoid (GBDAA) program. Volpe Center engineers have worked closely with the USAF to develop an automated solution, enabling UAS operators to conduct missions safely alongside other manned aircraft.

GBDAA uses existing air traffic data to provide UAS operators with a real-time display of aircraft in the surrounding airspace and alerts operators to potential conflicts with neighboring aircraft. The program advanced the science, safety, and efficiency of ATC by providing beyond-visual-line-of-sight capabilities to UAS operators in the national airspace. The multi-agency team recently received the Air Traffic Control Association's 2019 Team Award for Outstanding Achievement.

The Volpe Center is also reviewing how additional UAS operating in the NAS will impact current and planned procedures and infrastructure in the years ahead.

3D rendering of a military drone. (Source: 123rf.com/designprojects)



AAM screen capture from a Noise Simulation Video (NSV) depicting 55 to 95 dBA noise levels for a F-35A afterburner departure at Luke Air Force Base. (Source: Blue Ridge Research and Consulting, LLC)

Connected Automated Vehicle Testing and Evaluation

The Volpe Center has partnered with the FHWA's Turner-Fairbank Highway Research Center and the Army's Aberdeen Test Center (ATC) to develop, test, and evaluate connected automated vehicle mobility applications that include passenger car-heavy truck platooning based on cooperative adaptive cruise control.

Volpe engineers devised the test methodology and collaborated with ATC engineers to develop the testing safety mitigation plans, collect data, and evaluate the performance and capability of the vehicle-to-vehicle communication system and cooperative vehicle mobility applications.

Noise Analysis Automation

Volpe has been supporting the U.S. Air Force Civil Engineer Center (AFCEC) by updating, improving, and providing the Volpe Advanced Acoustic Model (AAM) for DoD and their support contractors. AAM automates noise analyses of military operations and is the noise model of choice for DoD National Environmental Policy Act (NEPA) actions. The model includes capabilities to predict helicopters, tiltrotors, and advanced high thrust military aircraft such as the F-35 and V-22. AAM has been developed over several decades and evolved from the Rotorcraft Noise Model, originally developed with NASA. Volpe and partners are developing an innovative nonlinear propagation module for AAM. Version 3.0 will be publicly released in 2020. ■

Enhancing Safety and Security

Maritime Domain Awareness

A critical mission focus shared by DoD and U.S. DOT is maritime domain awareness (MDA). Renowned for its major technological advances in communication, traffic management, and marine navigation systems, the Volpe Center is at the vanguard of developing and deploying state-of-the-art, easy-to-use, cost-effective vessel tracking networks and systems that increase MDA, safety, and security worldwide.

The Volpe Center has developed three powerful tools for the DoD:

- The Maritime Safety and Security Information System (MSSIS) network is a freely shared and unclassified Automatic Identification System (AIS) data collection and distribution network. Countries that agree to contribute AIS data to the worldwide MSSIS network in return receive the aggregated global data from all contributors. This feature results in a much wider and more complete picture of the vessels in the maritime domain. MSSIS promotes collaboration and data sharing among international participants, thereby increasing global maritime safety and security. Currently, over 70 participating nations leverage MSSIS to track commercial vessels worldwide.
- Transview32 (TV32) is a multifunction software program used to retrieve, decode, display, record, convert, and disseminate a variety of geographic positioning system report formats, including AIS and radar. TV32 is used for a number of applications including: chart navigation for maritime pilots; AIS data extraction, conversion, and ingest; geospatial analysis and anomaly detection; and a multitude of other custom adaptations to meet the specialized needs of many sponsoring organizations.
- SeaVision is a web-based vessel tracking and analytics system used by the U.S. Navy Fleet Forces and their coalition partners to improve global MDA unclassified information sharing. SeaVision assists nations in combating piracy, illegal fishing activities, and the smuggling of humans, drugs, and weapons. It plays a central role in supporting joint military naval exercises and helps to build and strengthen international maritime partnerships.

Air Carrier Analysis Support

The Volpe Center has been working with DoD's Aircraft Mobility Command, Commercial Airlift Division (HQ AMC/A3B) since the mid-1990s on its Air Carrier Analysis Support (ACAS) system. ACAS provides HQ AMC/A3B with an integrated system for safety trend analysis of commercial air carriers to ensure DoD requirements are met on a continuous basis, so only safe air transportation is provided to members of the U.S. Armed Forces, in accordance with applicable regulations.

Volpe provides operations support to continue the transfer of Safety Performance Analysis System (SPAS) data from the FAA to HQ AMC/A3B; data transfer activities are authorized via a memorandum of understanding. Source data from SPAS includes the FAA's National Vital Information Subsystem (NVIS); Aviation Accident and Incident information from the FAA's Accident and Incident Database System (AIDS); Air Operator Operations Specifications and Authorizations information from the FAA's Operations Safety System (OPSS) and Safety Assurance System (SAS); and FAA surveillance data from the National Program Tracking and Reporting Subsystem (NPTRS). When new data sources are identified, the Volpe Center designs and builds new data exchange interfaces between

T-SMART
(**Transportation Safety Management Analysis Research Tool**)
U.S. Transportation Command's Surface Deployment and Distribution Command (**SDDC**) collects and reviews DoD and DOT data about motor carriers and every ammunition and explosives (**AE**) shipment.

T-SMART will help find ways to improve the safety of transporting ammunition and explosives (AE). (U.S. DOT/Volpe Center)

SPAS and ACAS. The Volpe Center also develops software requirement specifications and software design specifications to integrate new data sources into the ACAS user interface, as well as provides system analysis, software design, programming, testing, and deployment expertise to HQ AMC/A3B.

Since Volpe developed and currently supports the SPAS application, technical personnel supporting ACAS can interact with SPAS team members as necessary to resolve operational issues that arise.

Munitions Cargo Transport Support

The Volpe Center is leveraging its expertise in motor carrier safety and analysis to help the U.S. Transportation Command's Surface Deployment and Distribution Command (SDDC) oversee the safe operation of motor carriers transporting ammunition and explosives (AE) cargo.

SDDC currently uses a manual and time-consuming process to evaluate the safety performance of its commercial motor carriers. Volpe staff are designing the Transportation Safety Management Analysis Research Tool (T-SMART), an analysis database and web application. T-SMART will give the SDDC better insight into which carriers pose the highest safety risk, and will help decision makers identify and implement targeted safety improvements to both safeguard DoD assets and protect the public from the risks of transporting AE cargo. T-SMART will also be used to analyze and visually share motor carrier safety data more effectively with all AE cargo stakeholders, including military services shippers, oversight agencies, and the actual motor carriers.

This work is helping the SDDC more efficiently identify and holistically address carrier-specific and systemic safety vulnerabilities, and will ultimately reduce the number of incidents related to AE transport on public roadways.

Automatic Crash Notification for Commercial Vehicles Transporting Sensitive Materials Assessment

The mission of the DoD's Defense Transportation Tracking System (DTTS) is to monitor the safe and secure movement of conventional arms, AE, and other sensitive material by commercial trucks and barges in North America. A key goal of this mission is to initiate rapid emergency response to in-transit crashes to minimize their impact and to secure sensitive DoD property.

The current Satellite Motor Surveillance Service (SNS) provides DTTS with in-transit security capability to monitor the visibility of sensitive DoD shipments. A particular weakness in this system is that when a driver is incapacitated or unconscious, there is a lag before the system automatically detects that the vehicle is no longer moving and the driver fails to respond when contact is attempted.

DTTS is now exploring the best methods to meet their emergency awareness needs through

automatic crash notification (ACN). ACN is an application provided by vehicle telematics systems that combine and integrate directly into the vehicle's electrical architecture, cellular communications technology, GPS satellite location capability, and sophisticated voice recognition.

For DTTS, the Volpe Center recently conducted a technical and economic assessment of ACN systems and fleet tracking/management services that notify a tracking center of a crash involving a commercial truck. The Volpe team recommended three alternatives to DTTS for ACN implementation: (1) vehicle dynamic sensors for crash detection, (2) vehicle dynamic sensors integrated with crash avoidance/mitigation systems, and (3) crash sensors fully integrated with vehicle dynamic sensors. ■

Strategic Mobility

The Volpe Center works with international partners to provide solutions for transportation and logistics challenges. Volpe Center software engineers and defense analysts collaborated with the United Kingdom Ministry of Defence's (UK MOD's) WATERGUARD Programme on conceptualizing and developing the Remote Access Movements Portal (RAMP), streamlining and standardizing the UK MOD's global military supply chain movements across all royal military branches. This joint enterprise-level effort between the UK MOD and the Volpe Center combines data from multiple sources to meet the daily military supply chain needs of the UK MOD and to support the UK MOD's annual military exercises.

RAMP enables users to move military assets and cargo from a point of origin to a desired destination utilizing multi-leg, multi-stop, and multimodal movements, and to schedule, research, track, analyze, and process transport options that reduce waste, serve customs compliance mandates, and support Defence-wide business needs.

Like the DoD, the UK MOD relies upon both military and commercial transport to move valuable cargo and equipment across the world. RAMP fills a significant gap in multibranch and multimodal military supply chain logistics operations by standardizing the UK MOD's military movements and ensuring that such movements are cost-effective, time-efficient, and compliant with UK regulations. ■

Economic and Cost-Benefit Analysis

The Volpe Center conducts economic and industry analyses for the U.S. Transportation Command (USTRANSCOM), calculating fuel, currency, and inland freight adjustment factors for military marine and inland shipping.

Volpe Center economists helped determine the risks associated with fixed-price contracts over time and how changes in high-variance input costs affect the economics of marine container shipping. The Volpe Center analyzed historical shipping patterns of USTRANSCOM goods along with worldwide vessel capabilities to understand the financial variations of the ocean carrier industry. The Volpe Center proposed clear and actionable adjustment factors for USTRANSCOM to apply to ocean carrier contracts.

The Volpe Center performs these analyses every few years to provide updates in support of USTRANSCOM's procurement process. ■

U.S. DOT's Volpe Center Capabilities

The Volpe Center is the U.S. DOT's in-house resource for multimodal systems engineering and integration, technology, analysis, planning, research, development, deployment, and evaluation.

With an extensive set of skills and capabilities pertinent to DoD's mission, the Volpe Center provides key support in the following areas:

- **Economic, energy,** data, financial, life-cycle cost, and **cost-benefit analyses**
- **Resilience and risk analysis** of transportation systems
- **Automation** of physical distribution processes and vehicles
- **Cybersecurity,** safety, and resiliency of cyber-physical systems
- Engineering and **human factors testing and evaluation** of advanced technology transportation systems
- Command, control, and communication of **unmanned aircraft**
- Development of **resource and information management** systems
- Development and deployment of **web-based applications**
- **Environmental** compliance and permitting
- **Acoustics** measurement, modeling, analysis, and regulatory framework development
- Occupational **safety and health**
- **Fire safety engineering** for air traffic control towers
- **Systems assessment and evaluation** of transportation-related technologies that directly apply to the mission and responsibilities of the DoD

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