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

A Partner in Laying the Foundation for the **Aviation System of the Future**

U.S. Department of Transportation
Volpe Center

Growing aviation safely, efficiently, and sustainably

In partnership with FAA and other key stakeholders, the U.S. DOT's Volpe Center applies its unique expertise to help design, develop, and deploy the future of air traffic management.

Integrating New Entrants into Our National Airspace

New entrants—such as unmanned aircraft systems (UAS) and space launch and re-entry vehicles—offer unprecedented opportunities for innovation and economic growth. The Volpe Center partners with other federal agencies to engineer solutions for their safe and seamless integration into our national airspace system (NAS).

Small Unmanned Aircraft Systems

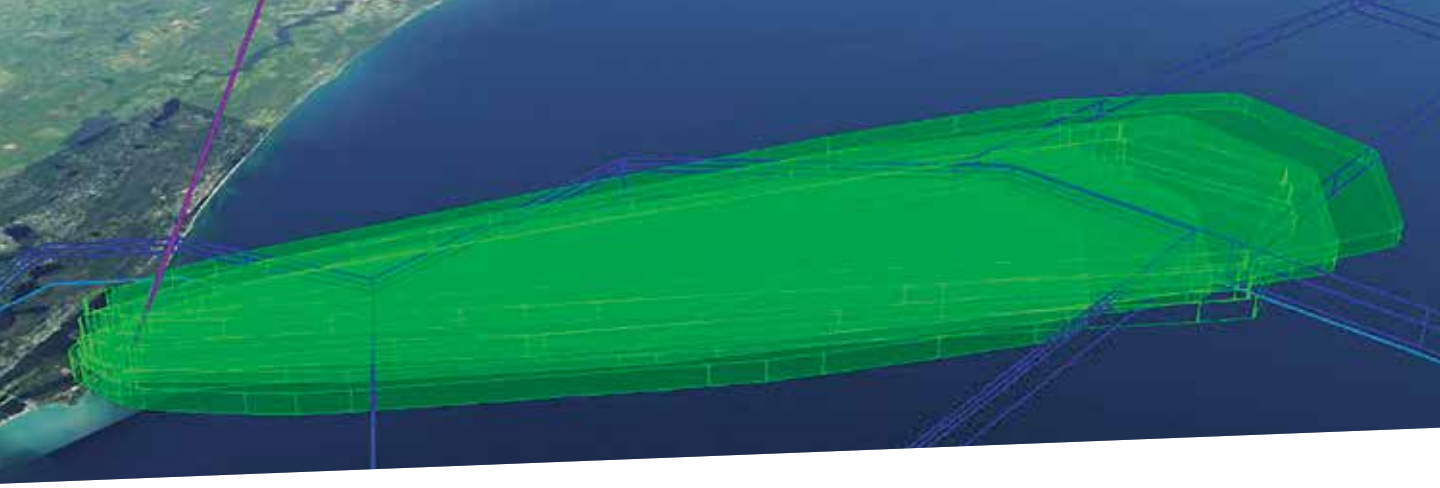
At the Volpe Center, multidisciplinary, multimodal teams of engineers, human factors experts, and technology, policy, and data analysts are working with partners at the Federal Aviation Administration (FAA), the U.S. Department of Defense (DoD), NASA, and other agencies to advance UAS integration. Safe, efficient introduction of UAS into the national airspace is a shared responsibility. Volpe Center experts collaborate with UAS researchers in government and the aviation industry to improve UAS safety, increase efficiency of UAS operations, ensure sustainability through benefit-cost analyses, and identify technologies that will enable UAS growth in new areas and modes. ■

Large Unmanned Aircraft

The Volpe Center is developing a Ground-Based Detect and Avoid (GBDAA) capability that detects aircraft in proximity to remotely piloted aircraft (RPA) by fusing aircraft position data from different types of ground-based radars and displaying the information in real-time. This enables RPA operators to detect-and-avoid air traffic at the same level of safety as a manned aircraft's ability to see-and-avoid aircraft.

The GBDAA configuration conducted at Springfield-Beckley Municipal Airport in Ohio will enable RPAs that are too small for detection by local surveillance radars to use GBDAA capabilities.

GBDAA provides a promising solution for the U.S. Air Force (USAF) and other branches of the military, along with states and municipalities, to more seamlessly conduct critical missions involving RPAs. As a result of this work, the Air Force Research Laboratory, the state of Ohio, and commercial operators will be able to safely test a wide range of RPAs within the NAS without being constrained by typical measures for complying with the see-and-avoid requirement. ■



Volpe engineers developed new software to display space vehicle trajectories in the NAS, reducing potential impacts on air traffic while maintaining a high level of safety. (Photo: FAA NextGen Integration and Evaluation Capability (NIEC) Laboratory)

Space Vehicle Operations

Operations of commercial space vehicles in the NAS, such as orbital and sub-orbital passenger space flights, are projected to increase significantly over the next decade. These new entrants challenge traditional techniques of managing air traffic, and current methods for integrating space vehicles into NAS operations involve blocking off large areas of airspace for extended periods of time.

A Volpe team supports the FAA's NextGen Space Vehicle Operations program by exploring ways of reducing the impact of space vehicles on routine air traffic operations. The Volpe Center developed new software, which enables the FAA to process and display space vehicle trajectories, associated hazard areas, and no-fly zones. This software now supports FAA demonstrations and evaluations of a wide range of space vehicle configurations and scenarios. The software is also being used for research and evaluation of advanced automation capabilities for other future air transportation systems. ■

Air Traffic Management

Evaluating Safety and Efficiency through Aviation Modeling and Simulation

To evaluate the safety and efficiency of a wide range of aviation scenarios, the Volpe Center modeling and simulation team supports FAA initiatives with comprehensive simulation and risk analysis tools for the aviation operations environment. These tools simulate complex air traffic scenarios with detailed models of aircraft, navigation systems, surveillance, airport, air traffic automation, pilot, and controller behaviors. The simulation platform provides extensive post-processing capabilities, graphical visualization, and animation to evaluate the safety and efficiency of proposed operations. ■

Demonstrating the Benefits of Integrated Metroplex Air Traffic Management

A Volpe Center team is supporting the FAA NASA Airspace Technology Demonstration 2 (ATD-2), which is integrating existing and emerging FAA, NASA, and industry technologies to significantly benefit arrival, departure, and surface operations in the multi-airport, metroplex environment. ATD-2 provides prototype traffic management tools to enhance throughput and improve predictability through a coordinated schedule between the ramp, tower, terminal, and center control facilities. ATD-2 technology will also allow for more efficient use of airspace. The Volpe team conducted safety assessments for the first two phases of ATD-2 which began in 2017 at the Charlotte Douglas International Airport. Because the demonstration will affect actual air traffic and operations, the safety assessment was required prior to the commencement of initial operations in each phase. ■

RECAT Standards Lead to Increased Airport Efficiency

The FAA depends on Volpe's experts to better understand the behavior of wake turbulence and to recommend critical adjustments to aircraft separation standards. The Volpe Center collects and analyzes aircraft wake turbulence data at airports, providing FAA with recommendations to improve terminal air traffic safety and increase efficiency.

Volpe engineers have helped FAA make critical operational changes, such as enabling aircraft to land on closely spaced parallel runways under instrument approaches. The FAA partnered with the Volpe Center to revise the single runway wake turbulence separation minima for aircraft.

Volpe's wake turbulence experts were part of the FAA/EUROCONTROL-led team that developed an overall Wake Turbulence Recategorization I (RECAT I), which has been implemented at 20 Terminal Radar Approach Controls—TRACONs—and 30 airports. This has led to more efficient arrival and departure sequences, and improved surface movements during peak periods.

RECAT Phase II is an upgrade of the aircraft single runway spacing defined under RECAT I, and uses additional data and analysis to establish a set of static pair-wise, instead of categorical, wake separation minima for both aircraft arrivals and departures. RECAT Phase II further improves aircraft separation minima while maintaining important safety levels, increasing runway throughput, and reducing overall congestion. ■

ADS-B Saves Time and Money for Air Travelers and Carriers

Automatic Dependent Surveillance-Broadcast (ADS-B) is a highly accurate and reliable system for tracking aircraft in the NAS. It combines Global Positioning System (GPS) data with aircraft identification and altitude information. Aircraft avionics broadcast this information to ground stations, which is then relayed to ground controllers.

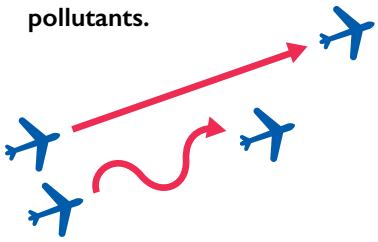
By transitioning from radar technology to a much more precise global satellite network, our skies will be even safer and more efficient. The Volpe Center has been a key partner in helping FAA develop and deploy ADS-B. ■

Efficiency

With ADS-B, commercial air carriers **reduce flight times and delays.**

Fuel Economy

Airplanes using ADS-B **burn less fuel and emit fewer pollutants.**



Safety

Improved situational awareness is increasingly important as our airspace becomes more crowded.

SWIM Streamlines Data Sharing Among Key Partners

The Volpe Center and FAA System Wide Information Management (SWIM) are partnering to develop and deploy services that enhance information exchange across the aviation enterprise using defined, standardized, secure, and scalable connections. SWIM delivers key information whenever and wherever it is needed, within FAA and between FAA and its partners, including air carriers, general aviation, and the military.

A Volpe team leads development of several enterprise services critical to SWIM, including the SWIM Terminal Data Distribution Service, SWIM Flight Data Publication Service, and the Integrated Terminal Weather System.

FAA also relies on a Volpe team to develop the newest SWIM service, the NAS Common Reference (NCR). Targeted for initial operating capability in March 2020, NCR will enable customized requests for weather, aeronautical, and traffic flow information, correlated both temporally and spatially.

In addition, FAA turns to the Volpe Center to apply its aviation expertise through system development and testing, data visualization tools, industry data formats, and cloud technologies and services. ■

Safety Management Systems and Human Factors

Aviation Safety Management Systems

Volpe's Aviation Safety Management Systems Division provides systems engineering and analysis, operations research, and associated information technology expertise to enhance aviation operational safety. Volpe engineers provide technical and risk analysis expertise on aviation and aerospace safety issues.

A large portion of Volpe's work focuses on designing, developing, and maintaining information systems used by FAA aviation safety inspectors.

The FAA turns to the Volpe Center for its expertise in several areas, including:

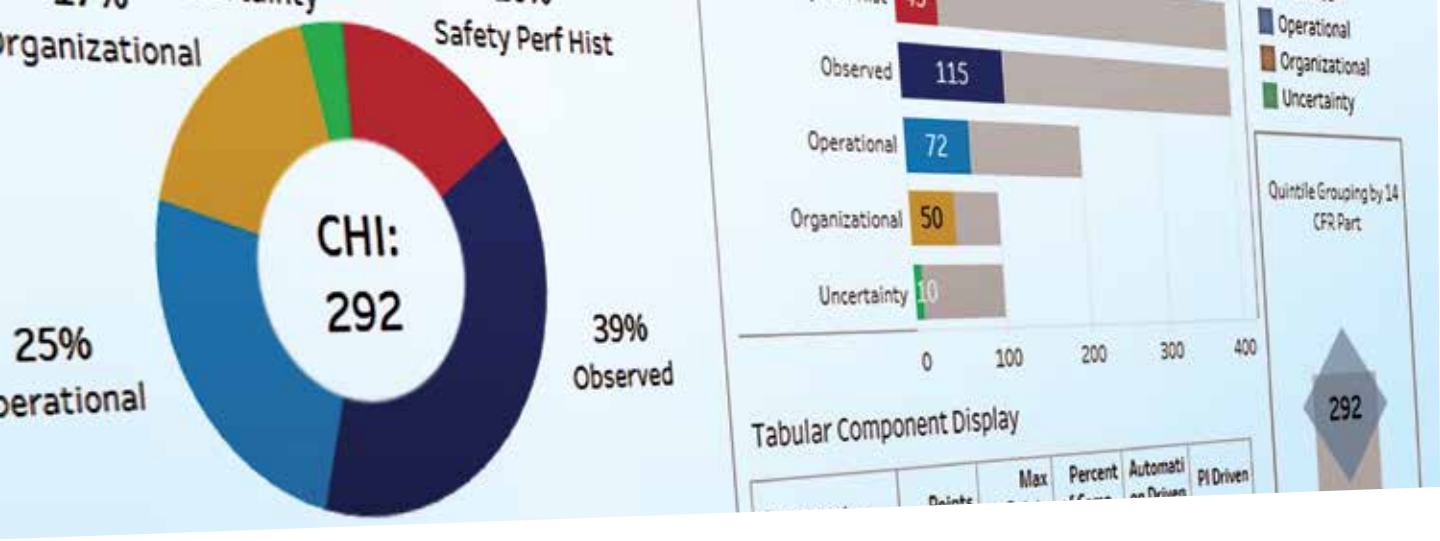
- Safety and surveillance information management systems development
- Data analytics and data visualization
- Analysis and decision support
- Safety studies for policy and regulatory support
- Resource management ■

Addressing the Human Side of NextGen

The Volpe Center's aviation human factors research focuses on how pilots and air traffic controllers access, share, display, and use information; how this process will change with new NextGen systems; and how new systems can be designed to maintain or improve safety.

Volpe Center analysts are studying how NextGen will affect pilots' use of flight deck displays, such as cockpit displays of traffic information, surface movement and guidance control systems for low-visibility operations, and electronic flight bags, and how best to convey this information. The Volpe Center is also developing guidance to implement datalink communications between pilots and controllers in the en route environment. Volpe's human factors experts are anticipating, mitigating, and reducing potential pilot performance issues related to flying new more complex procedures that require use of advanced navigation technologies. ■

Volpe's human factors experts look for ways to improve communications and streamline information for pilots and air traffic controllers.
(Photo: 123RF.com, Fernando Barozza)



Safety Risk Profile for certificate holders. (Photo: Volpe image)

Harmonizing International Data Exchange

The Volpe Center works closely with international aviation partners, such as the International Civil Aviation Organization, the European Aviation Safety Agency, aircraft and engine manufacturers, and surface movement and guidance control systems for low-visibility operations, to harmonize how flight information is defined and exchanged throughout the global air transportation enterprise. Volpe experts are key contributors in the development of a standards-based method for describing data about any flight in a common, machine-readable format. The Volpe Center is also playing a significant role in determining how the NAS must evolve to comply with international provisions for exchanging consistent and unambiguous information pertaining to global flight operations. ■

Infrastructure Resilience

Cybersecurity

The Volpe Center participates in FAA's multiagency work group, providing a path forward for interagency aviation cybersecurity. The FAA-led effort brings together the U.S. Air Force, NASA, and the Department of Homeland Security to establish a sustainable foundation for multiagency collaboration on NextGen cybersecurity.

Currently, Volpe Center cybersecurity experts are helping the USAF transition to the National Institute of Standards and Technology's risk management framework on platform IT and national security systems in the DoD NAS.

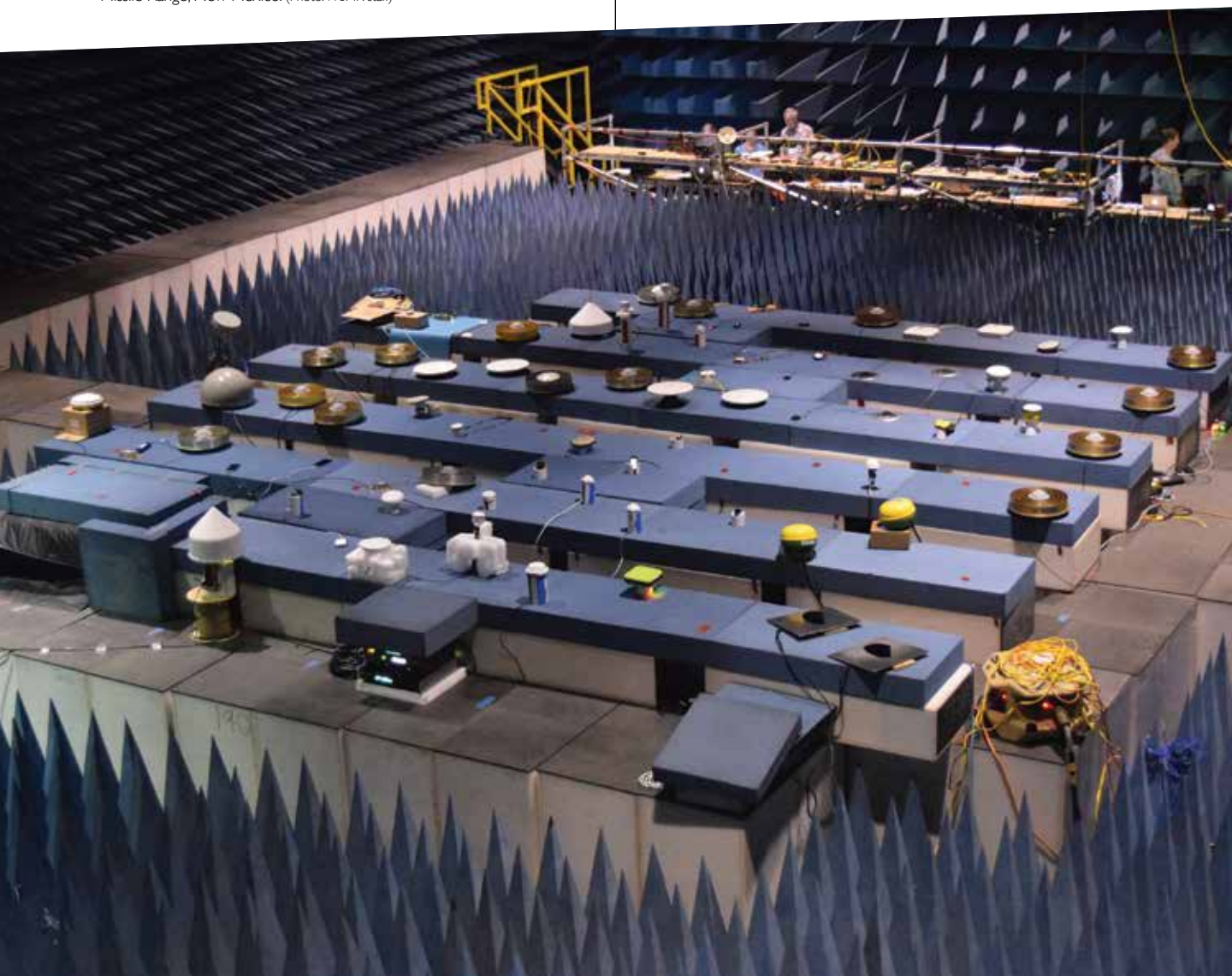
In addition, Volpe Center engineers and information technology specialists test the vulnerabilities and the efficacy of cyber-intrusion detection devices for vehicle telematics and wireless systems, develop guidance on selecting cybersecurity mitigation solutions, and help efforts to raise awareness of the responsibility for managing risk related to cybersecurity. ■

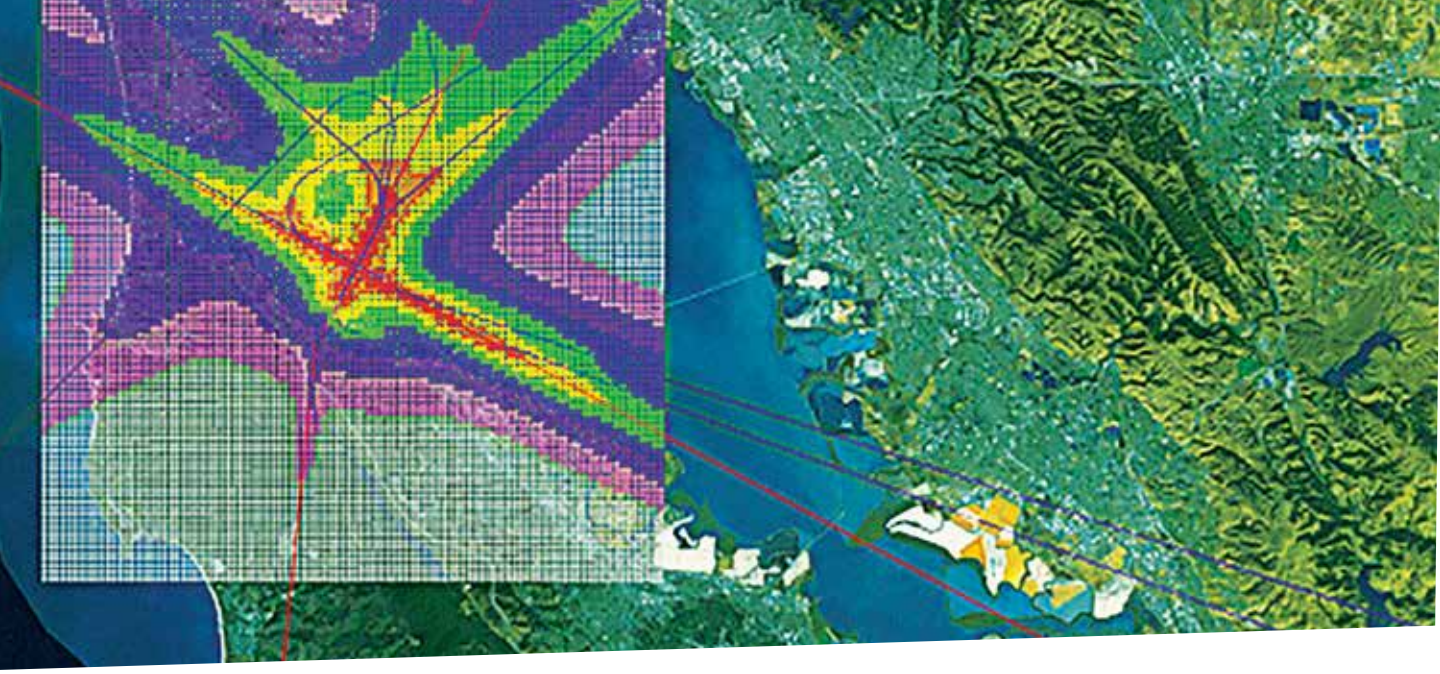
Keeping America Competitive and Safe with the Global Positioning System

U.S. DOT works closely with FAA, DoD, the U.S. Department of Homeland Security, and others, and is the civil lead in developing, acquiring, managing, and operating GPS. U.S. DOT and its partners work to increase awareness of GPS vulnerabilities, evaluate their impact, and research complementary sources of positioning, navigation and timing. The Volpe Center supports this mission by providing systems engineering expertise, working to implement GPS civil signal performance monitoring within the Next Generation GPS Operational Control System.

The Volpe Center conducted a GPS Adjacent Band Compatibility Assessment with FAA, DoD, and other partners. The goal of this effort was to evaluate the maximum power levels of adjacent band radiofrequency systems that GPS and Global Navigation Satellite System (GNSS) receivers can tolerate. These maximum tolerable power levels can inform proposals for commercial use of the bands adjacent to GPS/ GNSS signals without compromising essential space-based position, navigation, and timing services. ■

GPS Adjacent Band Compatibility testing at the Army Research Laboratory's Electromagnetic Vulnerability Assessment Facility, White Sands Missile Range, New Mexico. (Photo: WSMR staff)





AEDT Commercial Airport Noise Predictions. (Image generated by AEDT 2b)

Energy and Environmental Assessments

Understanding the Environmental Impact of Aviation

In support of FAA, NASA, and the International Civil Aviation Organization Committee for Aviation Environmental Protection, the Volpe Center is leading the design, development, maintenance, training, and user support of the Aviation Environmental Design Tool (AEDT). AEDT calculates noise, fuel burn, and emissions during ground and flight operations across various scales: individual flights, airport, regional, national, and global levels. ■

Freight and Fuel Transportation Optimization Tool

FAA has a strong need for reliable supplies of aviation fuels that can be efficiently distributed throughout the U.S. Volpe developed the Freight and Fuel Transportation Optimization Tool (FTOT) for FAA's Office of Environment and Energy, and the U.S. Department of the Navy's Office of Naval Research, in order to analyze national and regional energy scenarios. FTOT generates and lets users select among candidate fuel processing locations, and can calculate transportation-related costs, carbon dioxide emissions, vehicle miles traveled, network usage, and other performance metrics.

The tool leverages Volpe's national multimodal, flowable transportation network, constructed from modal agency and Energy Information Agency networks.

FTOT has been used to analyze jet fuel supply chain scenarios in collaboration with the FAA-funded Aviation Sustainability Center, the National Renewable Energy Laboratory, the U.S. Department of Agriculture, Michigan Technological University, the University of South Florida, and others. ■

Facing page photo: 123RF.com, Welcomia

NAS Infrastructure

Supporting Consolidation and Realignment of FAA Services and Facilities

One of FAA's primary modernization goals is to implement policies that ensure their 1,230 facilities enable robust air traffic control (ATC) services to meet air traffic demand in a safe and efficient way for all citizens. The number of annual U.S. air passengers will increase from 840.8 million in 2018 to 1.28 billion by 2038. ATC Facilities generally have a long service life. However, innovation and modernization is needed to eventually renovate, replace, and transform those facilities and supporting infrastructure to meet new and projected requirements.

In 2018, the FAA sought Volpe's unique capabilities to provide facility engineering investigation and assessment through economic modeling, metrics development, quantitative analysis, program integration and implementation. In cases of outdated and aging infrastructure, Volpe plays a key role in achieving U.S. DOT's mission of ensuring that all Americans are served by a fast, safe, efficient, accessible, and convenient transportation system. It is essential that decision makers are able to identify aviation facilities that merit further investment—and, to identify those that do not, allowing resources to be allocated to other important efforts. ■

U.S. DOT's Volpe Center is a federal resource for multimodal systems engineering and integration, technology, analysis, planning, research, development, deployment, and evaluation.

Volpe Center Capabilities

With an extensive set of multimodal skills and capabilities, the Volpe Center provides key support in the following areas:

- **Safety and Security Assessments**
- **Systems and Infrastructure Modernization and Optimization**
- **Applied Data Science**
- **Engineering and Technology Deployment to Enhance Transportation Safety**
- **Human Factors Research and Design**
- **Impartial Investigations and Program Evaluations**
- **Economic and Policy Analysis**
- **Knowledge Transfer and Capacity Building to Maximize Impact**

Contact Us:

John A. Volpe National Transportation Systems Center
U.S. Department of Transportation
55 Broadway—Kendall Square
Cambridge, MA 02142
www.volpe.dot.gov

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