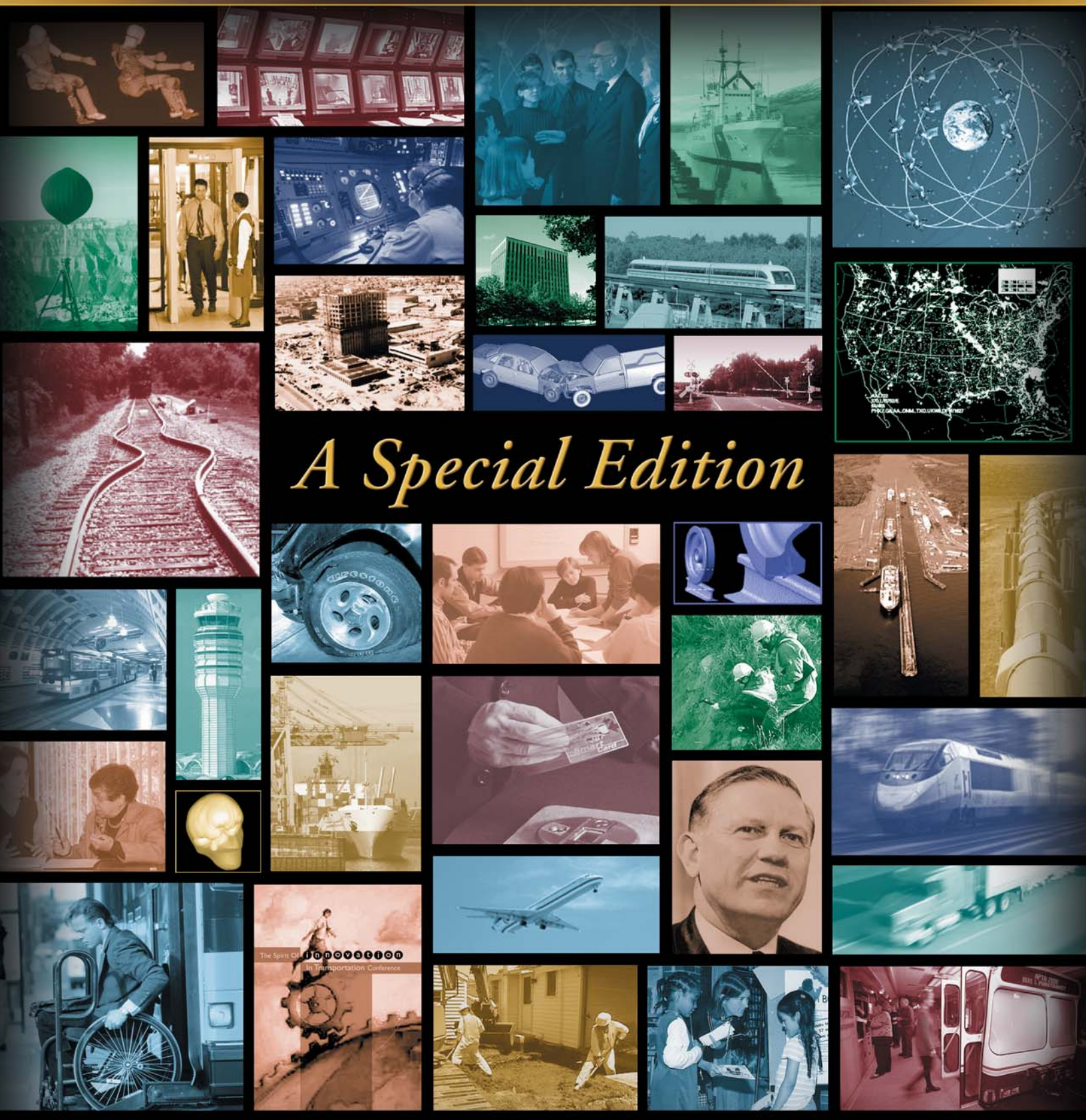
VOLPE JOURNAL

30th Anniversary



A Special Edition

U.S. Department of Transportation

Research and Special Programs Administration

The Volpe Journal is available on the Volpe Center Web site at www.volpe.dot.gov

ISBN 1526-5188

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Winter 2001

The Volpe Journal is published twice annually by the Volpe National Transportation Systems Center, 55 Broadway, Cambridge, Massachusetts 02142-1093, and is distributed free of charge. To be placed on the mailing list, contact Lynn C. Murray at 617.494.2224 or send e-mail to: murrayL@volpe.dot.gov.

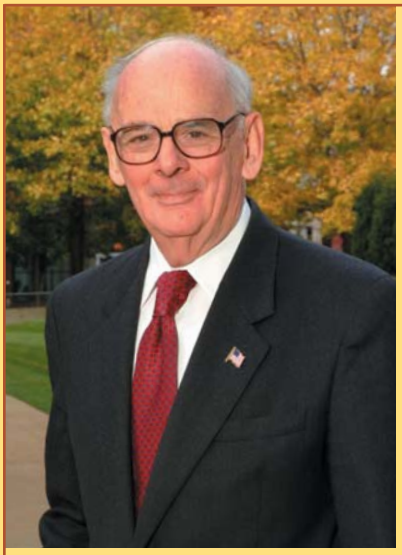
Dr. Richard R. John provided leadership in preparing this special edition of the Volpe Journal and shared his vast knowledge and insight into the history of the Center.

We also thank the Center's senior executives for their guidance:
Edith B. Boyden | Philip S. Coonley | M. Karen Cronin | David E. Lev | John P. O'Donnell | Robert C. Ricci | Edward A. Spitzer | Dr. Frank F. Tung, Deputy Director

The Volpe Center at Thirty

This special issue of the Volpe Journal is part of our celebration of 30 years of service to our nation and to the transportation community.

The Volpe Center is a hub of transportation research, analysis, and engineering. The articles in this issue demonstrate the Center's long-standing tradition as the focal point for fostering innovation in the transportation community. We are proud to be a center for new ideas and insights, consistently serving as a forum for highly respected national and international experts and leaders in the exchange of information and perspectives, with the goal of enhancing the public good.



This issue provides a selective overview of the work of the Volpe Center for the last 30 years. An introductory article is followed by articles on the five strategic goals of the Department of Transportation, which provide a broad picture of our work over time. The accomplishments described in this issue represent only a small portion of our work since our founding. You will find references to some of the research, analysis, engineering, and deployment tasks that we have performed, to support our sponsors in the Department of Transportation, other federal agencies, state and local agencies, and other nations. We are especially proud of our ability to respond rapidly to emerging needs, and our skill at deploying systems that work in complex environments.

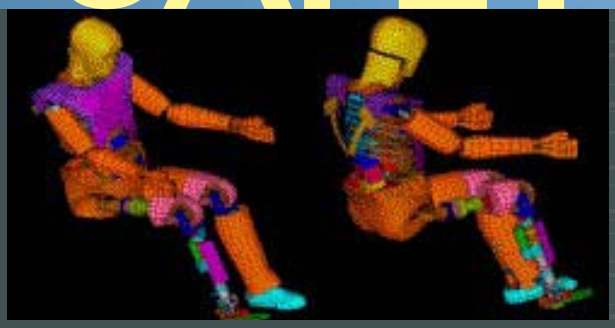
The Center's heart has always been its people. Our staff is the bridge to the future. We have a legacy of talent, with highly capable physical and social scientists, analysts, engineers, and program managers, working toward solving the nation's transportation problems. This legacy must continually be re-created in each new generation of Volpe employees. Newer staff members on the Volpe team are provided with both mentoring and leadership. They quickly have opportunities to experience the vitality and motivation that result from working on critical transportation issues.

This history would not be complete without describing the contribution of John A. Volpe, the Center's founder. As the second Secretary of the Department of Transportation, he opened the Center only three years after the department was created, giving us the opportunity to apply our skill and energy to the transportation enterprise at a critical time. In 1990, the Center was renamed the John A. Volpe National Transportation Systems Center in recognition of his contribution.

The historical view that we present here allows us to remember with pride the Center's accomplishments over the years. This issue also reflects the role that we hope to play in the future. Our vision is to continue to be a Center of Excellence for informed decision makers and a critical participant in meeting the public's needs by fostering a climate of innovation in the transportation community.

Dr. Richard R. John, Director

SAFETY



In 1900, the average American traveled 1,200 miles in an entire lifetime. Today, we each travel 12,000 miles by car alone, in just one year.

Our unprecedented mobility takes us to fascinating places and provides opportunities for work, education, and recreation. But it also puts us at risk for injury and death. One of government's primary roles is to protect its citizens from harm. Keeping the traveling public safe is an ongoing concern—and a key mission of the DOT and the Volpe Center.

Federal transportation safety initiatives have achieved significant results. Since the DOT was created in 1966, accident and fatality rates have decreased substantially. Yet despite improvement on many fronts, potential problems still exist. Changing circumstances can challenge the most sophisticated safety efforts. For example, increased air travel means more planes to manage safely in the air and on the ground. Innovation often poses new problems. High-speed trains promise fast, economical transportation, but their advanced technologies require new approaches to safety.

When we begin any trip, we're confident that we'll arrive safely at our destination. The Volpe Center will continue to devote substantial resources to improving the safety performance of all transportation modes. When it comes to safety, there is no such thing as "good enough."

Working Toward a World Without Accidents

Transportation safety depends on many factors: equipment, infrastructure, materials, engineering, biomechanics, technology, human performance, operations, and regulations. The Volpe Center has been involved with each of these issues, assisting the DOT to enhance safety and helping to save thousands of lives.

The most effective strategy is to prevent accidents from occurring at all. The Volpe Center has been engaged in a variety of accident prevention initiatives. Since many accidents are based on operator error, human factors research examines the interaction of people and machines to develop strategies to optimize safe operator performance. The Center also performs safety and risk assessment analyses of transportation systems. These studies identify safety hazards, accident causes and consequences, and actions that reduce the chance of accidents.

Crash avoidance is a more recent initiative that uses technology to reduce the number of accidents. Satellite-based navigation systems help operators and controllers "see" plane and ship positions under any weather conditions. Positive Train Control and Intelligent Cruise Control use computerized sensors to maintain safe distances between trains and motor vehicles on increasingly crowded tracks and roadways at the same time they maximize capacity.

Unfortunately, not every accident can be prevented, so the Center also works to understand and minimize the effects of accidents. Since the early 1970s, the Center has studied the complex body movements of crash victims. This research began with occupant-motion sensors and instrumented dummies, and today has evolved to computerized crash simulations. This biomechanical research enables the development of safer vehicles.

A Systems Approach Saves More Lives

Many issues influence transportation safety, and all are related. The Volpe Center's systems approach to problem solving examines every possible aspect to ensure that safety risks are fully addressed, and that work in one area doesn't compromise safety in another.

In addition to analyzing a problem, Volpe's systems approach factors in specific safety benefits, user acceptability, and the economic viability of potential corrective actions. Considering the full scope of issues leads to identification of the most effective solutions, because a safety initiative will work only if industry will build it and consumers will use it. This perspective also encourages changes in manufacturing philosophy. Today's planes, trains, boats, and automobiles are designed not only for looks and performance, but for safety as well.

The Volpe Center has established itself as a vital resource for transportation safety expertise. Volpe research has guided the development of regulations, design standards, inspection procedures, maintenance strategies, and safety preparedness plans. The Department of Defense (DoD), National Aeronautics and Space Administration (NASA), Federal Aviation Administration (FAA), and aviation organizations in over 30 countries depend on the Center's guidebook on human factors in air traffic control systems.

Keeping Tomorrow's Travelers Safer

Safety will continue to be a top priority as Americans keep moving through the 21st century. The Volpe Center's combined efforts in research and analysis, strategic planning and design, and new technology ensure that the goal of optimal safety performance is foremost for all transportation modes.

A hundred years ago, average Americans did not venture more than 20 miles from their homes during their entire lives. Today you can drive to a Park-n-Ride lot and catch the bus to a water taxi, which connects with a guided rail system that takes you to the airport so you can fly off to a faraway country…all in a few hours! And new modes of transportation are just over the horizon. The Volpe Center will continue its long-standing commitment to making every leg of the journey a safe one.

One area of focus for the Center will be new "smart" technologies such as crash avoidance technology in automobiles. The Volpe Center will continue to support development, testing, and deployment of innovative technologies that can truly deliver on the promise of improved safety.

The pages that follow contain examples of the way that the Volpe Center has responded to many safety problems or events over the years.

Transportation Hazards Spur Volpe Team To Find Solutions

More Accurate Breath Alcohol Measurement

In 1973, one-half of all traffic deaths involved a drunk driver. By 1998, there were 15,935 alcohol-related traffic fatalities (38.4 percent of the total traffic fatalities for the year), the lowest reported rate since the National Highway Traffic Safety Administration (NHTSA) began reporting these statistics in the 1970s. Reducing drunk-driving fatalities continues to be a priority for NHTSA.

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In the early 1970s, the Volpe Center was asked to participate in a high-profile alcohol countermeasures program. Early research included evaluating police breath analyzers and related equipment for effectiveness and accuracy, as well as initiating the development of automatic breath alcohol testers and collaborating with over 200 forensic blood laboratories. The devices must not only be technically accurate but also easy to use. Before any testing device is used by police in the United States, it is tested at the Volpe Center for accuracy and usability. Because of Volpe's national expertise in alcohol countermeasures, NHTSA and numerous judicial courts have called on the Center to give expert testimony.

Breath alcohol tester in use: before any new breathalyzer is used by the police, it is tested at the Volpe Center.

"Have a safe trip" is part of our everyday conversation. Everyone thinks about transportation safety. Whether we're driving the kids to school, commuting to work, setting off on a fishing trip, or flying home for the holidays, we want to feel that we'll reach our destination safely.

Firestone Recall Triggers Reporting System Improvements

In August of 2000, Bridgestone-Firestone recalled 6.5 million tires as unsafe. NHTSA announced shortly afterward that it had linked 174 deaths in the United States and an estimated 100 in Venezuela to the recalled tires, prompting a congressional investigation and an announcement by then-Secretary of Transportation Rodney E. Slater that the budget of the Office of Defects Investigation (ODI) would be sharply increased. One critical question at issue for Congress was why NHTSA had not been able to identify a defect trend in the tires with its existing information systems.

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ODI called upon the Volpe Center, with its extensive experience in database development and integration, to help pinpoint the problem areas and seek solutions. The Volpe team is in the process of finding ways to integrate NHTSA's many databases, to streamline and maximize the information available to the agency, and to identify defect trends before fatalities occur. Part of NHTSA's safety system is the Auto Safety Hotline, which allows citizens to report defects or accidents involving defects. Volpe will integrate information from the hotline with other databases into a new information system that will also accommodate a significant amount of new data from manufacturers, and will develop a strategy for making information available to the public as appropriate.

The public's dependence on the safety of our nation's transportation system is a fundamental responsibility shared and supported by the Volpe Center. For the last 30 years, the Center has demonstrated its commitment to improving transportation safety.

Database Experience Leveraged For New Projects

On December 12, 1985, a chartered plane carrying more than 240 American soldiers crashed in Gander, Newfoundland, killing all aboard. A review of the crash concluded that the plane was overloaded, and that the chartered carrier had no safety protocol to ensure that the combined baggage, carry-on, and passenger weight was calculated prior to takeoff. The reviewers recommended that a system be developed to assess the performance of carriers considered for DoD contracting, in the form of a centralized safety database.

The crash in Gander, Newfoundland, of a chartered plane carrying American soldiers sparked a series of safety database projects.

Because of the Volpe Center's proven expertise in developing safety databases, DoD turned to the Volpe Center for assistance. Volpe created a system for scoring contract carriers according to their records in five performance areas. DoD then had a tool to evaluate the safety record of carriers they would use. Volpe was asked to widen its scope and create the Safety Performance Analysis System, a system for scoring all air carriers, and then to develop SafeStat, which assesses motor carriers. In all of these projects, Volpe leveraged information and skills from one project to the next and demonstrated a holistic approach to solving transportation problems.

The SafeStat system assesses motor carriers for safety and makes the results available online.

Risk Management in Transporting Hazardous Materials

The crash of ValuJet Flight 592 near Miami in 1996, apparently caused by uncapped oxygen generators in the cargo hold, dramatically focused national attention on the risks of transporting hazardous materials (hazmat) as passenger aircraft cargo. The DOT's Research and Special Programs Administration (RSPA) regulates the transport of such materials within the United States. New regulations were immediately implemented after the ValuJet accident, but research continues into the effectiveness of those and other rules concerning hazmat transport.

To help evaluate the effectiveness of RSPA regulations, the Volpe Center conducted a comprehensive quantitative analysis to determine the amount of risk inherent in transporting hazardous materials in passenger aircraft cargo compartments. The results will help RSPA determine the effectiveness of current safety activities, target specific risks for priority action, and develop effective countermeasures. The Volpe Center is developing an overall theoretical and conceptual framework and definition for risk management as it relates to hazardous materials transportation.

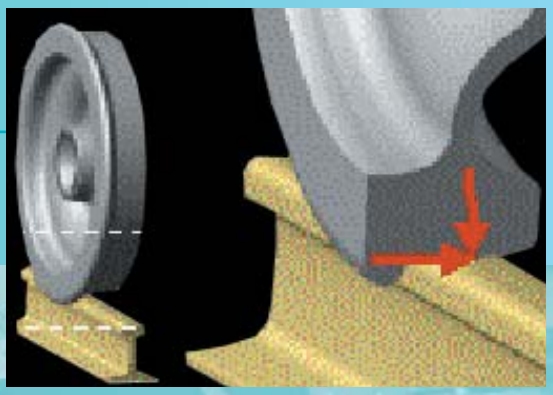
National Transportation Safety Board (NTSB) investigators determined that volatile oxygen-generating canisters stowed in the jet's cargo hold were the cause of the ValuJet airplane crash in the Everglades in 1996.

Looking toward the next 30 years, the Center stands ready to address new and potential problems by continuing to ask the right questions, apply lessons learned, and deliver innovative solutions.

Alloy Rail Safety Investigated

On November 12, 1983, an Amtrak passenger train operating on Missouri Pacific track near Marshall, Texas, derailed as it traveled at about 70 mph over a temporary track repair, killing four passengers. The alloy rail over which the train was passing fractured and fragmented into small pieces. The length of the fracture and resulting fragmentation were puzzling, since similar fractures observed in plain carbon steel rail generally had lengths one third those detected in the alloy rail.

To find the cause of the unusual failure of the alloy rail, which was coming into wide use at the time, the Federal Railroad Administration (FRA) asked the Volpe Center to apply its years of experience and technical expertise in analyzing accidents to conduct an evaluation. Volpe's task force identified the technical factors leading to the alloy rail failure, assessed the safety risks associated with similar installations, and identified measures that could reduce the risks related to alloy rail.



V-Tail In-Flight Failures Finally Assessed

In 1959, Buddy Holly, Ritchie Valens, and the "Big Bopper" (J.P. Richardson) died when their Model 35 Beech Bonanza (V-tail) airplane crashed. For many years the V-tail was the most popular single-engine aircraft in the world, known for its performance and luxury. However, the V-tail had a very high rate of in-flight failures. Although Beech, the manufacturer, did not acknowledge a problem, the deaths from in-flight failures continued to rise after the 1959 accident. By 1984, the FAA, responding to growing public concern, initiated an investigation to determine conclusively whether there were design deficiencies in the Bonanza V-tail.

The Beechcraft Bonaza (V-tail) airplane was plagued by a high rate of in-flight failures.

A panel of experts from the Volpe Center discovered several problems with the plane. The design satisfied the structural requirements for certification, but those requirements did not take into account the unique characteristics of the V-tail. The V-tail's handling and stability characteristics may have encouraged pilots to exceed the allowable flight envelope (speeds allowable at a given altitude). The in-flight breakup rates of most single-engine airplanes with retractable landing gear were significantly higher than other categories of general aviation aircraft.

Volpe Studies Aging Aircraft Risks

Aloha Airlines Flight 243 departed Hilo en route to Honolulu at 1:25 p.m. on April 28, 1988. As the Boeing 737 leveled off at the top of its climb, the fuselage ruptured and senior flight attendant Clarabelle Lansing was blown from the aircraft to her death. The cockpit door was blown away, and there was only blue sky where the roof had been. Jagged bits of metal broke loose and speared back among the passengers. Most of the passengers were injured, seven seriously.

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The accident was ascribed to undetected fatigue damage in the 19-year-old aircraft. The FAA launched a National Aging Aircraft Research Program (NAARP) to investigate and prevent future accidents due to aircraft aging. The NAARP called upon the Volpe Center to study the role of the factors implicated in aging, such as fracture mechanics, fatigue crack propagation, and airframe damage tolerance. The Center's work on Widespread Fatigue Damage (WFD) has set the standard for research into structural integrity of aging aircraft. As America's aircraft grow older and the traveling population becomes larger, Volpe continues to provide research that will prevent future disasters.

Aloha Airlines Flight 243, near Maui, Hawaii, following the April 1988 accident that was caused by undetected fatigue damage in the 19-year-old aircraft.

"...Promote the public health and safety by working toward the elimination of transportation-related deaths, injuries, and property damage."

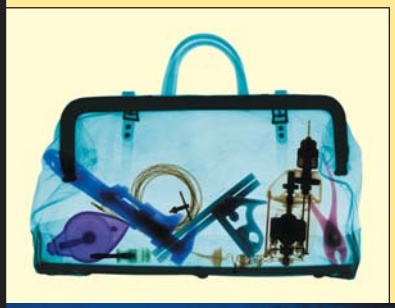
- From the Department of Transportation's Strategic Plan. FY 2000-2005 July 2000

Crashing Trains: Testing for Structural Integrity in the Colorado Desert

In 1970, the Volpe Center collaborated with the State of Colorado to build the Transportation Technology Center (TTC) in Pueblo. This Center was designed to test all types of rail equipment and vehicles in a variety of weather and terrain conditions. By crashing trains under test conditions, researchers are able to analyze the structural integrity of cab cars and examine the effects of crashes on passengers and crew members. This was part of the FRA's response to fatal rail collisions. Researchers were able to evaluate potential collision conditions, study locomotive structural design, and consider how colliding locomotives interact. Recently, the Volpe Center has coordinated a series of full-scale commuter train crash tests at the TTC and has analyzed the results of these tests. Further large-scale impact tests are planned at the Pueblo site in the near future. The Volpe Center has continued to support the FRA in this effort by developing innovative computer simulations to measure effects on passengers and equipment. This work is part of a larger effort in support of the FRA's crashworthiness research that focuses on developing and implementing procedures for improved crashworthiness of cab and coach door structural designs, as well as developing and validating computer modeling tools.

Full-scale crash tests of train equipment provide data for design improvements.

The terrorist attacks of September 11, 2001, heightened Americans' understanding of the tragic consequences of threats to our homeland security, especially through our transportation system. The human, financial, and social costs of security-related incidents can be staggering. The U.S. government devotes considerable financial, intellectual, and technological resources to protecting its citizens and interests from security risks. Since its inception, the Volpe Center has played a major role in addressing security for the nation's transportation system, the military, and other government facilities and operations.



National Security

Combatting security threats is like finding needles in an endless row of haystacks. The risks take many forms—from a lone gunman entering a facility to a small band of computer hackers or an organized group wielding explosives or chemical agents. Strategies to address security problems focus on identifying and preventing threats and minimizing potential impacts. These measures range from sophisticated technologies to strategic plans, policies, and procedures that incorporate security into standard operations. The Center's physical security efforts emphasize the protection of people, cargo, and infrastructure, while its work in information security protects critical computer and communication systems.

Defending Buildings and People; Civilians and Military

The Center's physical security initiatives began in the early 1970s, supporting the Federal Aviation Administration's (FAA) efforts to address a rash of airplane hijackings. Volpe teams helped develop and evaluate the technology to detect weapons and explosives that is now familiar to any air traveler. Government facilities soon benefited from the Center's growing expertise in security work. One major project developed a security system for the Bureau of Engraving and Printing to protect the nation's money supply. Over the years, the Center has assisted many government agencies in assessing and upgrading security for facilities worldwide.

A critical component of the Center's work has been supporting military logistics. Effective security is crucial to the Department of Defense's (DoD) ability to safely and efficiently move personnel and materials, provide appropriate defense, and carry out foreign policy initiatives. In-transit visibility systems developed by the Center have assisted a variety of operations. The sophisticated technology has tracked the movement of military vehicles traveling through the Saudi Arabian desert, and United Nations humanitarian aid shipments through Kosovo.

Working with the U.S. Immigration and Naturalization Service (INS), the Volpe Center has also used technology to facilitate the secure movement of people and goods across U.S. borders. The Center's SENTRI system uses transponders to speed up border crossings for pre-screened auto travelers, while INSPASS uses sophisticated biometrics to read the hand geometry of people entering the country through airports. Both systems integrate commercial off-the-shelf software in innovative ways.

Defending Information Infrastructure

Our increasing reliance on computer systems has made them, and our transportation system, vulnerable to sabotage. Hackers and cyberterrorists can gain access to sensitive information or disable systems that manage critical national infrastructure and operations. Protecting information presents unique challenges, since an invisible perpetrator can inflict damage from thousands of miles away. The complexity of computer systems also opens the door to numerous risks. The Volpe Center applies a comprehensive approach to computer security, thoroughly evaluating a system's potential technical, operational, administrative, and physical vulnerabilities.

One of the nation's most critical computer operations is the FAA's air traffic control system, which manages thousands of planes each day. The Volpe Center performed detailed risk and vulnerability assessments and developed procedures and technical solutions to ensure system integrity and fail-safe functionality.

Are We Ready for the Next Threat? Knowledge is the First Best Defense

One of the Volpe Center's primary approaches to security is "readiness evaluation," which helps clients to identify and understand the consequences of potential threats before developing strategies to manage them. The Center is increasingly involved in assessing the vulnerability of physical and information infrastructure and systems. Thorough assessment supports the creation of effective, comprehensive, and integrated solutions. It also emphasizes the inclusion of security measures in new facilities.

Recently, the Volpe Center conducted a risk and vulnerability analysis of the nation's transportation infrastructure, and supported the Presidential Commission on Critical Infrastructure Protection (PCCIP). The Center has also assessed vulnerability of the Global Positioning System (GPS) navigation system and Intelligent Transportation Systems, and assessed U.S. Postal Service technology and operations to improve identification and handling of hazardous materials.

Volpe experts from different fields share their learning and experience to continually offer new information, informed perspectives, and best practices to provide clients with the most effective, state-of-the-art security protection measures possible.

A Race Between Threat and Response

Threats to our security are constantly evolving in sophistication. Advanced chemical and biological agents can inflict greater damage than conventional weaponry. Changing times and circumstances can also create new risks. Post-Cold War efforts at the Center, for example, include assisting Russia during the dismantling of its nuclear arsenal.

Because so much damage can be inflicted by so few, terrorist threats are considered to be a form of "asymmetric warfare." Protecting our security is a battle against a moving target that must be fought continuously, combining existing knowledge and resources with creative thinking not only to thwart existing risks, but to anticipate and address those to come. The Volpe Center has made significant contributions to security over the last 30 years, and will continue its commitment to keeping the country's people, resources, and institutions safe.

The following pages contain more detailed examples of the Volpe Center's work in the national security transportation arena.

In the 1990s, the Center applied its growing knowledge of facility security systems to help develop improved infrastructure protection for several federal agencies.

Physical Security

Airport Security

Early in the 1970s, in the aftermath of the first wave of airplane hijackings, the Volpe Center was asked to evaluate electromagnetic detectors for concealed weapons that hijackers might carry on board. The Center evaluated technology borrowed from the coal-mining industry, which had for some time been using pass-through metal detectors with its coal conveyor belts to check for stray pieces of broken machinery as the coal came out of the mine. The detectors were redesigned to make them suitable to use with humans, and by 1973, the first systems were being installed in U.S. airports. The same detectors are now also used in many public buildings to make sure no one who enters is concealing a weapon.

Following on the heels of the Center's metal detector work were projects evaluating equipment designed to detect explosives in cargo and luggage. Since the mid-70s, the Volpe Center has participated in a number of initiatives to develop explosives detection strategies and devices, and to study ways to deploy these strategies in airports and buildings. Volpe continued to support the FAA in evaluating new refinements of existing x-ray and CAT scan techniques, and new approaches to sensing not only explosives but flammable liquids, until the mid-90s. In 1996, an analytical model developed by the Volpe Center was used to help determine the most cost-effective strategy for national implementation of baggage screening systems.

In the mid-90s, the Center worked with the FAA and the aviation industry to develop recommendations for airport employee identification badges, and worked with the airlines to demonstrate a "Universal Access System" at two U.S. airports. The Volpe Center helped the Miami-Dade Aviation Authority develop a security master plan for Miami International Airport in 1998, and assisted four airlines in developing security plans for a new terminal at John F. Kennedy International Airport in New York.

Protecting Government Facilities

In the last ten years, the Center has participated in several projects to deploy or upgrade security systems throughout the government, including projects outside the transportation community. By doing so, the Center has acquired expertise in state-of-the-art security technologies, which can ultimately be applied to transportation environments.

In the late 1980s, the Center helped the DoD evaluate intrusion detection technologies to protect DoD facilities and equipment. In the early 1990s, the Volpe Center assisted the Department of State (DOS) in identifying vulnerabilities in shipments overseas, and developing and testing improved intrusion sensors.

Providing security for the U.S. Capitol and its surrounding complex has never been more critical. The Volpe Center supports the Capitol Police in their security efforts.

In the 1990s, the Center applied its growing knowledge of facility security systems to help develop improved infrastructure protection for several agencies, including U.S. Customs aviation facilities, the national computer center of the Social Security Administration, and the headquarters of the Government Accounting Office. In 1995, the Bureau of Engraving and Printing asked the Center to design and install an integrated security

system for the national currency production facility in Washington, D.C. The Center completed this multimillion-dollar program ahead of schedule and under budget. In 1999, following the fatal shooting of two of its federal officers, the U.S. Capitol Police requested that the Volpe Center develop an integrated security system for the U.S. Capitol building and congressional office complex. A closed-circuit television system is being implemented that allows activities throughout the Capitol Complex to be monitored from a central control facility.

The Center is also developing a new access control system for the DOS. This system will be implemented at DOS headquarters and other facilities in the United States. It will use smart card technology to control access to facilities by employees and visitors, as well as employee access to computer networks.

Volpe is currently evaluating the latest counterterrorism technologies for the DoD. The Center manages the Entry Point Screening Program for the DoD's Interagency Technical Support Working Group; identifies technologies for screening vehicles, freight, and people for explosives; and evaluates these systems at critical DoD locations overseas. The Center is also helping DoD apply vessel tracking systems, such as those developed for the Panama Canal, to protect U.S. Navy equipment and personnel.

Protecting Our Borders

With the number of annual entries into the United States nearing 500 million by the early 1990s, INS officials faced the problem of how to screen ever larger numbers of people. So, in 1992, the INS requested that the Volpe Center conduct preliminary research into how biometric technology might be used to automate immigration processing.

Biometric systems use any of several physical characteristics of a person for identification. The most familiar is fingerprinting, but other systems use voice authentication, handwriting, iris recognition, and hand geometry.

INSPASS – Reading Hand Geometry

The first automated inspection system using biometric verification developed by the Volpe Center was unveiled in 1993 with the deployment of automated kiosks at John F. Kennedy International Airport and Newark International Airport, and at Pearson International Airport in Toronto, Canada. This program, named INSPASS, is intended to focus on airports with arriving international flights as well as on border crossings where high volumes of pedestrian traffic need to be processed by immigration inspectors.

Business travelers who come into the United States at least three times a year can apply for an identification card at an INSPASS enrollment center. Then, upon arrival, the traveler inserts the INSPASS card into the kiosk and places his or her hand where indicated. Once the system has verified the biometric reading of the person identified on the card, it prints a receipt to prove immigration admittance. The entire process takes less than a minute, a fraction of the time that would be required for an immigration inspector to manually review the traveler's credentials.

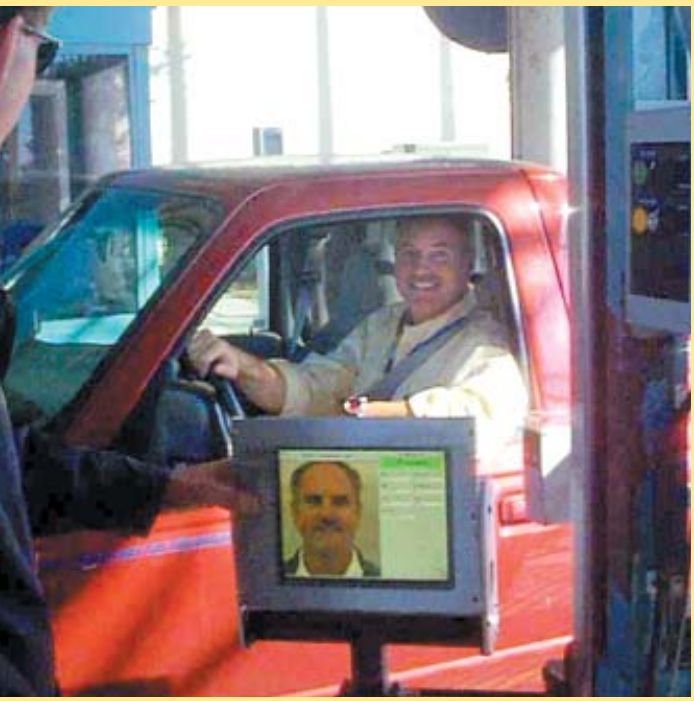
An INSPASS kiosk which enables pre-enrolled persons to enter the United States at busy U.S. and Canadian airports without waiting in the long lines for a traditional immigration inspection.

SENTRI – Easing Border Congestion with Dedicated Commuter Lanes

The Volpe Center was a member of a team, consisting of the INS, U.S. Customs, the Federal Bureau of Investigation, and the Drug Enforcement Agency, that collaborated in the design of a system called the Secure Network for Travelers' Rapid Inspection, or SENTRI, designed to ease congestion at heavily traveled borders by setting up dedicated commuter lanes. The vehicles of those travelers who are enrolled in the program and have passed the rigorous background checks are allowed into the dedicated lane.

Then, as the vehicle approaches the border, the system matches the people in the vehicle with pictures stored in its database of people authorized to enter the country. If there is a match and no violations appear, the vehicle can proceed past the gate. The whole border crossing is thus reduced to about three minutes.

In 1996, the border between Montana and Canada was the scene of the opening of the first Automated Permit Port, a fully automated voice-verification system that allows enrolled participants to cross the border outside normal port operating hours without the need for border personnel. From 1997 to 2000, the Volpe Center implemented remote immigration inspection systems at dozens of marine and land border crossings.



Dedicated commuter lane at Otay Mesa on the Mexico-United States border allows regular commuters to cross borders safely, securely, and quickly.

Security Procedures and Training

The Volpe Center promotes a systems approach to security that encompasses training, policy development, organizational development, and many other factors in addition to technology. Examples of this approach are the Center's recent extensive survey of passenger profiling at U.S. airports, and a study evaluating the effectiveness of security personnel in screening passengers at airport checkpoints. Process engineering, human factors, and training have been critical elements in the deployment of integrated security systems at the Bureau of Engraving and Printing and the U.S. Capitol.

The Center is also improving security awareness and training. For the FAA and the U.S. Coast Guard, Volpe developed and conducted training courses for information system developers and network administrators. The U.S. Postal Service recognized the potential for accidental or intentional risks from hazardous materials being aboard a plane as part of a shipment of mail, although no air disasters have been caused by U.S mail shipments. The Postal Service asked Volpe for assistance in training its employees how to recognize and handle potentially dangerous packages in the mail. The Center conducted a needs assessment and developed training materials for 350,000 employees, covering facility awareness, dock/platform transfers, processing and distribution, and flight assignment.

In 1996, Volpe developed a course for first responders to chemical and biological incidents on public transit systems, and conducted a training course for first responders in the San Francisco Bay Area. The Center has also developed courses on emergency response to other types of transit incidents, and works with the Research and Special Programs Administration (RSPA) and the Transportation Safety Institute to implement these courses throughout the country. The Center is also assisting RSPA's Office of Emergency Transportation to develop options for the movement of emergency teams to crisis locations.

Federal legislation requires that all rail transit systems develop safety plans that address security, so the Volpe Center is lending its assistance to the Federal Transit Administration's State Safety Oversight Program for Rail

Fixed Guideway Systems, and has created guidelines for developing transit security procedures and programs. The Center disseminates this guidance through a Web site, workshops, newsletters, and training courses.

Information and Telecommunications Security

The transportation sector relies on various advanced communications and information systems to perform specific transportation operations. However, these key infrastructures are extremely vulnerable to misuse and disruption.

A prime example of sensitive information disruption occurred when a teenage boy nicknamed "Jester" used his home computer, a modem, and self-taught hacking skills to infiltrate the local telephone company's switching network at the airport in Worcester, Massachusetts. The subsequent breach in security caused a system crash that knocked out telecommunications for six hours, disrupting communications to and from the airport control tower. During the ensuing investigation, airport officials discovered that the boy had had little difficulty infiltrating the switching system because the system lacked password protection.

Hackers can gain access to online freight shipment records unless sophisticated cyberdefenses are put in place.

The Center's involvement with electronic and information security began as part of an extensive program to develop improved mass transit technology in the 1980s, when Volpe helped transit authorities investigate electromagnetic interference (EMI) on new subway lines. The Center was able to capitalize on its expertise in EMI to assit DoD in shielding its computers from "leaking" information. Building on that project, Center computer specialists began working with the FAA to develop awareness of the need for security for their information systems and networks. In 1994, the Center helped the FAA develop a report to Congress outlining the potential vulnerabilities in air traffic telecommunications systems.

Global information is captured and transmitted every 15 seconds via the INTRANSIT tracking system.

The Volpe Center has also assisted the FAA in implementing improved information security measures. The Volpe Center has performed many information security assessments for the FAA's Air Traffic Services, and in 2000, the Center helped the FAA install the Computer Security Incident Response Capability (CSIRC). The CSIRC system utilizes advanced sensor technology to warn the FAA of potential intrusions into their air traffic control systems and networks.

The Volpe Center is the home of the INTRANSIT (INternational TRANSportation Information Tracking) program, with expertise in providing communications, tracking, identifying, and tagging for logistics and security efforts. INTRANSIT's computer and electronic capabilities include creating and deploying information systems, as well as providing key training and operations assistance. The focus of the program is global acquisition and movement of information. Examples of INTRANSIT projects in the 1990s include tracking aircraft for the Air Force and Patriot missiles for the

DoD; supporting the 82nd Airborne in Haiti; setting up asset visibility networks in Bosnia, Somalia, and Haiti; and monitoring the removal of hazardous materials from Europe.

INTRANSIT's electronic and satellite-monitoring capabilities have a number of applications for international security operations. For example, from 1992 to 1995, the Volpe Center participated in a project to improve the monitoring of goods shipments to enforce the sanctions imposed in Yugoslavia. Goods crossing borders were difficult to monitor for compliance with the terms of the sanctions. The Volpe Center developed a system that greatly reduced opportunities for violations.

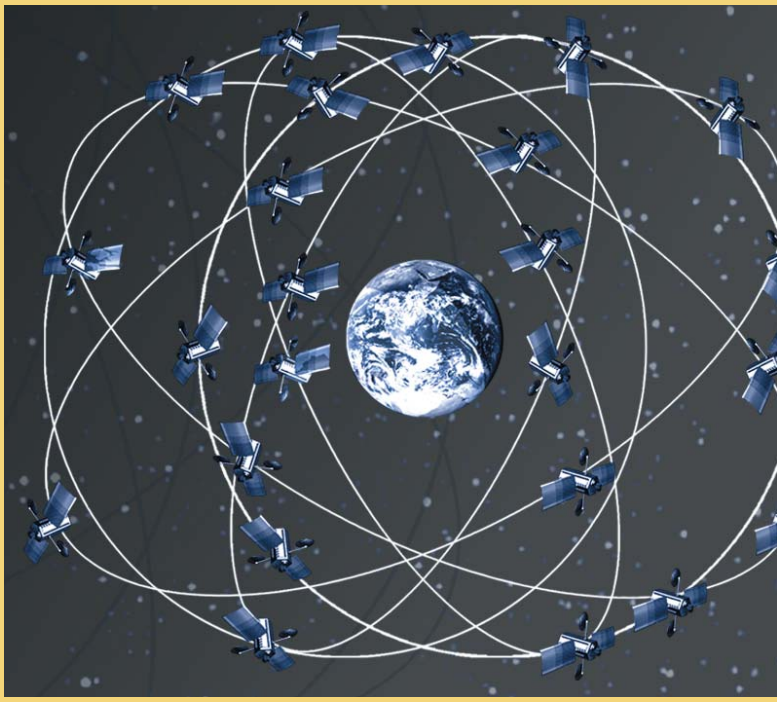
Policy Analysis, Risk Assessments, and Outreach Activities

In 1996, the Center supported the Presidential Commission on Critical Infrastructure Protection (PCCIP) to evaluate the vulnerabilities of the nation's transportation infrastructure and make recommendations to protect critical transportation assets. The commission focused on potential cyber attacks to the transportation system, particularly the air traffic control system. The Volpe Center evaluated the vulnerabilities of the National Airspace System (NAS), and concluded that connections with the Internet, open architectures, and system interoperability may introduce air traffic control system vulnerabilities. The Center later assisted the FAA in developing its response to 1998's Presidential Decision Directive 63, which mandated a national effort to assure the country's security, by ranking the elements of the NAS in terms of vulnerability and potential impact if compromised.

GPS Vulnerability

One of the most serious findings of the PCCIP was the nation's growing dependence on GPS. The Volpe Center developed an in-depth assessment of the vulnerabilities of GPS, and in a report released in 2001, recommended that GPS not be relied upon as the sole means of navigation for transportation systems, and that there be effective backup systems to GPS wherever possible. A major reason for GPS vulnerability is its susceptibility to jamming and spoofing, to signals with deliberately misleading information, and to unintentional interference such as solar flares. GPS security can be improved by strengthening the current system's resistance to disruption, and by integrating GPS with independent systems. Volpe's Center for Navigation is working to ensure sufficient robustness in GPS-based technologies by developing systems with adequate integrity monitoring.

Over the last five years, the Volpe Center has assisted the FAA in developing information security policy and training and has conducted vulnerability assessments for over two dozen major elements of the NAS.



GPS uses a minimum of 24 satellites and ground receivers to track movement for navigation.

(Illustration/Norris S. Padmore)

Volpe Center outreach meetings, designed to identify transportation system vulnerabilities, all identified the need for improved coordination and collaboration among public and private organizations to formulate protection strategies and carry out response plans.

Transportation System Assessments

Following the PCCIP initiative, RSPA received funding to evaluate surface transportation system vulnerabilities. The Volpe Center developed a comprehensive assessment of the vulnerabilities of highway, transit, rail, marine, pipeline, and intermodal transportation. Many scenarios were evaluated, describing the potential impact of terrorist and criminal attacks. The National Research Council (NRC) then formed a committee to evaluate the vulnerabilities outlined in the Volpe Center report, and to formulate priorities for future research and development. The NRC committee commended the Volpe Center for the quality of the assessment, and went on to recommend further research to develop countermeasures against chemical/biological and cyber attacks. The Center is currently conducting a study for RSPA on the interrelationships between transportation and other infrastructures, such as energy.

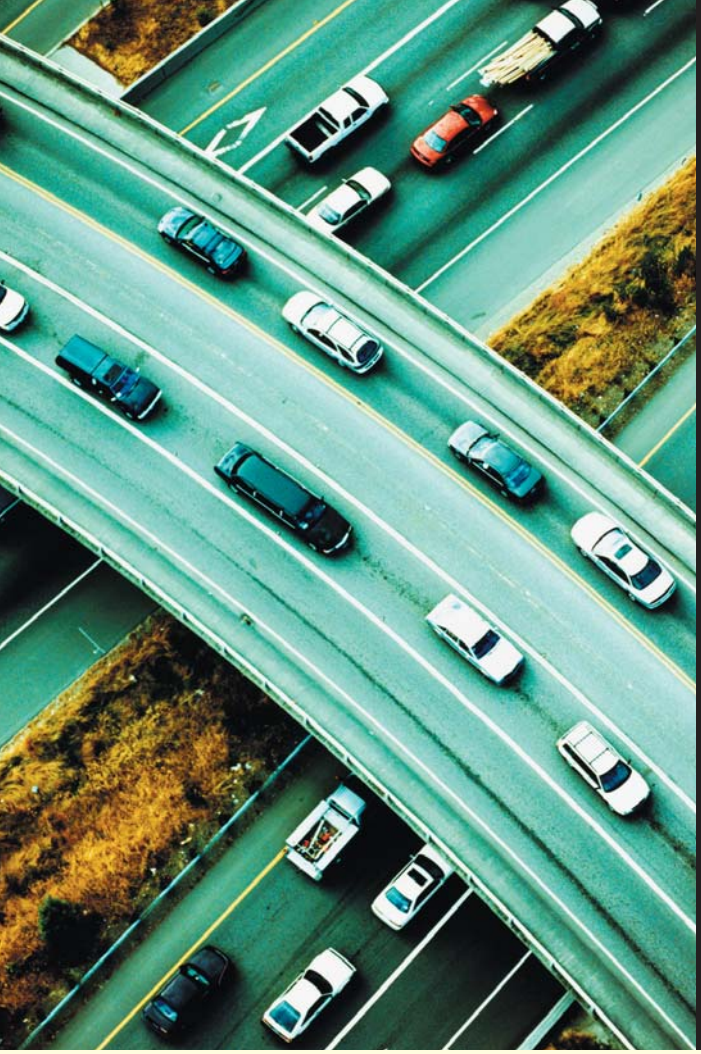
Pipeline Security

At the request of RSPA, the Volpe Center is supporting an initiative to assess the nation's 1.6 million miles of pipeline to determine whether supervisory control and data acquisition (SCADA) systems should be required on hazardous liquid pipelines. The SCADA system uses computer technology to gather data on pipeline pressure, temperature, and delivery flow rates from remote locations along the pipeline, which carries 600 billion ton-miles of oil and 19 trillion cubic feet of gas each year. Working directly with RSPA's Office of Pipeline Safety, Volpe staff found that SCADA and leak detection systems depend on the sophistication of the host computer, and concluded that while many computer operators have invested heavily in SCADA systems, very few have invested in effective software-based leak detection systems. Because of the pipeline industry's lack of uniformity, each system used for leak detection must be configured for a particular pipeline infrastructure. Volpe determined that while a SCADA or leak detection system can be constructed for most pipelines, the high cost and changing technology of such systems has slowed adoption of computer-based leak detection programs. The Volpe Center is working to implement a leak detection system that is both effective and cost-efficient.

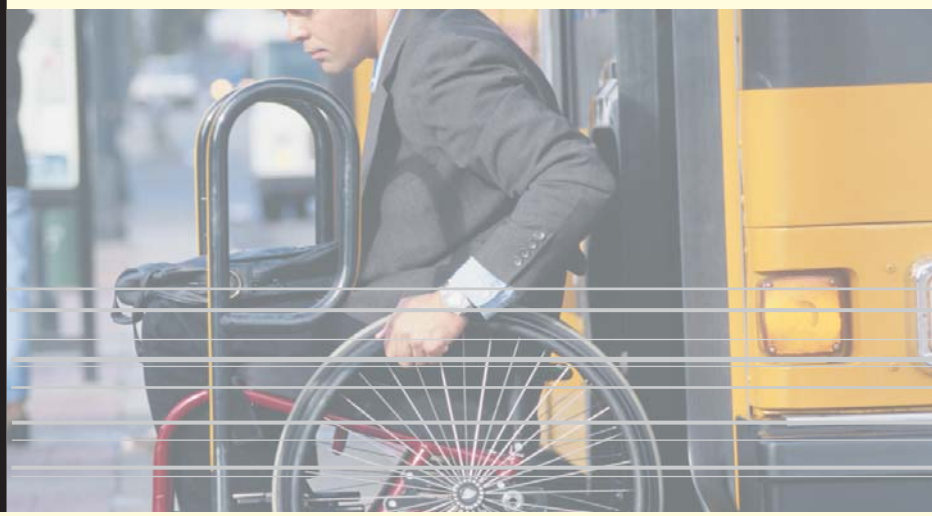
Intermodal Best Practices

Working with the National Science and Technology Council, the Volpe Center developed a compilation of the intermodal cargo industry's security best practices. This report has been distributed widely to industry, and the Volpe staff has presented the findings at numerous symposia, such as the National Cargo Security Council. The Center has also conducted detailed assessments of port facilities, evaluating the vulnerability of logistics processes and electronic commerce to both physical and cyber attacks. The Center is currently conducting a study for RSPA of the potential impact of disruptions to electronic commerce.

The Volpe Center has participated in several other initiatives to help guide future security research and development, and to facilitate the exchange of information on transportation security vulnerabilities and on developing countermeasures. It has hosted numerous outreach events to discuss transportation infrastructure vulnerabilities, emergency response strategies, and growing vulnerabilities of information systems and networks. These events brought together leaders from government at the federal, state, and local level, as well as key players from industry and academia. A common theme of the sessions was the need for improved coordination and collaboration among public and private organizations to formulate protection strategies and carry out response plans.



Mobility in passenger transportation and in the movement of goods is central to our social and economic well-being. The Volpe Center works effectively to assess and enhance mobility in support of U.S. Department of Transportation programs. The Center develops, tests, and implements improvements in mobility: advances in transportation reliability and accessibility, the expansion of the spectrum of choices offered to travelers and shippers, and increases in the quality and efficiency of the travel experience. In this work the Volpe Center fulfills key elements of its mission—to anticipate future national, state, local, and international transportation and logistics issues and requirements, to develop tools and technologies addressing them for the Center's clients, and to be a catalyst for innovation in transportation technologies and management processes.



People and Goods on the Move

MOBILITY

Mobility refers to the movement of people and goods, and the extent to which that movement takes place expeditiously and efficiently. Mobility affects each one of us, our families and neighbors, and our work.

If we wait too long on the runway for a flight to take off after boarding, or if we waste coveted weekend time in stop-and-go traffic, we are acutely aware of the effects of capacity on mobility.

If our sight-impaired parent misses schedule change information on a bus trip because it's offered only through visual information displays, or if our handicapped friend can't step up onto a tram, the importance of accessibility to mobility becomes obvious.

If the goods we need for our business are tied up on vessels because of inadequate access to unloading facilities, or if our containers sit idle because there is no double-stack rail link to a dock area, or if prices for our supplies go up because trucks consume valuable hours to reach a poorly located inner city intermodal freight center, then we realize that we must focus on how the management and technology of freight infrastructure affect economic mobility.

If our neighbor is unable to accept an employment offer because she has no car and there is no available public transportation to the workplace, we recognize the extent to which removing barriers to mobility can expand personal opportunities.

When we wait longer to transfer between bus routes than the time we actually spend in a bus, when the line at the train ticket counter adds 10 minutes to the daily commute, or when traffic lights are improperly timed, we see how using service improvements to speed up traffic flow can improve the quality of our lives and our economic productivity.

Mobility problems like these often emerge over long periods of time. They appear first on the distant horizon as minor, scattered, and tolerable irritations. Suburban and rural congestion, lack of access for disabled and disadvantaged populations, freight delays due to terminal access problems, and air traffic congestion are examples of this type of issue. By contrast, some other transportation issues arise in response to specific events in a short time period, such as those that might give rise to an automobile recall.

If a localized mobility issue is not addressed, it can gradually mature to become acute and pervasive, affecting large numbers of people and businesses. Often, vocal and organized constituencies asking for solutions emerge. By then minor problems have frequently become major ones that require ongoing programs and significant funding to study and remedy.

The Volpe Center's Mobility Initiatives

The Volpe Center has an established 30-year tradition of developing and testing a range of mobility solutions, especially in three linked areas: new technology, service innovations, and the comprehensive evaluation of new ideas and concepts. Addressing the complex and far-reaching issues of mobility affecting people and goods is a key part of the Volpe Center's support of national transportation-related initiatives. This work helps the Center serve as a federal bridge for transportation expertise between industry, academia, and other government agencies.

New Technology: Enhancing Transportation Systems

Volpe has contributed to many mobility initiatives that develop and refine new technologies, such as vehicle/guideway methods, computerized information systems to enhance the performance of existing technologies, and intelligent highways. These initiatives improve operating efficiency and reduce costs, and enhance the quality of travel and shipping for users through better on-time performance, improved safety, and shorter travel times.

Service Innovations: Improving Transportation Mobility in Our Cities and Towns

Service innovations are the transportation solutions most visible to the general public. These innovations include new services and new applications of existing services and technologies to respond to emerging or newly recognized needs in transportation. For example, the Volpe Center has played a key role in developing and implementing such initiatives as Bus Rapid Transit (BRT) systems, paratransit and ridesharing services, downtown people-mover systems, and dial-a-ride services.

Comprehensive Analysis and Evaluation: New Transportation Ideas and Concepts

During the development and adoption of mobility initiatives, the Volpe Center applies comprehensive quantitative and qualitative analysis to assess financial and operational feasibility, comparative effectiveness, and success in implementation. These analyses include a range of economic and environmental analyses to test customer response to new services and technology applications, and their effects on costs and "quality of life" indicators. Risk analysis, forecasting, human factors analysis, and simulation and modeling are techniques that are routinely refined and applied to evaluate mobility.

The Volpe Center's client-oriented work in these three broad areas can be illustrated by examples in four linked areas of current importance: access to transportation for all Americans; enhancing air travel and transport capacity; improving the technology of freight transport; and high-tech innovations for ground transport.

The following pages give some more detailed examples of the Center's work in the mobility arena.

No matter how technologically advanced, transit systems do not fulfill their roles if they are not readily accessible.

Access to Transportation for All Americans

No matter how technologically advanced, transit systems do not fulfill their roles if they are not readily accessible. Our population is increasing; buses, trains, subways, and trolleys together carry millions of passengers. But many locales are struggling both with increased congestion and with ensuring access to transit for their whole population.

Bus Rapid Transit

The Volpe Center supports the Federal Transit Administration (FTA) in projects to develop a system that combines the best of buses and trains. These include sleek, energy-efficient buses that use dedicated lanes in existing roadways and incorporate many innovations to increase accessibility. Bus Rapid Transit (BRT) systems use low-floor buses that permit easy entrance and exit; employ barrier-free fare collection systems; and provide real-time passenger information such as arrival times. A number of cities, such as Los Angeles, Detroit, and Las Vegas have pilot programs to test BRT.

Seattle's downtown bus tunnel is one segment of a regional BRT system that also includes an extensive network of exclusive transitways and High Occupancy Vehicle (HOV) lanes.

The new Metro BRT system along Ventura, Wilshire, and Whittier Boulevards in Los Angeles uses roadside sensors to determine the location and speed of BRT vehicles.

Dial-a-Ride Systems

Accessibility is important to every user of a transit system, but it becomes a critical issue to special populations such as the elderly, people moving from welfare to the workplace, and people with handicaps. The Volpe Center has participated in several projects to improve accessibility for those with physical and financial difficulties. For example, the design for an Autonomous Dial-a-Ride Transit (ADART) system, developed by the Volpe Center, is aimed at assisting customers such as the elderly or disabled who are not adequately served by conventional transit. Dial-a-ride transit is an on-demand service, often in a bus or van, for customers who telephone in their trip requests. The technology consolidates scheduling, fare collection, credit verification, and vehicle routing into a single automated system. The Volpe Center's ADART design does not require a dispatcher and combines off-the-shelf computer and communications components into a system that is highly efficient at a reduced cost. The ADART prototype has been successfully tested in Corpus Christi, Texas.

Welfare to Work: Helping People Get to Jobs

Special attention to accessibility is needed to move welfare recipients into the paid workforce. Without affordable and accessible public transit, many welfare recipients are unable to find jobs. The Volpe Center has been supporting the DOT in finding ways to increase transit accessibility for those without cars who are seeking work

For example, a computer-based Geographic Information System (GIS) is at the heart of a Volpe project to pinpoint specific neighborhoods in Boston where additional transportation services (e.g., shuttle vans, extended bus lines) are needed to allow welfare recipients access to employers. The study demonstrated that much recent employment growth is occurring in suburbs, which tend to be underserved by public transport. GIS can be used by area transportation planning organizations to design more efficient bus and van routes.

Air Transport Capacity

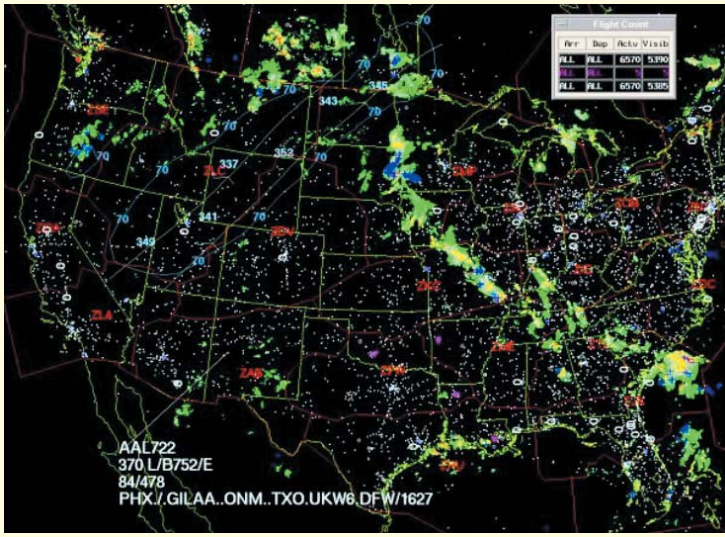
The Federal Aviation Administration is working to minimize airport delays without compromising safety.

When approved in 1978, airline deregulation was designed to produce consumer benefits, but there have been some serious repercussions. One result of deregulation was the shift by major carriers to hub-and-spoke operations. By consolidating passenger traffic and flights from many "spoke" cities into hub airports, major airlines were quickly able to gain footholds in additional markets. However, this model means that delays at one major airport can quickly spread throughout the entire aviation system. By July 2001, the Bureau of Transportation Statistics reported that more than 25 percent of airplane flights were delayed at America's airports. In response to this growing problem, the Volpe Center, in conjunction with the Federal Aviation Administration (FAA), is working to minimize airport delays without compromising safety. Delays come from many sources, including reduced visibility due to weather, construction on runways, too many aircraft, and the need to sequence landings and departures to avoid accidents.

Air Traffic Management System

The Volpe Center is the operating center for the FAA's Enhanced Traffic Management System (ETMS). This system, designed and implemented by the Volpe Center, graphically displays current aircraft positions.
It also projects traffic demands for all U.S. airports, and generates an alert when projected demand exceeds a threshold. The Center also helped develop an enhancement that provides Runway Visual Range data on weather conditions at 45 high-traffic airports. As part of its traffic management program, Volpe operates the Collaborative Decision Making (CDM) program website, the FAA's high-priority system for sharing information among the airlines and the FAA's air traffic organization.

The Volpe Center also supports the FAA's Safe Flight Program, a joint initiative of government and industry. It is meant to speed up the adoption of Free Flight, a model proposed in the 1960s, in which pilots could fly routes of their own choosing through defined airspace. Free Flight would help alleviate air traffic delays by allowing pilots more flexibility, but it depends heavily on flight crews having highly developed situational awareness—the combination of experience and perception of the environment that pilots and crew use in flight situations. Information derived from evolving communications, navigation, and surveillance technologies can contribute to improved situational awareness, but pilots and crew need to know how to use the data gained from systems such as global positioning. Safe Flight 21 is designed to increase crew awareness of new flight technologies.



An ETMS Traffic Situation Display screen, showing air traffic, weather, alerts, and statistical information.

Managing Planes on the Ground: Preventing Runway Incursions

Both the FAA and the National Transportation Safety Board have made preventing runway incursions (situations that could lead to accidents involving aircraft moving on the ground or in the process of takeoff or landing) one of their highest priorities. As part of its Runway Incursion Reduction Program, the FAA called on the Volpe Center to help develop improved, cost-effective Airport Surface Detection Equipment. This provides all-weather aircraft and vehicle detection and tracking capability and also provides warnings, alerts, and status information to air traffic controllers. The new system comprises a radar that scans an airport surface to locate aircraft and ground vehicles; a surveillance system that tracks transponder-equipped aircraft on the surface and on approach routes; and a system that blends this information to provide a unified surveillance "picture" of airport ground traffic.

Technology and People

With congestion on highways increasing as a result of population growth, economic expansion, and changes in demographic patterns, pressure to find ways to relieve overcrowded roadways is growing. Technological advances offer a variety of solutions that can alleviate congestion and make other forms of transportation more appealing. Information technologies used include the latest in computers, electronics, communications, and safety systems. Intelligent Transportation System (ITS) technologies can be applied to highways, streets, and bridges, as well as to cars, buses, trucks, and trains. The Volpe Center has undertaken a variety of ITS projects working with both the FTA and the Federal Highway Administration (FHWA) as well as state and local governments.

ITS innovations include dynamic message signs that will help alleviate congestion.

Smart Cards: No Need for Cash?

The Center has collaborated in developing "smart cards." Wallet-sized cards can store information and communicate with external devices. They can store monetary value and can also be used to control access to restricted facilities. They are ideal for everyday transactions such as paying for transit fares, tolls, parking fees, and gas, and are also useful for controlling access to parking lots or buildings. Because they eliminate many of the steps involved in collecting fees and tolls, they are an important part of ITS programs to increase mobility and reduce congestion.

For example, the Center is working with the Northern Virginia Transportation Commission and the Washington Metropolitan Area Transit Authority to broaden a program using smart cards that can be read without swiping through a reader. The plan is to provide a single card that will give access to buildings, computers, parking, and other facilities and services.

High-Speed Ground Transportation: On Track for Faster Trains

One means of reducing congestion on the roads is to increase the attractiveness of other forms of ground transportation. The United States is starting to keep pace with Europe and Japan in the realm of high-speed trains. The Volpe Center has been a major participant in the research and development needed to take high-speed ground transport from concept to deployment. For example, the Center performed studies to assess the feasibility and safety of systems like France's Train à Grande Vitesse (TGV) for American rail corridors. The Federal Railroad Administration's (FRA) Next Generation High-Speed Rail Technology program has fostered new interest in super-fast trains. The Volpe Center is at the hub of this research, looking into economic factors such as ridership, fare structure, and capital costs, as well as studying all aspects of safety, such as track geometry, vehicle safety, guideway integrity, and communications.

Speeds Up to 240 MPH

Maglev, or magnetic levitation, is a very advanced transportation technology in which magnetic forces lift, propel, and guide a vehicle over a specially equipped guideway. When Congress passed the Transportation Equity Act for the 21st Century, maglev was given its own deployment program to demonstrate the feasibility of maglev for speeds up to 240 mph. The hope for maglev is that it will prove to be a low-maintenance, low-cost, high-speed technology; the Volpe Center is in the forefront of its development by providing environmental, system-safety, and planning support to the FRA's maglev deployment research. The Center has sent teams to Europe and Japan to learn from those countries' maglev research programs as well.

The Transrapid 08 prototype maglev train in Hamburg, Germany, installed on an improved guideway.

Technology and Freight

Over the past 30 years, there has been a steady increase in the number of vessels carrying freight through international shipping lanes and inland waterways to domestic and foreign ports. Because of this increase many transportation agencies have begun to rely on innovative technologies to insure that goods and freight reach their final destination efficiently and safely. The Volpe Center has been in the vanguard of research to design and implement cost-effective state-of-the-art navigation technologies. The Center is responsible for several technological advances in marine navigation, and has provided support to many transportation agencies in the United States and abroad. Using advances in satellite technology and communications, the Volpe Center has developed navigation systems that are accurate and easy to use.

Navigating the St. Lawrence Seaway: From Sextants to Satellites

In 1979, the Volpe Center developed a precise all-weather navigation system for the St. Lawrence Seaway Development Corporation using Loran-C and Raydist-T electronic monitoring devices. Today, the Volpe Center is upgrading that navigation system with one that is more accurate. Volpe's Center for Navigation has implemented an Automatic Identification System (AIS) for vessels, using Global Positioning System (GPS) technology to track ships traveling in the Seaway. A vessel equipped with an AIS transponder transmits its exact location to the Seaway Traffic Control Center. The exact location of a particular vessel is plotted on a computer display and its speed and course are indicated. The Seaway Traffic Management System adds pertinent information such as wind speed and direction, ice conditions, availability of the next lock, and safety-related messages. The benefits of this system include: reductions in transit time and fuel consumption; safer operation through transmission of precise weather conditions; 24-hour navigation for vessels; and improved safety through real-time ship-to-ship communications. This new navigation and communications system has created considerable potential savings for vessels.

Navigation in Central America: Panama, Honduras, and Nicaragua

The Panama Canal is a challenging and treacherous navigation waterway. Nearly 13,000 oceangoing vessels traverse the canal each year. The pilots of these vessels must navigate in adverse weather conditions past landslides, around corners, over submerged rocks, and around huge dredging operations. In 1995, the Panama Canal Commission asked the Volpe Center to develop a system that would track the location of transiting vessels, tugboats, and dredges. The scale of the Panama Canal project is considerably larger than that of the St. Lawrence program. It includes 120 mobile GPS units that communicate with a system of 24 orbiting satellites, resulting in precise vessel location data accurate to one meter using differential GPS. The Communications, Traffic Management, Navigation (CTAN) system helps pilots to navigate this difficult canal.

To keep costs down, the Volpe Center designed the system to use "off-the-shelf" components. The mobile units consist of a GPS receiver and antenna, a laptop computer, and a separate radio antenna for communications with the control center. Approximately half of the mobile units are permanently installed in canal resources such as tugboats and dredges; canal pilots carry the remaining units aboard transiting vessels.

Volpe has also participated in other marine navigation projects in Central America. In the wake of damage caused in Central America by Hurricane Mitch in 1998, the U.S. Agency for International Development asked the Volpe Center to develop a system to replace navigation aids such as buoys that were lost in Honduran and Nicaraguan ports.

Aerial view of Gatun Locks in the Panama Canal.

A modern transportation system provides many benefits for America and its citizens. Yet transportation infrastructure and operations can negatively affect our natural and human environments. Necessary system expansions or improvements cannot be achieved at the expense of personal health or natural resources. Balancing transportation goals with environmental protection presents a formidable and ongoing challenge. The Volpe Center has long supported the Department of Transportation in its efforts to develop and maintain the finest transportation system in the world, while limiting and preventing the impact to our environment. The Center has also actively supported other federal, state, and local agencies in their environmental work.

Human and Natural Environment

The progression of Volpe's environmental work over the years has mirrored society's growing awareness of the need to protect the natural world. When the Center was founded, environmental issues were just emerging into public focus, initiated in part by passage of the National Environmental Policy Act of 1969 (NEPA), which established federal policy on protecting the environment. During the 1970s, attention centered primarily on responding to localized issues. With the passage of time and increased understanding, environmental concerns came to be regarded as national problems, and today reflect our sensitivity to global impacts.

Since NEPA was enacted, the federal government has enacted additional environmental legislation and regulation. The Volpe Center's activities have responded to these federal actions, beginning with supporting environmental initiatives of the DOT and expanding over time to include those of numerous federal agencies as well as state, regional, and local groups. The Center's work also reflects a strategic shift. Instead of reacting to problems, Volpe is proactively working not just to prevent environmental impacts through planning, policy, and exploration of alternative practices and technologies, but to enhance overall environmental quality through transportation initiatives.

Opening the Door on Environmental Actions

Urban noise and smog in the 1960s sparked Americans' awareness of environmental issues. Much of the Volpe Center's early environmental work related to addressing these problems. The Center created its Acoustics Facility in 1970 to develop a standard for airport noise modeling. Today, the facility performs noise-related work for several transportation modes, and its noise modeling tools are used in over a dozen countries.

The energy crisis also guided the Center's efforts in the 1970s. Volpe teams worked with federal agencies and the automotive industry to develop better fuel efficiency standards. Because energy use and the environment are intertwined, the Center's Motor Vehicle Goals Study analyzed potential air quality and other environmental impacts in developing the new standards.

Historical damage, such as the environmental devastation of the Love Canal site and later environmental incidents, strengthened Americans' desire in the 1980s for additional protections, and spurred the Volpe Center to expand into remediation work. The Center supports several federal agencies in these efforts, including asbestos removal for the Federal Aviation Administration (FAA) and the Environmental Protection Agency (EPA), and remediation of mining contaminants for the EPA.

The Center's systems approach and emphasis on knowledge-sharing allows for an agile response to emerging environmental challenges. For example, Volpe's experience in measuring noise levels in the national parks proved helpful when the Center later helped the U.S. Postal Service (USPS) assess the effects of hovercraft noise on fish and wildlife in Bethel, Alaska. The Center continues to perform risk assessments of noise levels to develop effective remediation plans in a variety of transportation settings.

From Repairing Environmental Damage to Preventing Problems

Airline and motor carrier deregulation in the 1980s led to increased impacts on air quality, and the Volpe Center continues to work in this area. These efforts expanded after Congress amended the Clean Air Act in 1990. By creating more stringent air quality standards, the legislation spawned new environmental activities for the Center, including examining the ability of urban areas to comply with the new requirements. The Center's Air Quality Facility, sponsored by the FAA in 1999, is currently working to improve analysis of air quality at airports.

As government took a more proactive approach to environmental issues, environmental analysis began to play a role in transportation projects. Passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991 mandated comprehensive consideration of environmental issues when planning transportation projects. The Volpe Center has conducted many project-related environmental reviews, and is also supporting recent DOT efforts to streamline the environmental review process. Streamlining will speed implementation of transportation projects needed to serve the public and business community, while ensuring that they are environmentally responsive.

ISTEA also led to expanded exploration of alternative transportation systems and fuels. The Volpe Center has provided technical and planning support to the Federal Railroad Administration's (FRA) Maglev Deployment Program. It is also working to support development of Intelligent Transportation Systems, and is studying how they can enhance air quality.

Going Global for Our Future

In the last decade, the localized, "not-in-my-backyard" attitude that arose in the 1980s has softened. The entire world is now seen as "our backyard," and there is a broader shared concern to protect the sustainability of the global environment and its resources.

As it has since its inception, the Volpe Center has adapted to the expanded cultural perspective on environmental issues. The Center supports DOT's Center for Climate Change and Environmental Forecasting, which serves as a clearinghouse for research and policy coordination related to transportation and global climate change. It also supports DOT's Advanced Vehicle Program to encourage development of "green" bus and rail transit. Keeping in step with the global approach, the Volpe Center assists other countries in developing national plans to address climate change.

America depends on a safe, efficient transportation system. At the same time, it takes pride in the quality of its natural environment. The Volpe Center will continue to support efforts to effectively achieve both priorities, while expanding its work to reflect growing recognition of the need to protect and enhance the fragile health of our planet.

The following pages present examples of our environmental work.

Addressing Environmental Problems

Transporting Mail in Alaska: Does Hovercraft Noise Affect Fish and Wildlife?

The U.S. Postal Service (USPS) has embarked on a multi-year program in which a hovercraft is used to transport mail to villages in the vicinity of Bethel, Alaska. The Volpe Center assisted the USPS in conducting a comprehensive study of hovercraft noise to assess the underwater effects of this noise on fish and wildlife. In January 2000, Volpe staff members visited Bethel to perform noise measurements of the hovercraft and to study Alaska blackfish behavior in response to its passage. In addition to conventional acoustic instrumentation, the Volpe team used hydrophones to measure underwater noise levels. Specialized video equipment was also used to monitor blackfish behavior. Volpe Center staff also interviewed local fisherman to obtain day-to-day information. Volpe Center staff took part in many town meetings where villagers were able to voice their opinions. The analysis revealed that hovercraft had little impact on local wildlife populations, and that subsistence harvesting by local villagers was not adversely affected.

Supersonic Aircraft: How Their Impact Was Measured

When supersonic aircraft, which typically fly higher and faster than conventional aircraft, started being seriously considered for military and commercial use in the 1950s and 1960s, critical questions were raised regarding the environmental impact of aircraft fuel emissions. The Climatic Impact Assessment Program was organized in 1971 to provide an assessment, by 1974, of the effects of perturbations of the upper atmosphere caused by supersonic aircraft. In conjunction with other federal agencies, the Volpe Center assisted in coordinating and assimilating data on this issue. The task of determining these effects was a monumental one, incorporating scientific disciplines from basic physics and chemistry to weather forecasting and medical and agricultural sciences. Several government agencies contributed information from their own research, including National Oceanic and Atmospheric Administration, National Aeronautics and Space Administration, Department of Defense, EPA, and the Department of the Interior. The findings of this study were presented at the Volpe Center in February and November 1972.

The Concorde's high speeds create sonic booms. The Volpe Center coordintated a monumental effort to measure the effects of these sonic booms on the upper atmosphere.

Still Cleaning Up after World War II: Bucks Harbor, Maine

In the mid-1990s, the FAA discovered a host of contamination issues at the Bucks Harbor Radar Facility in Maine, as many of the site's World War II-era buildings contained asbestos insulation, lead paint, mercury electrical switches, and electrical transformers containing polychlorinated biphenyls (PCBs). Unidentified waste drums littered the site, and diesel fuel and solvents had leaked into the soil, posing a threat to the public drinking-water supply. The Volpe Center assisted the FAA by providing site assessment, remediation design, project management, and field oversight for the complex cleanup effort, all under the auspices of the Maine Department of Environmental Protection. Volpe staff coordinated the excavation and disposal of 24,000 cubic yards of contaminated soil, and the removal or stabilization of several buildings.

Underground Storage Tanks: Removing Hidden Sources of Contamination

During 1998, Volpe staff designed and managed the removal and cleanup of 68 underground storage tanks from various locations across the country. These particular tanks ranged in size from 500 to 50,000 gallons in volume, and were located at service stations, airfields,

military installations, and industrial parks. Many of the tanks contained gasoline, diesel fuel, solvents, and other hydrocarbons. Older underground storage tanks can develop leaks, and when the stored liquid escapes, may contaminate water supplies. Recent EPA regulations require that all tanks be equipped with features that provide protection against leaks, spills, overfilling, and corrosion. The Volpe Center helped the FAA and the Western Area Power Administration meet a December 1998 deadline set by the EPA, by conducting site investigations, providing design services, and managing tank removals and replacements.

Lead and Arsenic Poison the Soil of Stockton, Utah

The Volpe Center implemented new technology to clean up contaminated soil in the town of Stockton, Utah. A bustling mining town over 100 years ago, Stockton has only recently recovered from the effects of the silver ore smelters and the residual lead and arsenic by-products found in the soil. When the EPA determined that the presence of lead and arsenic in the town's soil posed a serious threat to the health of the residents, the Agency contacted the Volpe Center to conduct a multi-million dollar emergency response action to remediate the most contaminated areas in town. Volpe staff engineers as well as engineering and construction firms assisted the EPA in removing over 40,000 tons of contaminated soil. Because the transport and disposal of contaminated soil is expensive, the Volpe Center implemented new technology to decontaminate on-site, thereby saving the EPA over a half million dollars.

Soil contaminated with lead and arsenic from old ore smelters being cleaned up in Stockton, Utah.

Older underground storage tanks can develop leaks, and when the stored liquid escapes, may contaminate water supplies.

Zebra Mussels Threaten Biodiversity: Effects of Invasive Aquatic Species

A number of aquatic species such as fish, mollusks, shrimp, algae, and microorganisms travel to the United States in the ballast water of international cargo ships, and are discharged into domestic waterways, where they multiply and choke out native species. Two of the hardest hit areas are the Great Lakes and San Francisco Bay. For example, the zebra mussel, which has its original home in the Caspian Sea, first spread to Lake St. Clair and then spread to the Great Lakes, where the one-inch striped mollusks are crowding out native mussels and clams. The Volpe Center helped the U.S. Coast Guard assess the extent of the problem and evaluate technologies that attack the organisms while the water is still on board ship as ballast.

Libby, Montana: Residents Exposed to Asbestos

Vermiculite was mined near Libby, Montana, for decades until 1990. When asbestos exposure resulting from mining, processing, and transporting vermiculite was linked to almost 200 deaths in the Libby area since 1961, the EPA asked the Volpe Center to undertake an immediate assessment of ongoing exposure risks. The Center's team was on site in Libby within two days of the request, testing and analyzing samples from residences, schools, former mines, and other locations. Samples showed the presence of tremolite asbestos, a rare form of asbestos that appears in mined vermiculite.

Tremolite fibers can be dispersed in the air and inhaled, and airborne fibers of tremolite were found at some residences. Asbestos was also found in soil samples. The EPA manages the medical assessment phase of the project, while Volpe continues to provide sampling, site assessment, and analytical support.

Preventing Environmental Problems

Environmental Impact Statements Guide Projects

The Volpe Center has received much publicity for its work in remedial actions, but preventing environmental problems from occurring in the first place is its foremost concern. Work on Environmental Assessments (EA) and Environmental Impact Statements (EIS) has guided the development of many "green" transportation projects, for example the FRA/Amtrak Northeast Corridor Improvement Project. By placing an emphasis on the planning process, the Volpe Center works to ensure that potential impacts are mitigated, and that the principles of "environmental justice" are served by not placing a disproportionate share of environmental harm on low-income and minority neighborhoods.

Since 1998, the Center has provided environmental, system-safety, and planning support to FRA's Maglev Deployment Program, whose goal is construction of a magnetic levitation (maglev) public transportation link. Volpe completed the Maglev Final Programmatic EIS, which addresses potential impacts on the human and natural environment and suggests possible measures to mitigate any adverse impacts.

Brownfields Initiative

Throughout the United States, vacant industrial or commercial buildings and lots lie unused, made worthless by real or perceived environmental contamination. Investors and developers do not want to assume liability for the cleanup of these "brownfields," and invest instead in pristine sites. The neglected properties are thus left to create health and safety risks as well as degrade the value of surrounding communities.

The Volpe Center is helping EPA's Region 1 implement its Brownfields Initiative, which promotes the cleanup and sustainable redevelopment of unused properties in Lowell and Hardwick, Massachusetts. The goal of the assessments is to determine the extent of pollution, potential cleanup strategies, and the cost to ready the sites for redevelopment. Both sites are contaminated by leaking storage tanks and hazardous materials. The assessments will identify the types and concentrations of contaminants, and the areas to be cleaned.

An EPA brownfields site in Lowell, Massachusetts, where contaminants are being cleaned up to ready the site for redevelopment.

Transportation's Impact on Global Warming

Global warming has become a major concern for transportation policymakers worldwide as fossil fuel consumption grows. The fastest growing source of greenhouse gas emissions in many countries is fossil fuel use for transportation. It is estimated that over the next century, the average global temperature could rise by as much as 3.6 to 6.3 degrees Fahrenheit as a result of the atmospheric accumulation of carbon dioxide and other so-called greenhouse gases. The Volpe Center has taken a proactive approach to finding solutions to the predicament, by helping developing countries assess their technological options and by evaluating market-based emissions strategies.

The Volpe Center has worked with countries such as Egypt and Argentina to improve their ability to understand and mitigate transportation-related greenhouse gas emissions. The Center provided Egyptian authorities with technical information regarding transit vehicle efficiency, full fuel-cycle emissions for compressed natural gas, infrastructure for gaseous fuels, and potential fuel costs. This information has helped Egypt make practical decisions for an effective greenhouse gas mitigation plan.

After meeting with Volpe Center staff in 1999, Argentine officials expressed an interest in hydrogen and compressed natural gas for transportation uses. Volpe Center staff provided detailed guidance regarding the use of these fuels, as well as information about the potential benefits of hybrid electric propulsion.

The Volpe Center has also played an important role in helping to advance market-based approaches to minimizing the cost of reducing greenhouse gas buildup. For example, in 1999, the Volpe Center brought together a range of transportation stakeholders at a seminar on greenhouse gas emissions trading.

Noise in our National Parks

The FAA and National Park Service (NPS) first came together to measure aircraft activity and noise levels in the 1980s when the NPS responded to growing public concern about excessive aircraft noise over the Grand Canyon National Park. In 1997, Congress passed the National Parks Overflights Act, designed as preventive legislation to impose restrictions at the parks most seriously affected, and to promote quieter aircraft technology and set minimum altitudes. In 2000, Congress passed the Air Tour Management Act, establishing a public process for the management of commercial air tour operators at 50 parks. Volpe Center environmental and acoustics experts are providing the technical leadership needed to develop air tour management plans that will result in no significant impact on park resources.

The Volpe team collected field data about aircraft noise in the Grand Canyon as part of a larger effort to reduce aircraft noise in our national parks.

The Air We Breathe

Transporation is a major source of air pollution, which in turn damages the environment and has adverse effects on human health. In the 1960s, scientists, environmentalists, and the public became aware that vehicle exhaust fumes play a major role in the deterioration of air quality in urban areas. Los Angeles and Houston, for example, had disturbingly high levels of carbon dioxide from emissions generated by automobile traffic, creating higher amounts of ground level ozone, a major component of smog. This prompted widespread state and federal regulatory activity, eventually resulting in the passage of the Clean Air Act of 1970, which sets limits on how much of a pollutant is allowed in the air anywhere in the United States. Since passage of this act, the Volpe Center has been developing innovative strategies to reduce the levels of carbon dioxide and particulate matter released by automobiles.

A prototype alternative fuel vehicle.

Air quality has improved over the last 20 years, but many challenges remain. Working in conjunction with the DOT and the Center for Climate Change, the Volpe Center is helping to create comprehensive and multimodal approaches to reducing transportation-related pollution and mitigating the effects of climate changes. Some of the Center's work involves providing information and training for metropolitan and regional planners attempting to meet the air quality requirements of the Transportation Equity Act (TEA-21). The Volpe Center has also worked with the Department of Energy to develop the Clean Cities Initiative, which supports public/private partnerships to deploy alternative fuel vehicles in our cities. Each of these efforts forms part of the bigger picture that will ameliorate the effects of transportation pollution and improve the quality of life of U.S. citizens.

Transportation plays a major role in America's economy. An efficient, modern transportation system both creates and supports engines of economic growth. One of the DOT's primary goals is maintaining a comprehensive and integrated system that serves citizens and businesses and keeps our economy competitive. Achieving this goal requires innovative thinking from a skilled, committed, and energized transportation community. The Volpe Center works to foster this environment by offering opportunities to share knowledge and information, encouraging development and application of the latest technologies, and supporting professional capacity building. By fostering a climate of innovation, the Center's activities help the nation's transportation enterprise to address changing demands and explore new opportunities.

Economic Growth

The Volpe Center understands the value of knowledge, particularly how knowledge can translate into making our transportation system more efficient and more cost effective. The Center's systems approach allows comprehensive information sharing across all of its functional areas, and its commitment to ongoing staff development exemplifies the ideal of a "learning organization." The Center strives to implement this philosophy externally as well, conducting educational training and outreach efforts to support continued learning and a valuable interchange of ideas.

The Center has a long history of involvement with conferences and symposia. In the late 1970s, it supported the Harvard Business School Symposium on Government, Technology, and the Automotive Future. More recently, the Center hosted the Spirit of Innovation in Transportation Conference, designed to facilitate technological innovation in transportation. These forums provide opportunities for transportation professionals from government, industry, and academia to gather critical information on research, new technologies, policy implementation, and future trends.

A highly skilled transportation work force is also important, and the Volpe Center contributes to many continuing educational programs. The Center works with the DOT's Intelligent Transportation Systems (ITS) Professional Capacity Building Program to design and implement nationwide training on new ITS technologies. In addition to developing the existing work force, the Center supports future talent. The Garrett A. Morgan Technology and Transportation Futures Program links students with transportation professionals to create a new generation of talent that can meet tomorrow's challenges. In sum, through the dissemination and application of knowledge and technology, Volpe successfully improves our economic competitiveness by enhancing the transportation system, its efficiency, and its cost effectiveness.

Working Together to Create Better Transportation

Pooling intellectual and technological resources through public-private sector partnerships spurs innovation and expedites the transfer of technology into commercial applications. This not only benefits our transportation system's performance, it also helps make the United States more economically competitive. In accordance with this collaborative model, the Volpe Center studies ways to stimulate partnerships in the transportation sector. It recently prepared three reports that examined a variety of partnership models and assessed their potential.

The Volpe Center has been active in fostering research and development relationships with businesses and universities. These relationship have been formalized with arrangements such as CRADAs, or Cooperative Research and Development Agreements, which are a type of public-private partnership in which private companies and government agencies agree to work together on a specific R&D project. These agreements allow the partners to make the most of their resources and reduce expenses by sharing the costs of research, pooling personnel, services, facilities, or equipment. The Center further supports innovation and economic growth by facilitating the entry of new players into the transportation sector and providing incentives for small business, thereby strengthening competition, fostering greater efficiency and lowering the cost of transportation.

Setting the Standards for Transportation Performance

Developing and applying uniform standards and protocols supports the transfer of transportation knowledge and technology both nationally and around the world. It also ensures enhanced systems functionality. In the 1970s, the Volpe Center worked with agencies, industry, and academia to develop motor vehicle fuel efficiency and safety standards. Today, Volpe teams are working with similar groups to harmonize ITS architecture.

Robust international trade is a key determinant of success in an increasingly global economy. The Volpe Center is consulting with several agencies to coordinate safety and environmental standards with U.S. trading partners under the North American Free Trade Agreement (NAFTA).

The Center also supports initiatives to encourage adoption of international standards and operational protocols. The Volpe Center assists DOT agencies in adopting the International Organization for Standardization (ISO) protocol, which is becoming recognized worldwide as the accepted standard of quality in products and services. The Center also works with the International Civil Aviation Organization to better integrate operation of the global positioning satellite navigation system.

Sustaining economic health in a changing world presents continual challenges. As we forge ahead into the 21st century, the Volpe Center's efforts to nurture a culture of knowledge and innovation ensure that we have a state-of-the-art transportation system that supports our economic vitality.

Transportation's Role in Economic Growth

Public-Private Partnerships Make the Most of Resources and Cut Costs

Public-Private Partnerships pool the capacities of different organizations in government and the private sector to accomplish a common purpose. These partnerships build on the different information, technology, and human assets of each partner while sharing the expenses, which allows participants to make maximum use of resources and eliminate duplication of effort. The Volpe Center actively facilitates these arrangements by hosting symposia, publishing reports, developing innovative tools and processes, and supporting specific initiatives.

Government and Private Organizations Pool R&D Resources

The Volpe Center participates in a number of CRADA's, including the Advanced Public Transportation Systems (APTS) Mobile Showcase in which Volpe collaborates with the Federal Transit Administration and several manufacturers to showcase new technologies. The expandable Mobile Showcase trailer travels around the country to demonstrate the latest in transit technology and equipment to transit officials and consumers in an interactive environment. The Center has also worked collaboratively with the Massachusetts Institute of Technology. Volpe's Center for Human Factors Research in Transportation is a model of cooperative R&D.

The APTS Mobile Showcase demonstrates innovations in transit technology and equipment all over the country.

The lab pursues joint projects with local businesses and universities under CRADAs. The Volpe Center also participates in the Partnership for a New Generation of Vehicles, which explores strategies to achieve federal mobility goals while protecting natural resources and the environment.

Facilitating Research to Promote Technological Progress

Since 1982, the Volpe Center has directed DOT's Small Business Innovation Research (SBIR) program, whose mission is to stimulate technology innovations in transportation programs by facilitating the research efforts of small businesses in the United States. The Volpe Center was chosen to host the SBIR Program Office because of its extensive background in technology transfer, cooperative R&D agreements, outreach projects involving a cross-section of the transportation community, and technical assistance to state and local governments, as well as to private organizations.

Training and Education: Encouraging New Ideas

The Volpe Center is dedicated to the idea that fostering a climate for innovation through training and education will stimulate important advances in transportation. For example, the Center manages the new Transportation Executive Leadership Institute, established in early 2001 as a way of educating senior DOT officials. Twenty or thirty upper-level DOT leaders will share their knowledge of transportation management issues and techniques in several short sessions each year. The sessions will provide case studies, curricula, and training scenarios culminating in group discussions on various themes.

Volpe actively supports DOT's University Transportation Centers program, which consists of learning centers integrated into universities and colleges, and is designed to provide training and support to future transportation professionals. The Center also works closely with DOT to develop professional capacity building programs in the areas of ITS and metropolitan transportation planning. These comprehensive programs provide assessments, curricula, web-based learning, case studies, and peer-to-peer exchanges to transportation officials, organizational leaders, and other stakeholders in the transportation enterprise.

Transportation and the Global Economy

As globalization grows and transportation issues take on an international flavor, harmonizing technical standards can ease the transfer of technologies and systems among different countries, facilitating trade. For instance, Volpe has been involved in developing ISO criteria for public transit, and it has explored ways to make ITS technologies mesh with overseas systems.

In the area of international safety and environmental standards, the Volpe Center provides significant expertise. For example, the moratorium on Mexican trucks and buses is expected to be lifted by January 2002. The Volpe Center is developing an environmental assessment to help the Federal Motor Carrier Safety Administration formulate rules for certifying carriers operating under NAFTA.

Volpe Fosters Innovation by Bringing Experts Together

The Volpe Center recognizes that one of the best ways to stimulate new ways of thinking and new approaches to problems is by bringing together the people who are most involved in specific transportation issues, and providing them with a way to share ideas, ask questions, explore different scenarios, and reach new conclusions. In that spirit, Volpe has, since its inception, been host to many conferences, symposia, and workshops on topics that affect the transportation world.

Motor Vehicle R&D Conference

A conference on basic research directions for advanced automotive technology, which took place in 1979 and featured DOT Secretary Brock Adams as the keynote speaker, was an early example of the Center's ability to facilitate this kind of event. It focused on generating new ideas for improving existing technologies and adopting new ones to improve the performance of motor vehicles. Two decades later, the Volpe Center continues its work in this area by conducting research in renewable energy sources, fuel cells, and highly energy-efficient vehicles.

Moving America

In the early 1990s, a new national transportation policy, entitled "Moving America," undertook an ambitious agenda: to stimulate the progress of U.S. transportation into the next century, by emphasizing the pooling of resources through a partnership approach. The Volpe Center's ongoing commitment to gathering experts from every branch of transportation to share ideas and experience played a key role in advancing this policy throughout the 1990s.

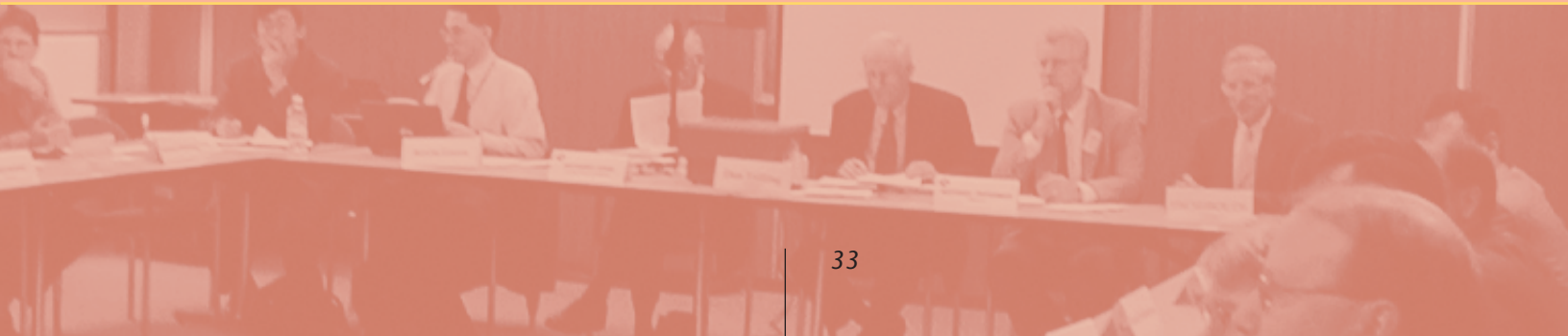
Spirit of Innovation in Transportation

The Spirit of Innovation in Transportation conference held at the Volpe Center in 2000 again demonstrated the Volpe Center's value as a catalyst for the exchange of ideas. The underlying theme of the conference was that transportation advances require creativity, cooperation, and hard work among all members of the transportation network. Discussions highlighted four major areas: cybertechnology, alternative fuels and vehicles, nanotechnology, and the education and training of the transportation workforce. Each of these areas continues to be a focus of research and innovation at the Center.

Former Secretary of Transportation Rodney Slater checks out a hybrid electric bus at the Spirit of Innovation conference.

National Symposia on Transportation

Recently, the Center hosted the National Symposia on Transportation, a series that addressed three transportation topics of national interest: public-private partnerships, education and the workforce, and enabling technologies. The Symposia brought together public officials, academics, transportation professionals, members of the financial and legal communities, manufacturers, and vendors. Besides providing valuable background information, the presentations used real-world examples to illustrate innovative technologies and techniques.



Continuing a tradition of innovation and public service, the Volpe Center's workforce has evolved in response to the changing needs of transportation and of our society at large.

The Changing Face of the Volpe Center

Over the years, the Volpe Center has fostered a culture of innovation, encouraging individuals to develop creative approaches and solutions to transportation and related societal issues. In 1970, when the former National Aeronautics Space Administration (NASA) Electronics Research Center was reopened as DOT's Transportation Systems Center, the onetime NASA employees were able to broaden their mission and to apply their scientific and engineering skills to the challenges of the entire transportation enterprise. At the same time a systems perspective was encouraged. The transfer of "space-age" technology to the mounting challenges of the country's transportation was the initial motivation in a 30-year path of innovation that has become the hallmark of the Volpe Center. As the national transportation system has evolved, so has the Center, remaining at the forefront of both technical and systems-oriented innovations. Early on, the Center's management realized that the real questions about transportation technologies had to do with their value to society, their practicality, and their economic viability, rather than simply their technical sophistication or excellence.

As the skills needed to address national transportation problems began to change, the focus of the Center's workforce began to shift from primarily engineering and hard sciences to include other disciplines, such as economics, social science, psychology, information technology, and operations research. Today, the diverse work force continues to evolve to meet changing national priorities and client needs. In this way, the Center has been able to establish a tradition of providing leadership and rapid response to decision makers and organizations in defining problems and pursuing solutions that are necessary for advancing transportation in the 21st century.

The current Volpe Center workforce represents a world-class transportation resource, with broad interdisciplinary and cross-modal technical and institutional expertise that is not replicated elsewhere. The Center places high value on critical thinking; this perspective has fostered an ability to transfer "lessons learned" across transportation modes. The flexible organizational structure at the Center promoted creative teamwork across disciplines long before working in teams became the norm in today's workplaces. Concurrently, the Volpe Center workplace has evolved to accommodate changing societal priorities and employee needs.

A History of Adapting to and Managing Change

Initially, the Volpe Center's staff was composed primarily of electrical and electronic systems engineers and physical scientists. The early addition of mechanical and civil engineering provided more traditional transportation engineering and analysis capabilities. This mix of skills and perspectives enabled the Center to carry out its mission: to address major issues that cut across the traditional modal structure of the transportation enterprise. According to Dr. Frank Tung, then an electrical engineer and today the Deputy Director of the Center, "We learned very quickly that we could not effectively solve our clients' problems without domain knowledge of transportation systems. We have evolved by integrating technical knowledge and transportation knowledge. This is what has always made the Volpe Center unique."

In the mid-1970s, socioeconomic research and analysis skills were added to the Center's skill mix. These capabilities quickly matured during the energy crisis, when the Center contributed to analysis of the automotive industry and the federal regulation of fuel efficiency. In the 1980s, the Center supported DOT initiatives in transportation deregulation and in the planning and evaluation of mass transit technologies and service innovations.

With the advent of microcomputers in the late 1970s, the Center began transforming its information system and information technology (IS/IT) skills from the existing time-shared mainframe capabilities to the new PC technology. In the 1980s, the Center developed capabilities in logistics system engineering and expanded its program management and IS/IT capabilities.

In the 1980s, Dr. Richard John, now the Volpe Center's Director, saw an opportunity to expand the services offered by the Center to include strategic planning and analysis. The service he envisioned would apply careful planning and analysis to national transportation goals from a much broader perspective than was generally true of technical projects underway throughout the rest of the Center. In 1988, a new division, the Transportation Strategic Planning and Analysis Division, became the focal point for this type of long-term strategic thinking related to transportation and technology.

In the 1990s, the Center's client base continued to expand to include a broad range of other federal, state, and local agencies, as well as some international entities. To meet the requirements of these new clients, the Center expanded in three areas—environmental engineering and remediation, human factors, and physical and information security. In addition, as disciplines such as computer modeling and simulation have become more sophisticated, the Center's staff has expanded in these areas.

The Current Volpe Team

Nearly two-thirds of the Volpe Center's 550-member federal workforce is made up of technical professionals, many of whom have advanced degrees in disciplines such as engineering, physical and social science, economics, and information systems.

The Center's federal employees work with more than 900 contractor employees from major private-sector firms. In addition, the Center has extensive relationships with leading organizations in both industry and academia. The core permanent federal staff provides a breadth of technical, project management, and customer-relations skills. Every project is led by a permanent federal employee who forms teams of federal and, where appropriate, contractor staff. Using contractors enables the Center to adjust quickly to changes in the distribution of work areas, and to emerging needs.

Building and Maintaining a High-Quality Workforce

The Volpe Center recruits aggressively to ensure a diverse workforce, and invests heavily in training to make certain that employees possess the technical, administrative, and professional skills required of a highly productive 21st-century workforce. Innovative programs that focus on collaborative working relationships, professional development, and work-life balance help us attract and maintain high-quality staff.

In 1991, as part of the initiative to attract talented individuals into the federal transportation community, the Volpe Center established the "Gateway to Careers in Transportation" program to help rejuvenate research, engineering, and analysis efforts. Recent graduates from undergraduate and graduate school were recruited into this program, where they had an opportunity to experience working at the Center without making a long-term commitment. The recruitment effort involved Center staff in visits to a number of colleges and universities.

Collaborative Working Relationships

Several programs help the Volpe Center develop a diverse, adaptable workforce by integrating highly qualified graduate and postgraduate students with experienced, established staff and enabling the transfer of knowledge through collaborative working relationships. Recently, the Volpe Internship Program was established to honor the second Secretary of Transportation, John A. Volpe. (See the profile of John Volpe in this issue.) The internship offers major tuition assistance and paid work opportunities at the Center for outstanding graduate students in the engineering, scientific, and social science disciplines who are interested in transportation.

Twenty colleges and universities have agreements with the Co-op Program, which each year employs about 30 highly qualified students at the Center. Since the program started in 1970, many co-op students have converted to permanent positions. The internship and co-op programs not only give the Center access to an excellent pool of future professionals, but also give students the opportunity to serve their country and "make a difference" while working side-by-side with leaders and experts in transportation.

Two programs take advantage of the expertise of seasoned management and technical staff. The recently redesigned Mentoring Program pairs new employees with established employees. Also recently established, the Emeritus Program allows retirees to continue to work at the Center on a part-time basis, either on a schedule or as needs arise. These programs capture and disseminate the accumulated knowledge of the Center's technical and management leadership and create learning partnerships within and across the organization.

Professional Development

Because the Volpe Center is a knowledge-based organization, strong investment in learning and development is critical to success. A significant investment is made annually to pay for learning and development opportunities for Volpe staff.

In 1994, the Volpe Center Fellows Program was established to help build environmental expertise in-house; today, the program continues to support and enhance the Center's capabilities. It pays full tuition, fees, and book expenses for up to 10 employees each year who are enrolled in graduate or postgraduate degree programs that directly support the Center work areas, core disciplines, or long-range goals. In addition to the Fellows Program, all employees are encouraged to enhance their expertise through a wide variety of professional development opportunities. The Center reimburses tuition, travel, and related costs for approved training and education, and regularly offers core-competency/skill-development programs.

Balancing Work-Life Issues

Dramatic social changes have occurred in the last three decades. The Volpe Center has led much of the private sector and most government agencies in responding to these changes, modifying the work environment to accommodate its evolving workforce. For example, the Center has become more family friendly, providing access to an on-site child care center, job sharing, telecommuting, part-time employment, and flexible working hours. And the Volpe Center has committed to employee health and fitness with its Fitness Center and Wellness Program.

Special emphasis programs have enabled the Center to benefit from a pool of well-qualified, nontraditional workers. During the last three years, 14 employees have been hired at the Center through the Welfare to Work program. The Center also makes a sustained effort to accommodate the needs of disabled workers and to utilize their knowledge and talents.

Children of Volpe Center employees at the on-site child care center.

language skills, which gives them opportunities for better jobs and a chance to integrate into American society. The Cambridge Chamber of Commerce has honored the Center with the Corporate Citizen of the Year Award.

These activities benefit both volunteers and program recipients by increasing mentoring skills; helping to prepare the future workforce; and transferring technology, information, and transportation career opportunities to others. The Volpe Center is now recognized as having one of the largest corporate volunteer programs in the City of Cambridge.

Serving the Community

The Volpe Center's staff generously contributes to the local community. The campus is often opened to community groups and local youth, and each year the Center continues its tradition of more than 90 percent participation in the Combined Federal Campaign, the government's analogue to efforts like the United Way. And, as part of the Center's formal TEAM (Tutoring, Educating, and Mentoring) Effort, Volpe staff serve as volunteers in a variety of education activities in the City of Cambridge. For example, twice a month, more than 100 volunteers from the Volpe Center walk to the nearby Robert F. Kennedy Elementary School in Cambridge to spend a half-hour reading to second and third graders. At the Cambridge Rindge and Latin High School, volunteers work with students on science and transportation-based activities; this involvement is designed to challenge and interest students not only in the transportation industry, but in all academic studies. Volpe Center employees have been volunteering their services to teach English as a Second Language for more than nine years. Students who enroll in this program originate from all over the world, from such countries as India, China, Russia, Haiti, Guatemala, Peru, Brazil, Japan, and Korea. They all come to improve their

Volpe volunteer giving a book to a second grader at the Robert F. Kennedy Elementary School in Cambridge, Massachusetts as part of the end of the year celebration of the reading (Lunch Buddies) program.

"As we live in times of change, we must be architects of that change, or we will surely and certainly be its victims."

- John A. Volpe, second Secretary of Transportation (1969 –1973). Volpe created the Transportation Systems Center in 1970, which was renamed in his honor in 1990.

JOHN A. VOLPE

Architect of Change

Sparked by inspiration and driven by commitment to change, John Volpe was one of the most resourceful modern American transportation leaders. In 1970 he launched the Transportation Systems Center, the first significant research and development center dedicated to innovative transportation solutions. Throughout Volpe's career as businessman, Governor of Massachusetts, Secretary of Transportation, and Ambassador to Italy, he knew how to create and manage change. He adapted to the complex dynamics of politics, finance, and technology to make things happen for a country dependent on mobility. The Volpe Center is now an essential resource where today's transportation leaders can find thoughtful answers to the central transportation questions of today and tomorrow.

Living the American Dream

John Volpe never lost touch with his roots. Born to Italian immigrants in 1908, his heritage provided strength, perseverance, and a work ethic. He assisted in his father's plastering business as a youngster, and during high school and college was a construction laborer. In 1941, he established the Volpe Construction Company, building hospitals, schools, shopping centers, and military installations.

Volpe entered statewide Republican politics and in 1953 was appointed Commissioner of the Massachusetts Department of Public Works. When the $27.5 billion Interstate Highway Program was approved in 1956, President Eisenhower chose Volpe as the first Federal Highway Administrator.

In 1960, when John F. Kennedy led the Democratic ticket, Volpe, a Republican, won election as Governor. He lost in 1962, but won again in 1964 and 1966.

In 1968, President Nixon appointed Volpe Secretary of Transportation. Volpe defined the recently created department's mission and built an organization that would shape the nation's future.

Responding to Changing Times

Secretary Volpe's priority was an integrated, accessible, multimodal transportation system that would improve the quality of life for all Americans. Volpe's vision incorporated innovative planning, R&D for emerging technologies, and new and different solutions.

Volpe led the first comprehensive national transportation policy review. Major challenges included highway, airport, and air traffic congestion; safety hazards; labor relations; economic regulation; rail and urban transit system finances; and environmental and social issues.

Creating the Multimodal Vision

Critical to Volpe's vision was the coordination of the many agencies within DOT and the establishment of the Transportation Systems Center, where R&D skills could be focused on issues cutting across traditional modal boundaries.

Volpe had championed the Interstate Highway Program and implemented the largest road-building program in Massachusetts. But after seeing the road congestion and urban decay resulting from highway construction, and true to his reputation as an agent for change, Volpe developed his multimodal approach. This included the Urban Mass Transportation Assistance (UMTA) Act of 1970, a $10-billion program to upgrade mass transit systems.

Volpe also proposed federal action to save passenger train service and reduce highway expansion in the Northeast, lobbying successfully for the creation of Amtrak.

Addressing Social and Environmental Issues

Volpe created DOT's Office of Civil Rights in 1969, increased minority hiring, and set minority hiring standards for DOT contractors. Environmental degradation was also a major concern of DOT, which initiated studies of air, noise, and water pollution caused by transportation.

Volpe's urban planning policy called for maximum public participation early in the process. However, the Interstate Highway Program was already impacting urban areas, often cutting through minority and environmentally sensitive areas. Volpe rerouted or canceled several highways to deal with these concerns, but still kept the highway program on schedule.

Ensuring Safety

Safety was a priority for Volpe. He established the DOT National Highway Traffic Safety Administration, and issued a tough safety standard including air bags in all new cars by 1972. Powerful U.S. car manufacturers fought hard against the order, and won. But Volpe was successful with the Alcohol Safety Action Project, which helped increase alcohol-related arrests and convictions by nearly 100 percent in test states; this program was quickly expanded to 35 states.

Applications of technology were key to Volpe's approach to safety. He saw that, compared to space flight technology, air traffic control methods were rudimentary. The Airport and Airway Development Act of 1970 provided funding for improvement and modernization of the air traffic control system.

Committing to the Future

Demonstrating the need to apply advanced technology to ground-based transportation problems, Volpe chose a National Aeronautics and Space Administration (NASA) administrator as Deputy Secretary and an aerospace engineer to head UMTA. Experimental ground transportation systems were developed, and these explorations of new technology laid the foundation for later innovations.

Volpe's most significant contribution to the future of transportation was the creation of the Transportation Systems Center. Working with Massachusetts' Congressional delegation, including Thomas P. "Tip" O'Neill, Volpe brought more than 400 employees from a NASA research lab scheduled for closing to DOT. With space-age expertise they began work on projects including noise and air pollution abatement, electronic guidance systems for highways, and drunk-driving prevention.

Continuing a Life of Public Service

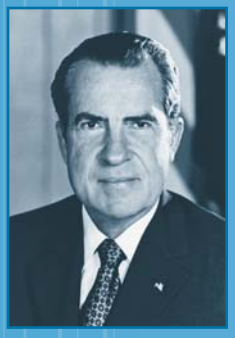
In 1973, Volpe became Ambassador to Italy, and later remained active in charitable efforts and public service. He became chairman of a presidential commission on drunk driving, earning a Presidential Citizen's Award from Ronald Reagan. In 1994, John Volpe died at the age of 85.

The Volpe Center - Carrying on the Commitment

The John A. Volpe National Transportation Systems Center is widely considered one of Volpe's greatest legacies; in 1990, on the occasion of its 20th anniversary, it was renamed in his honor. The Volpe Center, in its continuing work, embodies the attributes of its namesake–innovative thinking, multimodal vision, and commitment to the future.

U.S. Presidents and Transportation 1970-2001 Secretaries

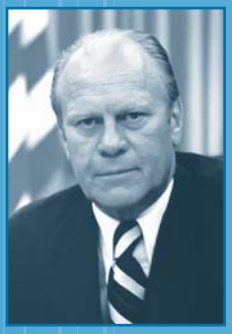
Since the Volpe Center opened in 1970, there have been seven U.S. presidents, and the U.S. Department of Transportation has been guided by the leadership of 13 Transportation Secretaries. Each administration has faced unique transportation challenges, and has advanced the nation's transportation system through a variety of policy, research, and technology initiatives. The Volpe Center has contributed to the DOT's research priorities by providing critical analytical and technical support. This section highlights 30 years of history and achievement at the U.S. DOT. The Secretaries of Transportation are noted below each administration.



Richard M. Nixon's Administration

John A. Volpe (January 1969-February 1973)
Claude S. Brinegar (February 1973-February 1975)

- National Highway Traffic Safety Administration (NHTSA) is established as a separately operating administration
- Airport and Airway Development Act of 1970 is enacted—intended to upgrade and revitalize the nation's airport and airways system
- The Transportation Systems Center (later renamed the Volpe Center) is established by DOT
- Amtrak is created by the National Railroad Passenger Service Act of 1970



Gerald R. Ford's Administration

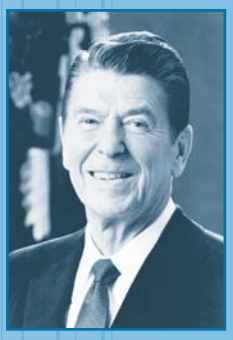
William T. Coleman, Jr. (March 1975-January 1977)

- The National Transportation Safety Board (NTSB) becomes an independent agency
- The Materials Transportation Bureau is established to oversee pipeline safety and the safe shipment of hazardous materials
- Release of the first Statement on National Transportation Policy
- Railroad Revitalization and Regulatory Reform Act of 1976 is enacted—begins deregulation of the railroad industry

Jimmy Carter's Administration

Brock Adams (January 1977-July 1979)
Neil E. Goldschmidt (August 1979-January 1981)

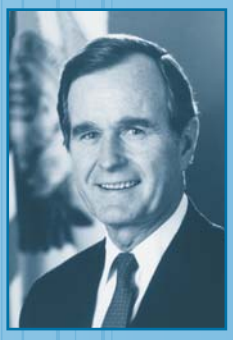
- New fuel economy standards are announced
- Multimodal Research and Special Programs Administration is established
- Airline Deregulation Act of 1978, the Staggers Rail Act, and the Motor Carrier Act of 1980 are enacted—all key pieces of deregulation legislation
- NHTSA launches nationwide campaign against drunk driving



Ronald W. Reagan's Administration

Andrew L. "Drew" Lewis, Jr. (January 1981-February 1983)
Elizabeth H. Dole (February 1983-September 1987)
James H. Birnley IV (December 1987-January 1989)

- Professional Air Traffic Controllers Organization (PATCO) strike in 1981
- The Maritime Administration is transferred to DOT from the Department of Commerce
- The National Airspace System (NAS) Plan is issued, detailing proposed air traffic control and navigational system modernization efforts
- Rule mandating air bags and/or automobile seat belt restraints is introduced



George H. Bush's Administration

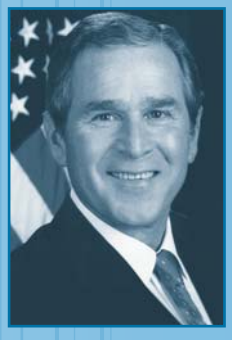
Samuel K. Skinner (February 1989-December 1991)
Andrew H. Card, Jr. (February 1992-January 1993)

- The Federal Aviation Administration's first annual Capital Investment Plan becomes effective, superseding the NAS Plan
- Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) is enacted
- Office of Intermodalism and the Bureau of Transportation Statistics established

William J. Clinton's Administration

Federico F. Peña (January 1993-February 1997)
Rodney E. Slater (February 1997-January 2001)

- The National Highway System is unveiled
- The Surface Transportation Board is established to perform functions previously carried out by the Interstate Commerce Commission
- Transportation Equity Act for the 21st Century (TEA-21) is enacted
- The Federal Motor Carrier Safety Administration is established



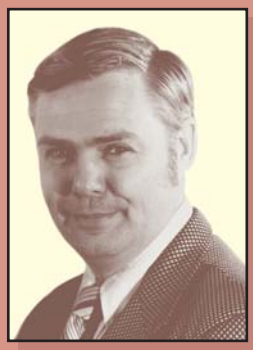
George W. Bush's Administration

Norman Y. Mineta (January 2001-

- According to President Bush, Norman Mineta has "made a reputation in the halls of Congress as someone who understands that a sound infrastructure in America will lead to economic opportunity for all Americans." Secretary Mineta's experience as Mayor of the City of San Jose, California, as a long time member of the U.S. House of Representatives where he chaired several transportation-related committees, as a senior executive at Lockheed Martin, and as Secretary of Commerce enriched this understanding and made him an expert on transportation issues. Already he has met a tremendous challenge, leading the DOT in a comprehensive re-examination of all transportation security issues in response to the terrorist attacks of September 11, 2001.

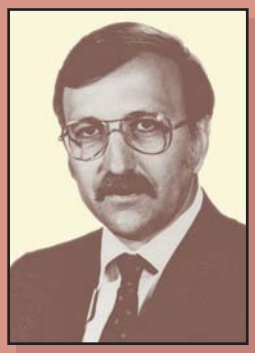
The Volpe Center
1970-2001 Directors

James C. Elms
July 1970 -
December 1974



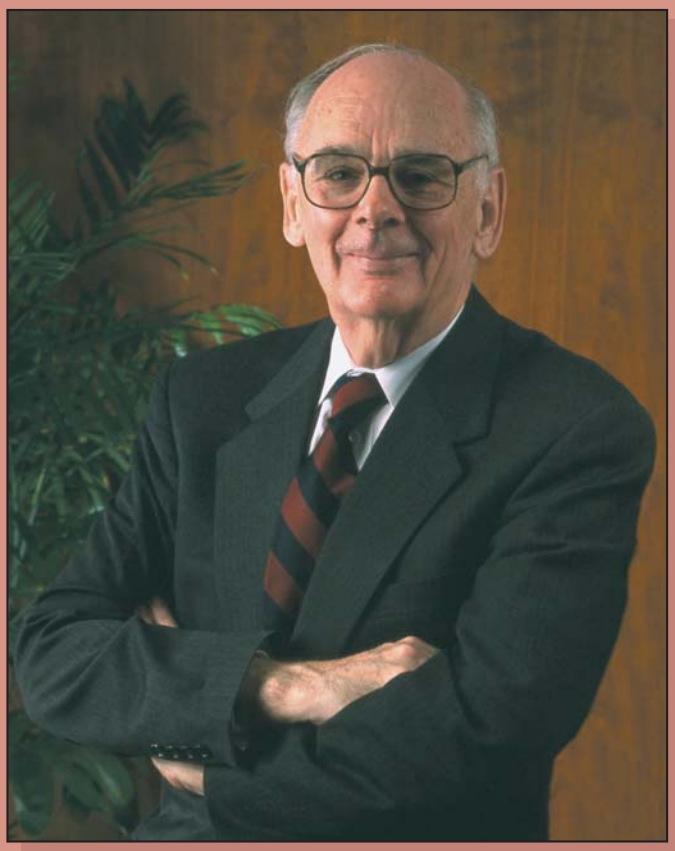
Dr. Robert K. Whitford
December 1974 -
January 1976

Dr. James Costantino
January 1976 -
November 1983



Dr. Robert J. Ravera
November 1983 -
September 1984

Dr. Louis W. Roberts
September 1984 -
July 1989



Dr. Richard R. John, Director

Dr. Richard R. John has been the Director of the Volpe Center since 1989. Dr. John joined the Volpe Center in 1970. During the course of his career at the Center, he initiated and led the early development of many of the Center's current world-class capabilities, and participated in early groundbreaking studies on the international competitiveness of the U.S. automobile industry. More recently, Dr. John has heightened awareness in the Department of Transportation and in the transportation community on the importance of bringing about technological innovation in shaping a transportation system that meets America's needs in the 21st century. He has successfully led the Volpe National Transportation Systems Center in its ambitious mission of becoming a world-class federal center for facilitating transportation innovation. He is frequently called upon by federal, state, and local officials and by the diverse national and international transportation community for advice and counsel on complex transportation programs.

He received his undergraduate and graduate training in engineering physics and aeronautical engineering at Princeton University. He has published extensively in the fields of combustion, high-temperature gas flows, advanced space propulsion, and, most recently, industrial competitiveness.

The U.S. Department of Transportation has recognized Dr. John by bestowing upon him the Distinguished Presidential Rank Award (the federal government's highest civil award) twice, once in 1991 and again in 2001; the Presidential Rank Award for Meritorious Executive; and three Secretarial awards.