the VOLPE center
U.S. Department of Transportation
Research and Innovative Technology Administration

APRIL 2009
# HIGHLIGHTS

## Experts Focus on Transportation Operator Fatigue

National and international leaders in research, transportation management, and labor, as well as regulators and program evaluators from all modes of transportation convened in Boston to participate in a highly successful conference on fatigue management in transportation operations. The March 24-26 conference was sponsored by the U.S. DOT Human Factors Coordinating Committee (HFCC).

The 2009 International Conference on Worker Fatigue Management in Transportation Operations focused on disseminating information on the latest fatigue-related research, technology, and countermeasures, and facilitating the use of this information, and evaluation methods needed, for achieving better fatigue management in transportation.

Michael Coplen, HFCC Chair and Director of Culture and Safety Performance Studies at the Federal Railroad Administration's Office of Railroad Development and Dr. Stephen Popkin, Volpe Center Director of Human Factors Research and System Applications COI and Executive Agent to the HFCC led efforts to convene experts from around the world to address this critical topic. The U.S. Coast Guard, the Department of Defense, the National Transportation Safety Board (NTSB), and Harvard University Medical School also collaborated on conference planning and execution.

"Human fatigue is a risk factor that is avoidable," said keynote speaker Deborah A. P. Hersman, NTSB Member. "Yet, this risk factor continues to affect our pilots, drivers, train crews, mariners, and pipeline controllers." Human fatigue has been on the NTSB's Most Wanted List of Safety Improvements since the list's inception in 1990.

The honorable Richard Moore, Massachusetts State Senator, provided his views on the legislative role in addressing operator fatigue management, and has recently introduced legislation related

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### Operator Fatigue Facts

- **220,000 people fall asleep behind the wheel each day (even if for just a second or two)—***Harvard University Division of Sleep Medicine*
- **Over 100,000 police-reported crashes and more than 1,550 fatalities occur each year due to drowsy driving–***National Highway Traffic Safety Administration*
- **Of the reports in the Aviation Safety Reporting System (ASRS), 21 percent were related to general issues of fatigue** *—Federal Aviation Administration*

### IN THIS ISSUE



## COI Spotlight—Human Factors and System Applications

We continue our series COI Spotlight, which provides an overview of each new Center of Innovation (COI) within the Volpe Center. Featured this month is the Human Factors Research and System Applications COI, headed by its Director, Dr. Stephen M. Popkin.

Human error is the single most common cause of transportation accidents, accounting for 60 to 80 percent of the total. Understanding potential causes and fixes will become more challenging as systems become more sophisticated and add automated functionality, increasing the importance of user-centered system design.

Solid human engineering can reduce training costs, minimize the likelihood of human error in system operation, and mitigate the consequences of unavoidable error. This is the benefit of Human System Integration.

### Centers of Innovation

- **Multimodal Systems Research and Analysis**
- **Safety Management Systems**
- **Environmental and Energy Systems**
- **Freight Logistics and Transportation Systems**
- **Physical Infrastructure Systems**
- **Communication, Navigation, Surveillance (CNS) and Traffic Management Systems**
- **Human Factors Research and System Applications**
- **Advanced Vehicle and Information Network Systems**

The COI's staff of internationally recognized human factors professionals provides systemic thinking with an operational focus through experimentation and demonstration both in support of its clients and those of Volpe Center project managers from other technical disciplines. The COI pioneers new relationships between humans and policy, and automation and technology, thus helping improve transportation safety, security and productivity, with due concern for unintended consequences. Technical staff maintains an active leadership role in an array of national and international associations, committees, and standards bodies.

The COI's client portfolio includes U.S. DOT operating agencies, principally the Federal Aviation Administration (FAA), the National Highway Traffic Safety Administration

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## COI Spotlight–Human Factors and System Applications *Continued*

(NHTSA), the Federal Railroad Administration (FRA), and the Federal Motor Carrier Safety Administration (FMCSA). About one third of the COI's work is in support of other Volpe Center COI project portfolios. The core of the COI's work includes:

> The COI strives to foster awareness of the central role the human plays in our transportation system policies, structures and practices, and to support projects and sponsors across the Center to ensure human factors are appropriately addressed in system design and operations.
>
> – Dr. Stephen Popkin, Director Human Factors and System Applications COI

**Aviation:** research and analysis of flight simulation, runway safety, and flight deck technologies in support of the FAA human performance, and human-system performance requirements associated with NextGen. Specific projects include:

- Study the effect of pilot training on transfer of the skills between flight simulation and airplane operation and provide scientific guidance for flight simulator requirements, design, and certification.
- Develop metrics of system safety performance, including developing the Runway Incursion Severity Calculator, which categorizes the outcome severity of runway incursions, and the Separation Conformance metric for losses of standard separation in the air.
- Analyze controller, pilot, and vehicle driver error in runway operations.
- Provide guidance to the aviation community related to electronic flight bags, symbology, and moving map displays.

A locomotive simulator at the Volpe Center Human Factors laboratory. (*Volpe Center photo*)

**Rail:** assess railroad system performance, investigate human performance in railroad accidents, and develop tools and methods to proactively manage risk to achieve safe and productive railroad operations in support of FRA. Specific projects include:

- Design and evaluation of grade crossing warning devices, locomotive cabs, and blue signal warnings to enhance operational safety.
- Develop, demonstrate, and evaluate proactive safety management systems such as behavior-based safety and the confidential reporting system, with the goal of identifying safety concerns before they cause harm.
- Study fatigue management in scheduling railroad operations and managing locomotive crews.
- Integrate human-systems into the design and evaluation of high-tech railroad systems and train control systems.

**Highway:** develop tools and methods to improve vehicle operator safety as well as that of passengers and other road users in support of the NHTSA and FMCSA. Specific projects include:

- User acceptance of vehicle-based systems that tailor warnings to driver workload and distraction and study usability of vehicle-based warning technologies.
- Research to improve the emergency evacuation of motor coaches.
- Simulator testing of vehicle-based alcohol counter-measures to help reduce alcohol impaired driving and associated crashes.
- Research of pedestrian safety with the advancement of quieter vehicles, such as hybrids.

## Experts Focus on Transportation Operator Fatigue—*Continued*


Massachusetts State Senator Richard Moore is flanked by conference co-planners Mike Coplen of FRA and Stephen Popkin of the Volpe Center. (*Volpe Center photo*)

to drowsy driving geared toward reducing the incidents of accidents related to drowsy driving within the Commonwealth of Massachusetts.

The National Institute for Occupational Safety and Health's new National Occupational Research Agenda related to transportation and fatigue issues was presented by Audrey Reichard. Marvin Dainoff presented the Liberty Mutual Research Institute for Safety's strategic roadmap for transportation fatigue management research.

In addition to the research and demonstration activities carried out by the U.S. DOT's operating administrations, HFCC, a representative body within the U.S. DOT that addresses multimodal issues, has focused on the topic of operator fatigue, initiating its Operator Fatigue Management program nearly a decade ago. HFCC has sponsored the development of fatigue management tools that are now freely available to the transportation industry and related organizations.

## Volpe Center Develops Simulation Standard Targeting Increased Aviation Safety

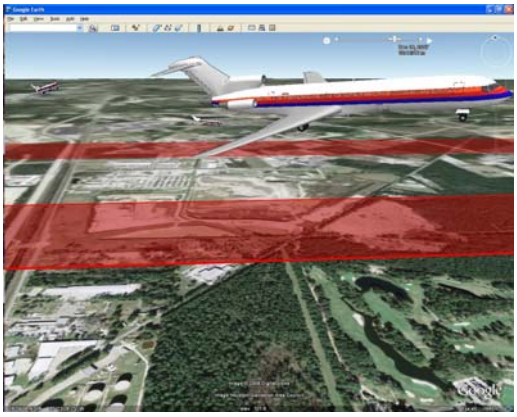
The Volpe Center recently released the first version of a National Airspace System (NAS) simulation and analysis capability. This effort, in support of the Federal Aviation Administration, is focused on providing a quantitative safety analysis of simultaneous parallel approaches at airports. The goal is to develop a simulation capability that enables a rigorous analysis and certification of procedures, equipment, and airspace in the NAS to optimize individual airports' operational procedures and improve aviation safety.

The simulation tool is designed to be intuitive and easy to use while achieving a high level of precision in replicating real-world entities such as radar and aircraft. This precision is the product of complex mathematical models as well as detailed operational procedures. The tool runs on a personal computer yet is flexible enough to model various aircraft and airports in different environmental conditions, with multiple surveillance and navigation systems, and even account for human performance characteristics.

The simulation tool is the result of an extensive effort by the Volpe Center's technical staff. This Monte Carlo-based computer simulation capability employs stochastic models of nearly every component of the NAS—mechanical, electronic, and human. These components, including navigation aids and surveillance systems, pilots and air traffic controllers, and weather and aircraft types are combined with known, discrete artifacts such as runway size and airport configuration.

The simulation also utilizes Volpe Center-developed airframe-type-specific kinematic aircraft models, a high-performance random number generator, and a precise WGS-84-compliant elliptical earth model to create a robust tool with photo-realistic airport depictions and real-time 3-D animation.

Begun in January 2009, the second phase of development will include enhancements such as additional NAS navigation and surveillance systems, and high-fidelity aircraft flight models, as well as the inclusion of land-and-hold-short-operations and converging runway operational scenarios.



The simulation tool's photorealistic real-time animation feature. (*Volpe Center image*)

## High Speed Rail Grade Crossing—First of its Kind to be Installed in the U.S.

Volpe Center's staff from the Physical Infrastructure Systems COI recently accompanied a team of highway rail grade crossing engineers from Transport Canada (TC) on a site visit of the School Street four-quadrant gate grade crossing/vehicle presence detection system in Mystic, Connecticut. The site visit was organized at the request of the Rail Safety Directorate of TC and was facilitated by Federal Railroad Administration (FRA) Region I and Volpe Center staff.


An Amtrak train passes the School Street crossing on the Northeast Corridor High Speed Rail Line in Mystic, CT. (*Volpe Center photo*)

The crossing is the first with four gates to be installed on the National Railroad Passenger Corporation's (Amtrak) Northeast Corridor (NEC) high-speed rail (HSR) line in Connecticut, and the first of its kind to be installed in the United States.

It uses inductive loop vehicle presence detection technology to sense when a vehicle is inside the grade crossing gates within the rail track infrastructure. When this occurs, the two exit gates are automatically raised, allowing the vehicle to safely depart the crossing. The system also alerts the oncoming train to the vehicle's presence and will invoke Automatic Train Stop if the operator fails to stop the train.

Volpe Center rail systems and safety experts have a long history of cross-border cooperation and knowledge-sharing with Canadian government colleagues. Volpe Center staff members serve on Canadian research and development committees and cooperate extensively to accentuate their knowledge sharing activities. In this site visit, the group, including FRA Region I personnel, observed the revenue service operation of the enhanced warning devices at the School Street grade crossing. This technology was specifically designed to provide enhanced safety at HSR grade crossings and is unique to the NEC.

The Volpe Center previously conducted an evaluation of this technology in support of the FRA's Office of Research and Development and was able to add considerable background information and insight to the site visit. Transport Canada is extremely interested in the four-quadrant gate/vehicle presence detection technology and the information they gathered at this site visit as well as the technical background provided by the Volpe Center, may lead them to deploy the technology at grade crossings on Canadian high-speed rail lines.

The Volpe Center has been instrumental in establishing the viability of the four quadrant gate/vehicle presence detection grade crossing technology. Since the Volpe Center's experts proved the viability of its initial deployment at the School Street crossing, the technology has been installed at five other crossings on the Amtrak high HSR corridor between Stonington and New London, Connecticut.

## Volpe Center and WPI—Promoting Women in Technology

The Volpe Center's Jayne Rossetti, left, and fellow female student Lesley (Small) Zorabedian on the WPI campus in 1968. (*Photo courtesy of WPI*)

Worcester Polytechnic Institute (WPI), in Worcester, Massachusetts has recently marked the 40th anniversary of its first coeducational class. Jayne Rossetti, an IT Specialist in the Volpe Center's Navigation and Surveillance Division, entered WPI in the fall of 1968. She was just one of two female students when the institution became coeducational after 100 years. Jayne left in her junior year to join the U.S. Navy and finished her degree in computer science at Boston University in 1984.

When Jayne first stepped on campus that first year, the school offered no residence halls for women so she lived in a dorm at a local secretarial school. "The greatest difficulty the first year was finding restrooms!" Jayne recalls today. "I was fortunate to have been adopted by a group of seven fellow freshmen who really looked out for me. There were over twenty female students the next year and half of a dormitory floor was converted to a female residence hall. We felt more a part of the community once we were living on campus."

Today, two other Volpe Center employees, Charlotte Song and Elizabeth Tyree, both Aerospace Engineers in the Volpe Center's Navigation and Surveillance Division, have ties to WPI. Charlotte completed a BS degree in Mechanical Engineering–Aerospace in 1990 and a PHD in Mechanical Engineering–Fluid Mechanics at Georgia Tech in 1993. Elizabeth is currently in the MS Program in the Physics Department at WPI and expects to graduate in 2011.

Jayne, right, today with colleagues Charlotte Song and Elizabeth Tyree. They are part of a well established and respected group of Volpe Center staff with WPI ties. (*Volpe Center photo*)

## Volpe Center Joins Earth Hour's Call to Action on Climate Change

At the invitation of City of Boston Mayor Thomas J. Menino, the Volpe Center helped raise awareness about climate change and asked employees to extinguish all non-essential lighting and to power down their offices before they left work on the eve of Earth Hour 2009.

Earth Hour is an international climate-change awareness campaign organized by the World Wildlife Fund that asked people, businesses, governments and communities to turn off their lights between 8.30 p.m. and 9.30 p.m. on March 28, to demonstrate their concern about global warming.

Earth Hour's global wave of participation included 2838 cities and towns in 83 countries across all seven continents including 829 icons and landmarks including New York's Empire State Building, the Golden Gate Bridge in San Francisco, Beijing, China's Bird Nest and Water Cube, Sydney, Australia's Opera House, the Arc de Triomphe in Paris, France, and Petronas Towers in Kuala Lumpur.

The Volpe Center was proud to join others around the world, from small island nations of the South Pacific to the densely populated cities of the Americas, in a moment of global solidarity aimed at creating a compelling statement on the future of the planet.

## Volpe Center Highlights

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