

TRANSPORTATION SECURITY TRAINING AND EDUCATION

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Transportation Security Training and Education: Building Up Resources, Techniques, and Strategies

Yuko J. Nakanishi

Securing the U.S. transportation infrastructure requires training and educating transportation employees in prevention, deterrence, and response. The TRB Critical Transportation Infrastructure Protection Committee has formed a subcommittee to assemble, stimulate, and disseminate practical information to prepare workers at the front line.

4 Assessing Transportation Security Training: A Survey of Needs and Programs

Daniel J. O'Neil and Yuko J. Nakanishi

Ongoing training of transportation personnel is necessary to impart new skills, sustain skill levels, and to provide updates on evolving threats, vulnerabilities, and risks. This overview illustrates some of the strengths, inadequacies, and progress toward establishing a coordinated, cost-effective, efficient national program to provide transportation security training for a geographically dispersed workforce with diverse needs.

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Evacuation planning emphasizes the development of scenarios—a process conducive to training. A real-time emergency planning system, the authors point out, could generate evacuation routing and traffic management plans in response to accidents, terrorist attacks, or other catastrophic events that change the capacity or the topology of the road network and could serve as a training simulator for emergency planning.

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In any natural or man-made disaster, unified programs can eliminate communication problems among the regional agencies involved in response and recovery operations and in coordinating relief. Computer-based virtual environments can help trainees from many agencies gain familiarity and acquire skills interactively for coordinated response to major incidents that affect large regions.

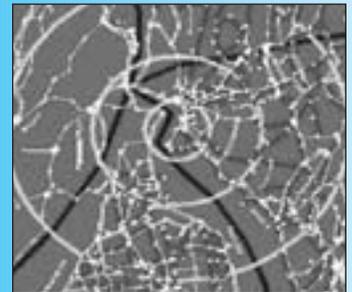
23 Developing and Expanding a Security Curriculum for Frontline Transportation Workers: The National Transit Institute's Programs

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Decades of transportation security experience have proved that a workforce trained to be alert, observant, diligent, and conscientious in reporting unusual activities and objects is one of the most effective security measures in a system designed to be open, accessible, and reliable. Here are descriptions of programs developed to provide that kind of training to frontline transportation employees and their supervisors.



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COVER: Transportation Security Administration officer mans state-of-the-art security equipment—a walk-through portal that detects explosive materials—at John F. Kennedy International Airport, New York. Training must keep pace with the demand for skilled security personnel at all levels. (Photo: Ramin Talaie, Corbis.)

TR NEWS

features articles on innovative and timely research and development activities in all modes of transportation. Brief news items of interest to the transportation community are also included, along with profiles of transportation professionals, meeting announcements, summaries of new publications, and news of Transportation Research Board activities.

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The conduct of research is a longstanding gap in the system for ensuring hazardous materials safety and security. A National Research Council-appointed committee has recommended establishing an ongoing program of cooperative research for hazardous materials transportation, involving the likely users to guide and govern the program, set the agenda, oversee the research projects, and disseminate the findings.

33 WORKSHOP REPORT Marine Salvage Capabilities: Responding to Terrorist Attacks in U.S. Ports—Actions to Improve Readiness

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COMING NEXT ISSUE



Participants voiced a range of insights at a TRB-sponsored discussion on the earmarking of funds for transportation research, October 2004, in Washington, D.C.

Management strategies that are helping state departments of transportation complete projects on budget and on time, despite shortages of personnel; the legislative earmarking of budget allocations and its effects on transportation research; a practical laboratory for accelerating the implementation of railroad technology; and an examination of the U.S. highway safety record—these are some of the headline topics slated for the July–August TR News.



Transportation Security Training and Education

BUILDING UP RESOURCES, TECHNIQUES, AND STRATEGIES

The U.S. transportation infrastructure—which includes roadways, railways, airways, waterways, vehicles, systems, and facilities—must be secured to protect the national economy, the traveling public, and our way of life. Security and preparedness require training and educating transportation employees. Many are frontline workers whose vigilance can prevent—or at the least deter—terrorist attacks, and whose readiness can assist the public in emergency evacuations and can support emergency workers in response and recovery.

This issue of *TR News* focuses on transportation security training and education and presents articles on programs and on training techniques. The first article assesses the state of transportation security training, provides an overview of available programs, outlines the training needs of the transportation industry, and addresses a strategy for training the national transportation workforce.

An article on evacuation planning and an article on emergency and incident management describe training strategies that employ state-of-the-art software and simulation programs. Other articles present the security training courses developed by the federally funded National Transit Institute and the security training initiatives of the Indiana Department of Transportation.

The Training, Education, and Technology Transfer Subcommittee of the TRB Critical Transportation Infrastructure Protection Committee addresses issues of transportation security education and training. Following are some of the subcommittee's recent accomplishments and activities.

The subcommittee website,¹ designed by William Sauntry of Science Applications International Corporation, offers information about the group's mission, activities, members, and events. The website also features a training database and events calendar:

- ◆ The online training database links to transportation security training resources.

- ◆ The events calendar, organized by Yonnel Gardes of California Partners for Advanced Transit and Highways, is updated continually and includes listings and brief descriptions of security training events.

The subcommittee has organized several TRB annual meeting activities:

- ◆ A session at the 2005 TRB annual meeting included presentations on transportation security training needs, programs, and best practices; the Federal Highway Administration's transportation security professional capacity building program; security training for motor carriers engaged in hazardous materials transportation; and maritime and port security training.

- ◆ The morning session of the Transit and Intermodal Security Training Workshop, also at the 2005 TRB annual meeting, presented the National Transit Institute's course on transportation security awareness. The afternoon session covered Federal Transit Administration security training programs, highway watch training, and emergency incident management training.

- ◆ A 2004 TRB annual meeting session addressed Transportation Security Education and Training Best Practices. Summaries of the speaker presentations are available in a web circular.²

The advice, support, and assistance of Daniel O'Neil, immediate past Chair of the TRB Critical Transportation Infrastructure Protection Committee, and of TRB Senior Program Officers Joedy Cambridge and Stephan Parker were invaluable in developing this special issue of *TR News*.

Please visit the subcommittee website and participate in our activities.

—Yuko J. Nakanishi, Chair
TRB Training, Education, and Technology
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Rego Park, New York

¹ <http://san-antonio.tamu.edu/trbabe40/Subcommittees/trbTEandT/Intro%20Page.dwt>

² <http://gulliver.trb.org/publications/circulars/ec065.pdf>



Transportation Security Training and Education

Assessing Transportation Security Training

A Survey of Needs and Programs

DANIEL J. O'NEIL AND YUKO J. NAKANISHI

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Transportation security training and education programs are diffuse, diverse, disparate, and complex. Assessing the programs is a priority for the Transportation Research Board's Critical Transportation Infrastructure Protection (CTIP) Committee, which is charged with promoting awareness of security and protection issues throughout the transportation community.

The committee identifies training and education programs that meet the security awareness and practice needs of a transportation workforce that is diverse, yet declining in numbers. The committee also identifies limitations and gaps in the programs (1). A goal is to provide technical expertise for establishing a unified and coherent training and educational system to meet the needs of the public- and private-sector owners, operators, and users of the national transportation system. To address this goal, the committee has established a Training, Education, and Technology Transfer Subcommittee.

Interdependencies and Cross-Training

The transportation sector is 1 of 12 critical infrastructures (see box, right) defined in the 2003 *National Strategy for the Physical Protection of Critical Infrastructures and Key Assets* (2). All transportation agencies are interdependent, as are the various modes and key assets within the sector.

The attacks of September 11, 2001 (9/11), demonstrated the importance of these links within the transportation sector and with other sectors, such as telecommunications, emergency services, and public health. Disruptions in key interdependencies caused chaos in emergency response and recovery and had a significant impact on the national economy—for example, suspending banking and financial operations.

Even before 9/11, during the Clinton Administration, the Presidential Commission for Critical Infrastructure Protection issued three reports addressing

National Critical Infrastructure Sectors

Water
Transportation
Telecommunications
Public Health
Postal and Shipping
Food
Energy
Emergency Services
Defense Industrial Base
Chemical Industry and Hazardous Materials
Banking and Finance
Agriculture

the formidable task of protecting and securing the national critical infrastructures (3–5). The reports motivated TRB to initiate a task force in 1998—the precursor to the CTIP committee—to increase awareness of security and protection throughout the transportation community.

CTIP, however, did not become a priority for the transportation community until 9/11. The earlier studies and reports set the stage for an onrush of new reports prescribing national strategies for the physical protection of critical infrastructure assets (2) and for safeguarding the information assets of the 12 sectors (6).

A 2002 report from the National Academies (7)—which contains a section on transportation, published separately by TRB (8)—considers the complex interdependencies of the national critical infrastructure system and makes recommendations for developing and deploying science and technology to safeguard the nation (7, 8). The report recognizes that deterrence and protection require preparation, and that transportation security is best accomplished through well-designed security systems integrated with transportation operations.

The report advocates a layered security system for the national transportation sector, noting that security fixes have been deployed piecemeal for various modes and should be integrated and optimized across the entire sector. The scope of the National Academies report, however, did not extend to the need for training and educating the transportation workforce to transfer, deploy, operate, and understand security products and procedures or to interact with interdependent sectors.

Yet building human capital is as important as building technological assets. Trustworthy, reliable, and trained personnel must be available to protect critical infrastructures and key assets from terrorist attack or in any emergency. Security personnel and first responders require adequate training, equipment, and other support to carry out their responsibilities effectively.

Shortages of personnel skilled in security hamper the protection of critical infrastructure and key assets. In many circumstances, transportation workers are the first responders and the primary resources for protecting the sector's infrastructure. Ongoing training of transportation personnel, therefore, is necessary to impart new skills, sustain skill levels, and to provide updates on evolving threats, vulnerabilities, and risks.

Training Needs

The approach to security training has been piecemeal. The aviation industry and the Transportation Security Administration (TSA) have undertaken a massive training initiative for airport screeners and air mar-



PHOTO: BARRY LANE, U.S. COAST GUARD

shals, and the U.S. Coast Guard has established a sea marshal training program. For the most part, however, training and education have received quick-fix solutions under political or customer pressure, focusing on component instead of systemwide security.

An exception is the *National Strategy for the Physical Protection of Critical Infrastructures and Key Assets*, which directs the Department of Homeland Security (DHS) and the U.S. Department of Transportation

U.S. Coast Guard sea marshal from Marine Safety Office, San Francisco, trains for aerial delivery boarding for rapid deployment onto vessels at sea.



Mock-drill training exercises for security officers and personnel create scenarios involving public transit vehicles (*left*) and aircraft (*below*) and supplement classroom training with practical perspectives.



(DOT) to create a national transportation security education and awareness program. The goal is to increase cooperation and coordination of security efforts for highways, roadways, intermodal terminals, bridges, tunnels, trucks, buses, maintenance facilities, and roadway border crossings (2, p.58).

In a survey of the DOTs of all 50 states and 2 territories by the CTIP committee and the Transportation Security Task Force of the American Association of State Highway and Transportation Officials (AASHTO), respondents rated security training as a priority (9). In an earlier survey of 28 state DOTs, respondents called for additional training in terrorism awareness, vulnerability assessment, strengthening security, emergency response planning, and media and public information (10).

Another compelling need for increased education, training, and cross-training is the “graying” of the U.S. workforce. The federal government labor pool of 1.6 million civilians is facing a retirement crisis, with an estimated 50 percent or more eligible to retire by the end of 2008.

A U.S. DOT workforce analysis conducted last year revealed that between Fiscal Year (FY) 2001 and FY 2006, more than 6,800 in the department’s leadership cadre—including approximately 66 percent of the career executives—will have reached eligibility for optional retirement (11). Among critical occupations, for example, 17 percent of the air traffic controllers, 42 percent of the aviation safety inspectors, and 35 percent of the rail safety inspectors will be eligible for optional retirement. Best estimates are that almost 12,000 employees will opt for retirement by FY 2006.

Training Programs

Transportation-specific security education and training programs and courses are selective and often limited in scope. Most transportation organizations rely on external agencies for security training. With the exception of programs for the aviation sector, security education and training for the workforce of the various transportation modes is developing under a fractious nonsystem.

Modal Approaches

Assisted by executive and Congressional initiatives and federal funding after 9/11, the aviation sector trained a cadre of airport screeners and expanded the air marshals program. The Aviation and Transportation Security Act of 2001 established the Transportation Security Administration (TSA), subsequently integrated into DHS. Civilian aviation security was placed under federal authority, providing a possible model for unifying transportation security education and training.



Newly trained TSA screeners staff and operate a variety of airport security checkpoints.

Before the Act, the Federal Aviation Administration oversaw and regulated civilian aviation, but the private airlines and airports—owned and operated by local and state bodies—controlled operations and finances. By systemically altering the sector with the establishment of TSA, the federal government was able to accomplish the formidable task of training approximately 60,000 screeners. The results, however, are mixed, according to a classified report to Congress by the DHS Inspector General in September 2004.

Security in surface and maritime transportation remains the responsibility of local and state law enforcement agencies, the various public and private bodies that own and operate the transportation systems, and the federal agencies that oversee the security of port and border crossing facilities.

State Approaches

A survey in early 2002 determined that only 19 of 51 state and territorial DOTs had sufficient resources for training in transportation security. Moreover, 45 to 55 percent of the state DOTs sought assistance for training materials and courses from state emergency management agencies (SEMAs), the Federal Emergency Management Agency (FEMA), other federal resources, and universities. State DOT in-house security training has been limited to emergency response and hazardous materials topics.

AASHTO has found that 70 percent of the state DOTs provide some training in transportation security (10). California DOT (Caltrans) has used in-house and external sources to increase employee awareness of transportation security issues, emergency response, and hazardous materials.

Caltrans’ internal training division has used a variety of media—simulation, videos, presentations, and print—and has provided training to other state agencies and to organizations in the private sector. However, much of the training targets first respon-

ders, such as police, firefighters, and emergency medical providers.

Oregon DOT identified a terrorism awareness program for highway maintenance workers, called B-NICE to indicate coverage of biological, nuclear, incendiary, chemical, and explosive hazards. Oregon DOT also assembled a comprehensive training program including such topics as first responder awareness and operations, incident command systems for public works, emergency bridge inspection, emergency operations planning, and emergency response tabletop exercises.

Pennsylvania DOT used a train-the-trainer format for a course in facilities emergency operations for representatives from regional offices. Washington State DOT developed an employee disaster response plan assigning responsibilities to teams of personnel.

Virginia DOT adapted portions of FEMA's antiterrorism training course to increase terrorism awareness among all employees. The department produced an antiterrorism kit for managers to use in training staff throughout the state.

Wisconsin's Work in Progress

At Wisconsin DOT, the development of security training is a work in progress, typical of most state agencies (12). Wisconsin DOT has identified various types of security training as essential to the development and maintenance of the state's security program and processes. The DOT is assessing training needs and priorities, along with funding sources.

Wisconsin is providing or developing transportation-focused security training for DOT staff on assessment and on system security awareness. The assessment training program, developed by AASHTO, includes threat, vulnerability, criticality, and risk assessments and is designed for specialized staff. The system security awareness program is for all DOT staff and includes training in continuity of operations and continuity of government.

All structural professionals at Wisconsin DOT attend a training program on blast design, developed by the Federal Highway Administration. The sessions present the principles of explosives, as well as design and maintenance practices to mitigate the effects of explosions on bridges, tunnels, and other transportation structures. The Federal Bureau of Investigation and state bomb squads also have developed training in explosive devices awareness, which is being presented to all Wisconsin DOT field staff.

Wisconsin SEMA has developed incident command system training for personnel who would have contact with first responders in a security emergency. The training is given at different levels and determines the employee's role in a security emergency.



Program Providers

Several organizations have been proactive in supporting the training needs of the transportation sector and the various modes. Providers of onsite training and technical assistance are listed in the box below.

The National Transit Institute¹ (NTI) at Rutgers, the State University of New Jersey, is piloting a train-the-trainer program, System Security Awareness for

¹ www.ntionline.com/

Jeffrey Western (standing), Director of Infrastructure Security, Wisconsin DOT, reviews materials on continuity of operations planning with department executives.

Providers of Onsite Training and Technical Assistance in Transportation Security

- Bureau of Explosives
www.aar.com/boe/index_boe.htm
- Center for National Response
www.centerfornationalresponse.com/
- Federal Air Marshal Service (U.S. Immigration and Customs Enforcement)
www.ice.gov/graphics/fams/training.htm
- Federal Emergency Management Agency (U.S. Department of Homeland Security)
www.fema.gov/tab_education.shtm
- Law Enforcement Training Database (Bureau of Justice Assistance)
<http://bjatraining.aspensys.com/>
- Office for Domestic Preparedness (Homeland Security Preparedness Technical Assistance Program)
www.ojp.usdoj.gov/odp/ta.htm
- Security Solutions International
www.securitysolutionsint.com/
- Transportation Emergency Preparedness Program (U.S. Department of Energy)
<http://web.em.doe.gov/otem/program.html>
- Transportation Security Administration
www.tsa.gov/public/
- Transportation Technology Center, Inc.
www.aar.com/ttci/index.htm



Chicago law enforcement personnel attend seminar about aviation security, suicide terrorism, and physical security.

Passenger Vessel Employees, at four state DOTs—Washington, New York, Florida, and Missouri. Developed for front-line vessel and facility employees and supervisors, the course treats the essentials of preventing and responding to security-related incidents and complies with the Maritime Transportation Security Act of 2002 and with U.S. Coast Guard regulations for the security of maritime vessels and facilities.

In addition, NTI offers system security awareness for frontline transit employees and supervisors who have direct contact with the public or with the vehicles and facilities used by the public (see article, page 23).

Although focusing on law enforcement and first response, the U.S. Department of Justice offers a resource for identifying and locating security courses suitable for transportation agencies (13). Courses address maritime, transit, rail, and aviation applications, as well as ports, buses, and highways.

Academic Resources

Academic institutions have focused on generic programs for critical infrastructure protection and homeland security. The National Academic Consortium for Homeland Security (NACHS) lists a membership of more than 270 colleges and universities, including community colleges, that share the mission of improving the security of the United States and its worldwide interests.²

Regional institutions of higher education—

Cybersecurity Programs

A Scroll of Resources

University Training and Education Programs

Carnegie Mellon University Center of Academic Excellence in Information Assurance Education
 Drexel University Electrical and Computer Engineering
 Florida State University Information Technology Assurance and Security
 George Mason University Center for Secure Information Systems
 George Washington University Computer Security and Information Assurance
 George Washington University Information Security Management
 Georgia Technology Information Security Center
 Idaho State University National Center of Academic Excellence in Information Assurance
 Indiana University of Pennsylvania
 Information Resources Management College of the National Defense University
 Iowa State University Information Systems Security Laboratory
 James Madison University Information Security Program
 Johns Hopkins University Information Security Institute
 Kennesaw State University
 Massachusetts Institute of Technology Information Security Program
 Mississippi State University Intelligent Intrusion Detection Research Group
 Naval Postgraduate School Center for Information Assurance and INFOSEC Studies and Research

Norwalk Community College
 Norwich University Computer Science Department
 Princeton University Secure Internet Programming
 Purdue University Center for Education and Research in Information Assurance and Security
 Stanford University Security Laboratory
 Syracuse University Center for Systems Assurance
 University of California–Davis Computer Security Laboratory
 University of Fairfax
 University of Idaho Center for Secure and Dependable Software
 University of Illinois at Urbana–Champaign Security Research
 University of Maryland, Baltimore County, Continuing Education Information Security Program
 University of Maryland, Baltimore County, Information Security and Assurance
 University of New Haven, Connecticut, Forensic Computer Investigation Program
 University of North Carolina–Charlotte Laboratory of Information Integration Security and Privacy
 University of Texas at Austin
 University of Tulsa Center for Information Security
 University of Wisconsin–Milwaukee Cryptography, Computer, and Network Security
 U.S. Military Academy–West Point Information Assurance Curriculum
 West Virginia University Lane Department of Computer Science and Electrical Engineering

particularly community colleges—have been active in providing security and safety training for local first responders in civil protection services, such as police, fire, and emergency medical personnel. Some academic programs are transportation-specific; descriptions of the programs are available from NACHS, along with contact information.

The Center for Advanced Transportation Systems Simulation (CATSS) at the University of Central Florida provides security training to the commercial transportation industry and related government agencies. CATSS also hosts conferences and seminars on commercial and public transportation safety and security to create networking opportunities for participants.

The federally funded Naval Postgraduate School in Monterey, California, awards master's degrees for security-related studies conducted mostly via the Internet. DHS has established centers of excellence at the University of Southern California, the University

of Minnesota, Texas A&M University, and the University of Maryland.

With the funding from DHS, the University of Southern California has created an interdisciplinary master of science degree in system safety and security. The program serves government agencies and their contractors and will be available online as a certificate program.

Texas A&M University's National Emergency Response and Rescue Training Center provides technical assistance and support to state administrative agencies, urban areas designated by the Office for Domestic Preparedness, and local jurisdictions, to facilitate the completion of assessments, the development of homeland security strategies, and planning for emergency response.

The National Information Assurance Education and Training Program covers a topic common to transportation and the other 11 critical sectors. The program's successful initiatives include the Centers of Academic Excellence for Information Assurance,

² <http://homelandsecurity.osu.edu/NACHS/>

Worcester Polytechnic Institute Cryptography and Information Security Research Laboratory

Commercial Training and Education Programs

Backbone Security Systems
Computer Security Institute
eHighLow.com, Inc.
Executrain
Foundstone
Cisco Training delivered by Global Knowledge
InfoSec Institute
InfoSec University
Inspired eLearning Inc.
Intense School
KEI Pearson
Knowledge
Learning Tree International
LearnSecurity Online Courses and Training
MIS Training Institute
NetworkTraining.com
New Horizons Computer Learning Center
Productivity Point
Pro-Ware Computing
SecureInfo Corporation
Skillbuilders
Sunset Learning
System Administration, Networking, and Security Institute
TechNow Training Centers

Government Training and Education Programs

Computer Emergency Readiness Team Training and Education
Defense Information Systems Agency Awareness and Training Products
Defense Security Service Academy
Department of Agriculture Graduate School
Department of the Interior University
Federal Learning Exchange
Health and Human Services Distance Learning Portal
Los Alamos National Laboratory Safeguards and Security Training
National Cybercrime Training Partnership
National Defense University Chief Information Officer University
National Defense University Information Resources Management College
National Defense University Security Education Program
National Information Assurance Partnership Common Criteria Training
National INFOSEC Education and Training Program
National Institutes of Health Computer Security Awareness and Training
National White Collar Crime Center
Navy INFOSEC
Transportation Virtual University

SOURCE: Computer Security Resource Center, Computer Security Division, National Institute of Standards and Technology, http://csrc.nist.gov/ATE/te_full.html#academia



Antiterrorism specialist Jeff Beatty conducts seminar on hazardous materials transportation for the Federal Motor Carrier Safety Administration.

jointly managed by the National Security Agency and DHS, to develop a professional workforce to protect and secure the nation's information and communications systems.

University centers of excellence for cybersecurity, as well as commercial and government training organizations, are listed in the box on pages 8–9, compiled by the Computer Security Research Center of the National Institute for Standards and Technology.³

Federal Resources

In April 2002, FEMA conducted a study for Congress on the terrorism response training available from federal agencies for state and local officials. Local officials and responders repeatedly told FEMA staff about the need for a single source of information on training.

In partnership with FEMA's Office of National Preparedness, the U.S. Fire Administration's training division developed a searchable online database to provide a single source for terrorism response training information, a first step in developing a training management system. The information in the database comes from the DHS-FEMA *Compendium of Federal Terrorism Training for State and Local Audiences* (14) and from several federal agencies.

Finding the Funding

Security-related requirements have added a financial burden on the transportation sector. Federal coordination and funding have not sufficiently supported the public- and private-sector owners and operators of the national transportation infrastructure.

The transportation sector is pressed to mitigate the risks identified in vulnerability assessments; to undertake emergency planning; to secure facilities against chemical, biological, and radiological attacks; and to protect information and communications assets. Security education and training must create a new cadre of transportation workers and professionals at all levels.

Some opportunities may arise for external support and cost-matching or for subsidies through grants and contracts, but few are specific to the needs of transportation security for regional, state, and local public- and private-sector transportation organizations. A transportation organization, however, may be eligible as a collaborator or a subcontractor with a grant applicant from another sector.

The DHS-FEMA compendium lists hundreds of federal training programs for state and local audiences; the document is a starting point for identifying external funding for in-house training (14). Another guide prepared for AASHTO lists 38 funding

programs in five federal agencies as resources for state transportation agencies (15). The list on page 11, excerpted from the guide, summarizes sources of federal assistance for state DOT security issues, including education and training.

Many state DOTs do not have adequate internal resources to conduct security training. For example, 60 percent of state DOTs expressed the need for federal assistance in developing a comprehensive security training program to synthesize in-house and external resources cost-effectively (10).

Optimizing Resources

Some state DOTs have tapped into state and federal training programs and are using different media to accommodate skill levels and topics. Georgia DOT established a security task force with other state agencies, such as the Georgia Emergency Management Agency, to optimize resources.

Agencies must offset the costs of travel for offsite courses, as well as the loss of productive employees during the training period, even for tuition-free or subsidized courses. Alternative methods of delivering training to the workplace can minimize costs; sometimes the traditional classroom format onsite may be cost-effective. Academic, commercial, and government training programs are offering training in a variety of formats, known as "blended learning."

Videos and CD-ROMs offer a convenient means for disseminating training courses that can be viewed onsite at the student's convenience, although instructor-student interaction is minimal. Web-based training offers onsite delivery, as well as the opportunity to interact with the instructor and other students online.

Unified Approach

These examples illustrate some of the strengths, inadequacies, and progress toward establishing a coordinated, cost-effective, efficient national program to provide transportation security training for a geographically dispersed workforce with diverse needs. The United States is in the early stages of acting on



Onsite security training sessions at Wisconsin DOT cover assessment and system awareness.

³ http://csrc.nist.gov/ATE/training_&_education.html

Summary of Federal Assistance Sources for State DOT Security Issues

Program Identification Focus

ID	Funding Agency	Program Name	Fund Type	General Topics	Fund Uses	Modes
1	DHS-ODP	State Homeland Security Grant Program (SHSGP)	Formula grant	Terrorism—all hazards	Equipment, exercises, training, planning	General
2	DHS-ODP	Citizen Corps Programs	Formula grant	Terrorism—all hazards	Outreach, education	General
3	DHS-ODP	Urban Area Security Initiative Grant Program (UASI)	Formula grant	Terrorism—all hazards	Equipment, exercises, training, planning	General
4	DHS-ODP	Urban Area Security Initiative Grant Program (UASI): Transit System Security	Formula grant	Terrorism—all hazards	Equipment, exercises, training, planning	Mass transit
5	DHS-ODP	Urban Area Security Initiative Grant Program (UASI): Port Security	Formula grant	Terrorism—all hazards	Equipment, exercises, training, planning	Water
6	DHS-ODP	ODP Weapons of Mass Destruction Training	Training	Terrorism—all hazards	Training courses	General
7	DHS-TSA	Port Security Grants	Project grant, competitive	Terrorism—all hazards	Equipment, exercises, training, planning	Water
8	DHS-FEMA	Operations and Firefighter Safety Program	Project grant, competitive	Weapons of mass destruction; fire	Training, equipment, wellness, building modifications	General
9	DHS-FEMA	Fire Prevention Program	Project grant, competitive	Weapons of mass destruction; fire	Education, awareness, detectors	General
10	DHS-FEMA	National Fire Academy Training Assistance	Training reimbursement	Fire	Student travel reimbursement	General
11	DHS-FEMA	National Fire Academy Education Program	Training	Fire	Training for fire prevention and control	General
12	DHS-FEMA	Emergency Management Institute Independent Study Program	Training	Terrorism—all hazards	Emergency management, preparedness, mitigation, etc.	General
13	DHS-FEMA	Emergency Management Institute Resident Educational Program	Training	Terrorism—all hazards	Emergency management, preparedness, mitigation, etc.	General
14	DHS-FEMA	First Responder Counter-Terrorism Training Assistance	Training	Terrorism	Terrorism consequence management	General
15	HHS-HRSA	Cooperative Agreement for Hospital Bioterrorism Preparedness	Cooperative agreement	Bioterrorism	Hospital capacity, pharmaceutical caches, training exercises	General
16	DOJ	Byrne State and Local Law Enforcement Assistance	Formula grant	Security	Personnel, planning, equipment, training, investigation	General
17	DOJ	State and Local Antiterrorism Training	Training	Terrorism	Preparedness training, planning, terrorism database	General
18	DOT-FTA	Federal Transit Technical Assistance	Project grants & training	Security & safety	Transit safety, security, drug & alcohol control	Mass transit
19	DOT-FTA	Transit Planning and Research	Project grant, cooperative agreement	Security & safety	Transit safety, security, training, drug & alcohol control, statistics	Mass transit
20	DOT-RSPA	Hazardous Materials Emergency Preparedness Training and Planning Grants	Project grant	Hazardous materials	Emergency planning, training, preparedness, response	General
21	DOT-MARAD	Supplementary Training	Training	Security & safety	Maritime training, safety, firefighting, tuition	Water
22	DOT-FMCSA	Motor Carrier Safety	Training	Security & safety	Motor carrier safety, training	Highway
23	EPA	Superfund State and Tribe Core Program Cooperative Agreements	Project grant, cooperative agreement	Hazardous materials	Emergency response, risk remediation, training	General

Note: The table does not include sources that solely fund exercises.

DHS-ODP = Department of Homeland Security, Office for Domestic Preparedness; DHS-TSA=Department of Homeland Security, Transportation Security Agency; DHS-FEMA=Department of Homeland Security, Federal Emergency Management Agency; DOJ = Department of Justice; DOT-FTA = Department of Transportation, Federal Transit Administration; DOT-RSPA = Department of Transportation, Research and Special Programs Administration; DOT-MARAD = Department of Transportation, Maritime Administration; EPA = U.S. Environmental Protection Agency

Sea marshals from Marine Safety Office, Los Angeles, climb up accommodation ladder for vessel inspection.



PHOTO: NATHAN HENSE, U.S. COAST GUARD

national strategies for homeland security and critical infrastructure protection. An implementation plan should place training and education at the fore for every sector.

Transportation agencies and organizations are responding, despite constraints on available resources and on the workforce. Cooperation is necessary among all agencies and organizations, at the local, state, and national levels. Perhaps DHS, which incorporates the professional workforce, programs, and infrastructure of the U.S. Coast Guard, Customs Service, Immigration and Naturalization Service, and the Transportation Security Administration, should be the agency to take the lead in transportation security, including training, education, and technology transfer, working closely with experts in U.S. DOT.

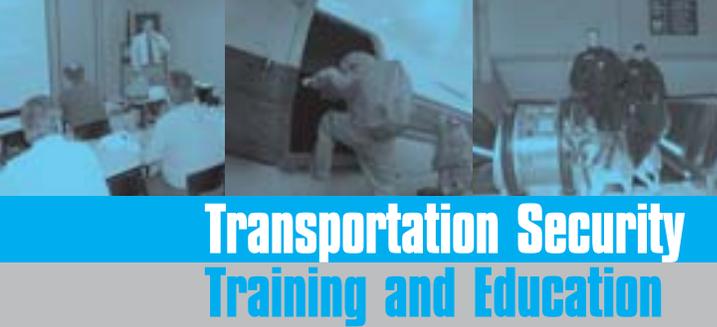
The recommendations made by the Government Accountability Office to redress DHS inefficiencies in research and development and in building working relationships and coordination with U.S. DOT and the transportation industry (16) appear to apply equally to transportation security education, training, and technology transfer. The implication would be for TSA and DHS to establish communications and working relationships with the transportation industry to identify training and education needs and to develop a unifying, coherent mechanism for establishing and implementing a national plan for transportation security education and training.

The pre-9/11 *National Transportation Science and*

Technology Strategy (17) focused on education and training as a foundation, with coordination among stakeholders. This may be an appropriate starting point for a post-9/11 national transportation strategy.

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Evacuation Planning, Human Factors, and Traffic Engineering

Developing Systems for Training and Effective Response

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Evacuation planning is a key component of emergency planning. Originally a requirement for the nuclear power industry, evacuation planning has extended into other venues, involving, for example, chemical plants and military installations charged with destroying chemical or biological weapons.

Evacuation planning emphasizes the development of scenarios. The emergency planning staff works out procedures and selects the most appropriate response to a hypothetical emergency. The process itself is conducive to training. In addition, simulators can be used for evacuation training in real time within a closed-loop system.

Evacuation Time Estimates

The general public and some professionals misunderstand the nature and meaning of evacuation time estimates (ETEs). An ETE is a criterion in a protective action recommendation (PAR) addressed to emergency decision makers by the technical staff evaluating the emergency. A PAR generally presents three choices for public action: do nothing, shelter in place, or evacuate the area. To the public, ETEs become indicators of risk.

The ETE is the time required to move the at-risk population out of the evacuation area. It is an aggregate measure and should not be confused with individual evacuation travel times. The ETE does not represent the time for an evacuee to travel to a final destination—for example, to a congregate care center or a relative's home.

Before beginning the evacuation trip, an evacuee must mobilize, or prepare for the journey. Preparatory activities vary depending on the person's needs and situation.

Evacuation time and mobilization time start with the release of a public advisory to evacuate. Mobilization and evacuation are processes that occur over time and space—they are not events that take place at a point in time.

Figure 1 presents the relationship between ETE and the average evacuation travel time. The ETE is the time elapsed from the public transmission of an evacuation

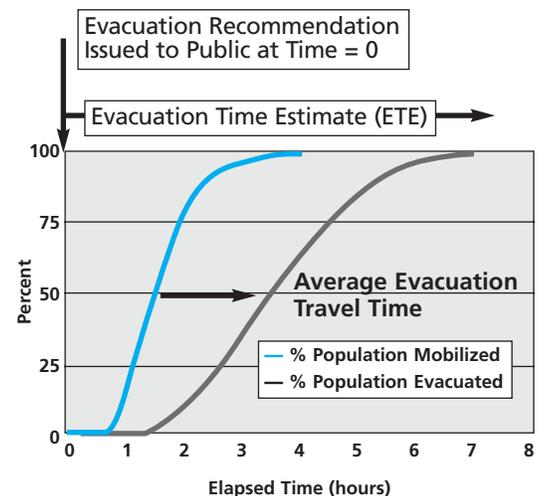


FIGURE 1 Relationship between ETE and average evacuation travel time.

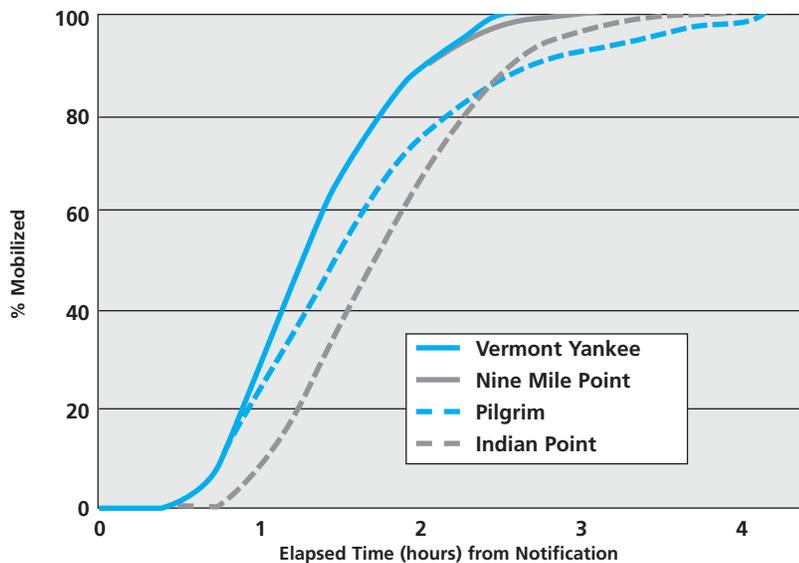


FIGURE 2 Household mobilization times.

advisory until the evacuation is complete. The average travel time for an evacuee is the time elapsed from the start of the evacuation trip to the time that the evacuee leaves the affected area. Figure 1 shows that the average evacuation trip is shorter than the aggregate ETE.

The evacuation travel time depends on traffic demand and highway capacity. When demand exceeds capacity, travel speeds decline, and the traffic begins to queue—that is, becomes stop-and-go—which is a characteristic of congestion. The traffic moves, but slowly. Under these conditions, the ETE can exceed the time required to mobilize the population.

If an area to be evacuated does not generate traffic with a high ratio of demand to capacity, then the evacuation travel time will approximate the travel time at free-flow speeds. The ETE therefore is closely related to the population mobilization time.

Human Factors

To develop ETEs for an emergency planning zone (EPZ), an analyst must identify the travel patterns, the car ownership, and the household size characteristics of the population. Demographic information may be available from countywide census data.

Census data, however, have several drawbacks for emergency planning. First, the data do not encompass the range of information needed to calculate the time required for the mobilization. Second, census data may not focus on the specific population of the EPZ and consequently may not represent accurately the characteristics of the evacuating populace.

Telephone surveys have been used successfully to address these concerns. The surveys ask respondents about family demographics and elicit estimates of

response times to well-defined events. The surveys avoid asking “What would you do if ...?” but ask specific questions instead about familiar activities: “How long does it take you to ...?”

Mobilization Time

Mobilization time consists of a sequence of events and activities. Each event occurs at a point in time and is the outcome of an activity. The principal focus of family activities before evacuation is gathering members together to evacuate as a group. For example, a resident of the area to be evacuated who is at work at the time of an emergency may engage in the following activities:

1. Becoming aware of the emergency condition. Notification may arrive via media announcements, siren alerts, tone-alert radio, or other means.
2. Preparing to leave work. Office workers may require less time to prepare for leaving work than would merchants or farmers who must secure the property before leaving.
3. Traveling home. Employees who want to gather their families together before evacuating will have to travel home from work.
4. Preparing the home for departure. Before beginning the evacuation trip, families secure their homes and pack bags for the journey.

Figure 2 presents the results of this analysis for four EPZs surrounding nuclear power stations in the northeast United States. The EPZs at Vermont Yankee, in southern Vermont, and at Nine Mile Point, outside Oswego, New York, can be characterized as low population rural environs. The other two sites, Pilgrim, about 35 miles southeast of Boston, and Indian Point, about 30 miles north of New York City, are characterized as medium- to high-density suburban areas.

Figure 2 presents the evacuation mobilization times for households with commuters who will return home to gather the family before beginning the evacuation trip. In both sets of curves, the time required to return home from work is key. Because the work-to-home travel time takes longer in heavily populated suburban areas than in rural areas, suburban sites have longer mobilization times.

Evacuation Response

Figure 2 indicates that more than 80 percent of households with returning commuters are prepared to begin their evacuation trips within 1 to 2 hours after the advisory. One likely result is that during the early phases of an evacuation more traffic may be moving toward the EPZ than evacuating the area. The agencies that provide both the traffic control to assist the evacuation and the access control to deny entry therefore

must not start too early, to avoid impeding return of commuters and delaying the evacuation.

Figure 3 presents the public response to a recommendation for evacuation. In the case of a terrorist scenario or a technological emergency—such as a chemical spill or a radiological release—a map of the evacuation area usually takes the shape of a keyhole: a central circular area determined by the toxic release plus an area extending outward in the downwind direction. The extent of the evacuation area depends on the nature of the toxic release and on the wind conditions, including wind speed and atmospheric stability.

People who live or work in the immediately surrounding region—represented by the middle ring in Figure 3—may decide to evacuate voluntarily, even if they are not at risk. The evacuation region could extend into portions of this area, however, if the wind shifts and puts more people at risk.

Finally, the outermost ring in Figure 3 represents an area called the shadow evacuation area. People here may choose to relocate farther from the source of the hazard. Both the voluntary evacuation area and the shadow evacuation area must be considered in projecting potential traffic congestion that could delay the departure of evacuees from the central area.

Evacuation Planning

Evacuation planning involves an iterative process to identify the best routes and to estimate the time required to evacuate the area at risk. Some of the steps are as follows:

- ◆ Identify the region to be evacuated. Is the area circular or keyhole in shape? The EPZ may be subdivided into emergency response planning areas (ERPAs), which are defined by recognizable geographic or political boundaries and are understandable in specific instructions to the public—for example, “People within the town of Plymouth should shelter in place.” Groups of ERPAs that receive the same emergency instructions constitute a region.

- ◆ Identify the travel demand in terms of numbers of vehicles, as well as in terms of probable destinations for people from the evacuation area and for people from the voluntary and shadow evacuation areas.

- ◆ Use a traffic distribution and assignment model to compute the optimal routing of evacuation trips on the nodes to the specified destinations and to simulate the movement of vehicles during the evacuation. The simulation model should describe traffic conditions under saturated flow, to account for the effects of congestion; the model also should be capable of rerouting traffic from a congested route to one

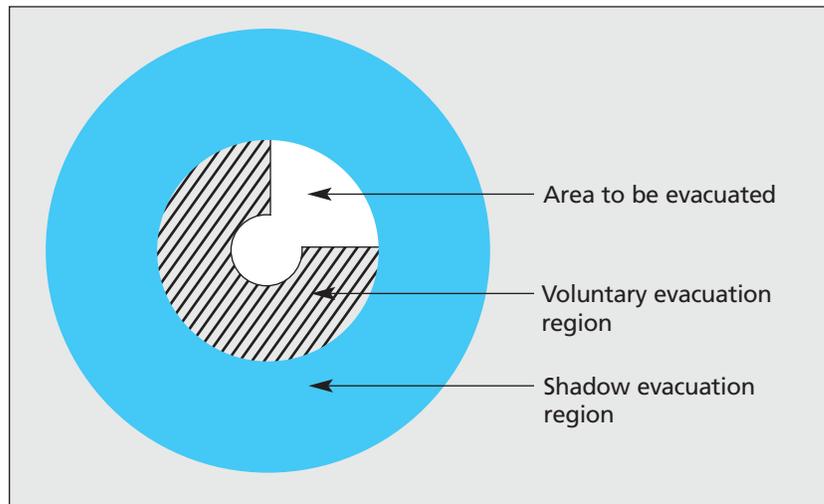


FIGURE 3 General map of an evacuation area.

that is less congested, to avoid unnecessary delays.

- ◆ Review the simulation results to determine the traffic management needs for the evacuation. Introduce the traffic management tactics into the simulation and repeat the ETE analysis.

Computer Modeling

Evacuation simulation can be performed with microscopic models or with macroscopic models.

- ◆ Microscopic models move individual vehicles through a network. The vehicles have their own characteristics and the drivers respond to the presence of other vehicles and to traffic control devices. Micro models provide a detailed simulation at a slow computing speed.

- ◆ Macroscopic models describe the overall traffic flow on a link of the network, instead of the movement of individual vehicles. Macro models can simulate quickly the conditions of large areas operating under high traffic demand.

Both classes of models are valuable tools in evacuation planning.

An evacuation study conducted for Nine Mile Point allowed a comparison of microscopic and macroscopic modeling. The evacuation network consisted of 964 route links. Statistics indicated that the ETEs produced by the micro and macro models were similar, with less than a 5 percent difference over a 5.5-hour period. The microscopic model, however, took 300 times longer than the macroscopic model to yield the results.

The PC DYNEV Evacuation Planning System,¹ developed for the Federal Emergency Management

¹ PC DYNEV = PC-based dynamic network evacuation.



FIGURE 4 Sample animation display showing traffic congestion during an evacuation.

Agency, has been used in the United States and abroad to conduct evacuation planning studies for areas near nuclear power stations and chemical weapons disposal facilities and for areas subject to hurricanes. PCDYNEV comprises two principal models: TRAD and IDYNEV.²

TRAD is an integrated traffic assignment and distribution model that yields vehicle turn percentages for every node in the network and uses these to guide vehicles along an evacuation route. The analyst specifies the highway network, the volume of traffic generated from all centers of origin, a set of probable destinations on the periphery of the area to be evacuated, and the capacity—that is, the attractiveness—of each destination. TRAD then calculates the optimal trip distribution and the optimal trip assignment or routing of the traffic from each origin to the probable destinations, to minimize evacuee travel times.

The premise is that the selection of destinations and the selection of routes are intrinsically coupled.

² TRAD = traffic routing and distribution; IDYNEV = interactive dynamic evacuation.

People in vehicles seek to travel out of an area of potential risk as rapidly as possible by selecting the best route. The model identifies the best routes for distributing vehicles from origins to destinations and guides them over the highway network in a consistent and optimal manner.

IDYNEV is a macroscopic simulation model based on CORFLO,³ also developed for the Federal Highway Administration. The model describes traffic flow with time-varying statistical histograms for each link. The IDYNEV simulation model employs a dynamic routing feature that overrides the TRAD-generated turn movements under certain conditions, to reflect driver behavior.

For example, if an evacuation route reaches a point on the network where two routes diverge and one of the routes is congested, then vehicles destined for the congested route will divert to the alternate route. The destination on the periphery may change, but the objective of leaving the at-risk area in the shortest time will be satisfied.

PCDYNEV includes a computer graphics display for animated presentations of evacuations (see Figure 4). Highway links are color coded for level of service, with severe traffic congestion shown in red. The analyst then can identify the need for traffic control to support the evacuation traffic flow.

Evacuation Case Study

The Indian Point Energy Center is located on the eastern shore of the Hudson River. The EPZ includes parts of four New York counties: Orange, Putnam, Rockland, and Westchester.

The EPZ is subdivided into 51 ERPAs, defined by a combination of geographical, topological, and political features. Table 1 presents estimates of the peak EPZ population for three categories. The peak population does not occur for all categories at the same time—for example, the employment population would peak on a midweek midday scenario, and transients would peak on a summer weekend.

The study examined 14 evacuation scenarios, each with a different combination of conditions that can affect evacuation demand or roadway capacity. For

³ CORFLO = corridor flow; also known as TRAF Level II.

TABLE 1 Indian Point Energy Center Peak Population Estimates

Population Category					
Permanent Residents		Employees		Transients	
Evacuees	Evacuating Vehicles	Evacuees	Evacuating Vehicles	Evacuees	Evacuating Vehicles
305,276	123,524	74,057	69,339	70,391	25,617

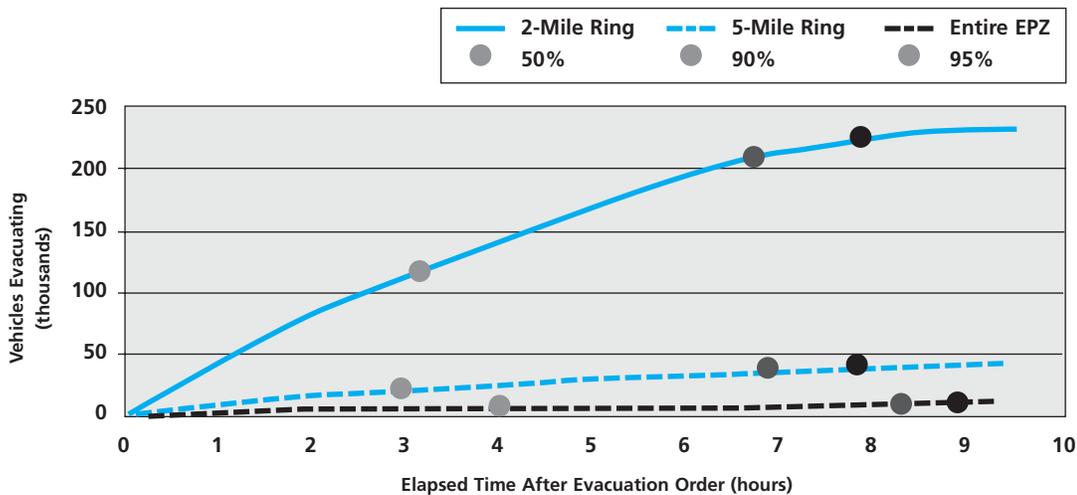


FIGURE 5 Evacuation time estimates: summer midweek, midday, good weather. (EPZ = emergency planning zone.)

example, a summer midday weekend scenario would represent a peak transient population, with state and local parks and campgrounds operating at capacity. Winter midweek scenarios would involve schools and would require the evacuation or relocation of school-children.

Weather conditions also affect the capacity of the roadway—for example, rain or snow can reduce free-flow highway speeds, as well as capacities. A full evacuation of the entire EPZ would involve more than 300,000 vehicles, with 239,000 leaving from the area at risk and an additional 63,000 leaving from the shadow evacuation region.

The ETE results for the Indian Point case study vary from slightly more than 7 hours to approximately 12 hours. The ETEs for rain and snow scenarios are higher than for the equivalent good weather scenarios. The differences among the times for public mobilization activities and among the resulting ETEs are directly attributable to the presence of significant highway congestion.

Figure 5 presents a graphical display of the ETE for a given scenario. Each curve represents the time needed to clear the indicated radius. Points on each curve identify the 50th, 90th, and 95th percentiles.

Improving the Process

The evacuation planning in the case study involved a fixed infrastructure facility. Federal guidelines define the extent of the EPZ for nuclear power stations. This kind of planning would work for any fixed facility, such as chemical plants, toxic material storage sites, or refineries.

The procedures need to be upgraded, however, to apply to emergencies at other kinds of sites. Trans-

portation accidents can occur almost anywhere; terrorist attacks require fast response from emergency personnel.

A real-time emergency planning system would be needed to respond to these events. Provided with the location and the nature of the threat, such a system would generate evacuation routing and traffic management plans from the database.

The evacuation models would have to be fast enough to operate in real time; PCDYNEV can produce an Indian Point evacuation case in less than 1 minute. The integration of emergency planning functions into ITS technologies also would enhance the real-time utility of the system.

A real-time evacuation planning system, moreover, can become an integral part of an emergency planning training simulator. The model would be able to generate incidents—such as traffic accidents or other events that change the capacity or the topology of the road network—during a simulated evacuation.

The emergency trainee would become aware of the problem and would respond either by changing the routing instructions or by notifying emergency response teams to proceed to the incident. The results of the user-specified mitigation activities would be incorporated by the simulator into the completion of the exercise.

Acknowledgments

The authors acknowledge the guidance and information received during the Indian Point project from the New York State Emergency Management Office and from emergency planning personnel in Westchester, Rockland, Orange, and Putnam Counties, and at Energy Nuclear Northeast.



Transportation Security Training and Education

New Frontiers in Emergency and Incident Management Training

Multiagency Models and Interactive Simulation Systems

KAAN OZBAY

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The damages and losses from natural and man-made disasters can be minimized through effective mitigation, preparedness, response, and recovery. Effective response requires planning.

But emergencies like the 1994 Northridge earthquake in Southern California or the September 11, 2001 (9/11), terrorist attacks require planning on a much larger scale than the standard emergency response measures adopted by local and federal authorities. Events of such magnitude affect large areas; therefore a comprehensive regional plan is necessary to coordinate the efforts of agencies and groups at the local level. A regional plan also should include the mobilization of resources from areas outside the impact of the disaster.

The first step is to examine available resources and what would be needed for a response to a major disaster. Detailed procedures should be worked out for mobilizing emergency resources from neighboring areas, to determine how to transfer personnel and equipment from other locations rapidly to the disaster site.

The evacuation of residents and workers from the disaster area is critical. A robust evacuation plan can assist transportation managers in traffic control, reduc-

ing the evacuation time and minimizing the evacuees' risk of exposure. This would reduce the chance of personal injury or fatality and would facilitate the transport of personnel and equipment to the disaster site.

The movement of people and resources to and from the disaster area is essential to response and recovery operations. This goal requires increasing the level of preparedness of all the involved agencies for the efficient use of the transportation system, which plays a central role in disaster response and recovery.

Training and Preparedness

Developing detailed response plans for all disaster scenarios is not possible, because disasters are unpredictable. Therefore a generic set of guidelines should be prepared for each of the functions in the response process. The guidelines would provide the basis for more detailed response plans, including those for specific postdisaster needs.

Extensive training is a key to the success of response operations. Most U.S. cities and regions have training programs for handling events that can cause disruptions in traffic. The Federal Emergency Management Agency (FEMA) operates an Emergency Management Institute, which

develops [and] administers resident and nonresident training programs in areas such as natural hazards (earthquakes, hurricanes, floods, dam safety), technological hazards (hazardous materials, terrorism, radiological incidents, chemical stockpile emergency preparedness), professional development, leadership, instructional methodology, exercise design and evaluation, information technology, public information, integrated emergency management, and train-the-trainers programs. (1)

In addition to FEMA and other state and federal training programs focusing on emergency management since the 1990s, interest and investment have increased in the development of incident management programs and associated training.

Multiagency Cooperation

Figure 1 depicts the general framework of a multiagency incident and emergency response operation that requires input from all of the decision-making agencies involved. The response personnel at the traffic control center collect and view real-time information about the traffic and incident conditions on the transportation network; the personnel use their expertise and the decision support tools to make final decisions.

The decisions then are communicated to the par-



Scenes from a 92-vehicle pileup on Interstate 95, October 16, 2004, which required coordinated response from many agencies and jurisdictions. More than 50 people were transported to hospitals, responders set up separate commands for each major crash site, and environmental specialists were called in to deal with fuel spills. Glare and a fast-moving storm may have contributed to the incident, which backed up the Interstate near Baltimore,

Maryland, for 11 miles. Initiatives to build interagency partnerships improved the efficiency and effectiveness of the emergency response.

icipating agencies. Regional transportation operations programs take this multiagency incident and emergency response approach to the next level by including agencies from a larger region; some examples are

- ◆ TRANSCOM, a coalition of 16 transportation and public safety agencies in the New York, New Jer-

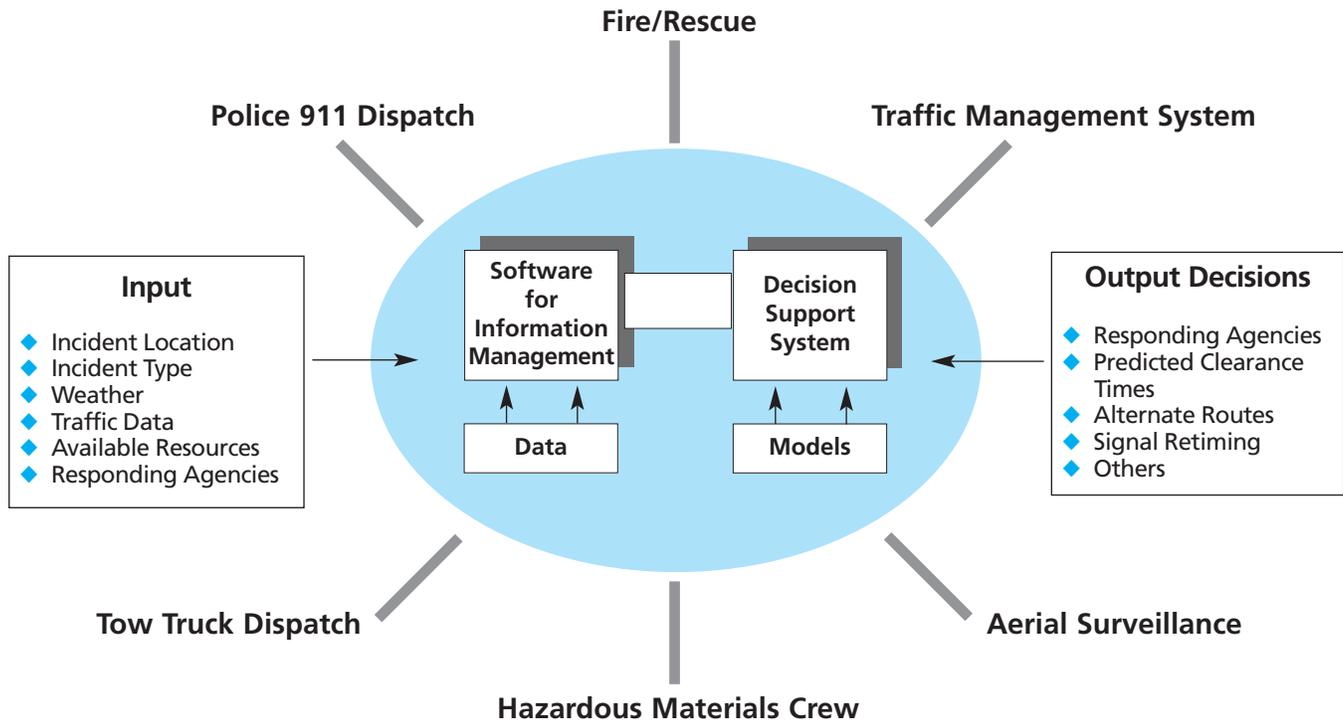


FIGURE 1 General multiagency framework for incident and emergency response and decision making.

sey, and Connecticut metropolitan areas;¹

◆ The I-95 Corridor Coalition, an alliance of transportation agencies, toll authorities, and related agencies from Maine to Florida;² and

◆ CHART, a joint effort of the Maryland Department of Transportation and the Maryland State Police to improve highway operations through “teamwork and technology,” in cooperation with federal, state, and local agencies.³

Through the management of traffic operations, the coordination of responding agencies, and the establishment of procedures among the regional partners, such programs play a central role in responses to major incidents that affect large regions.

This type of regional multiagency communication and response is needed during major emergencies caused by natural or man-made disasters. The effectiveness of emergency and incident management operations depends on interagency partnerships strong enough to withstand the test of high-pressure events, such as the fuel tanker truck explosion that occurred on January 13, 2004, on the I-895 bridge over I-95 in Baltimore County, Maryland (2).

In any disaster that requires major response and recovery operations, unified programs will play a central role in eliminating communication problems among the agencies involved and in coordinating disaster relief operations (Figure 1). Maryland State Highway Administrator Neil J. Pedersen has stated that “the systems and teamwork established by CHART were a critical part of the efficient response that helped motorists move to alternative routes and make informed decisions about travel when the fuel truck exploded on January 13” (2).

According to FHWA’s Regional Transportation Operations Collaboration and Coordination web page,

regional programs such as CHART, I-95 Corridor Coalition, and TRANSCOM build relationships that lay the foundation for effective regional transportation systems and services that cooperate in all situations, under a range of conditions, and with other related systems, for the good of the ultimate customers—those who depend upon the regional transportation system. (3)

In short, interagency partnerships that have been built over time can deal efficiently with man-made and natural disasters. Nevertheless, to ensure readiness to respond to major, although rare, events such as 9/11 or the August 14, 2003, power outages, pro-

grams and partnerships like these require improvement through continuous, hands-on training.

Relationships and Operations

The August 14, 2003, power outage—the largest in U.S. history—affected a vast section of the Northeast, from Detroit to New York City, including portions of Michigan, Ohio, Pennsylvania, New Jersey, New York, Connecticut, Vermont, and Canada. Most of the transportation systems in New York City came to a halt.

In a recent *Public Roads* article, Marygrace Parker of the I-95 Corridor Coalition states that “whether it’s a hurricane, a blackout, or a terrorist event, the way you manage traffic incidents is essentially the same. There’s no incident that occurs on any scale that doesn’t have traffic impacts. Most important is having the institutional and personal relations in place, and nurturing and sustaining them.”

The same article reports that Joseph Bober, Chief of Police at New Jersey Transit Corporation, “can’t emphasize the importance of training enough.” Many agencies, such as the Detroit and Canada Tunnel Corporation, which operates the Detroit-Windsor Tunnel, regularly train with live drills, simulations, and tabletop exercises to maintain readiness. Tabletop exercises, in particular, are well-suited to simulate the actions, reactions, policies, and procedures involving different agencies in incident response (4).

In sum, effective emergency response requires multiagency coordination through the establishment of plans and procedures, as well as multiagency training to ensure efficient implementation.

New Frontiers for Training

Tabletop exercises involving various agencies can be conducted efficiently with simulation programs that provide a realistic virtual environment, allowing participants to become familiar with emergency and incident management operations. The training triangle in Figure 2 depicts the relationship between level of proficiency and the amount of time spent in each learning environment.

The literature indicates that the majority of training time focuses on acquiring skills and information through lectures and demonstrations, with the least amount of training time devoted to validating the skill sets in live environments (6). Computer-based virtual environments can help trainees to gain familiarity and to acquire skills interactively, reducing the time needed for working on live equipment or for onsite training.

“Anytime, anywhere” training enables participants to improve skills without making major changes in daily work routines. This type of training

¹ www.xcm.org/

² www.i95coalition.org/

³ www.chart.state.md.us/

also can allow users in different locations to interact online. These are attractive advantages for emergency management personnel who may have difficulty participating in continuous training.

Another advantage of virtual training is the capability of creating different disaster or emergency scenarios involving participants from geographically dispersed agencies. The military has relied on these types of simulations since the 1970s in training for battles and conflicts.

One of these military programs, JANUS, a “two-sided, interactive, conflict simulation” system, was used by battle laboratory staff to test the reverse lane procedure for hurricane evacuation in New Jersey (7, 8). Several agencies participated in the exercise and took advantage of the program’s advanced graphical and multiuser capabilities (8). Another military package, the Joint Tactical and Conflict Simulation, enables personnel to train with military instead of vendor-supplied equipment (6, 7).

Simulation Capabilities

Civilian versions of these advanced simulation concepts can be combined with advanced transportation network simulators, such as Paramics or CORSIM, to depict more accurately the traffic conditions that

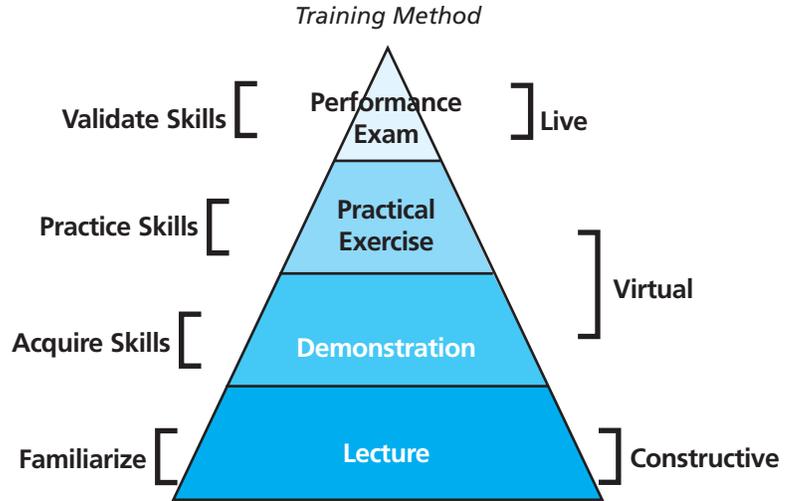


FIGURE 2 Training triangle [adapted from Hubal and Helms (5)].

would result under specific disaster scenarios and to improve the training of emergency and incident management personnel. A simulation system for emergency management operations planning and training should have the following capabilities:

- ◆ A graphical user interface (GUI) to visualize

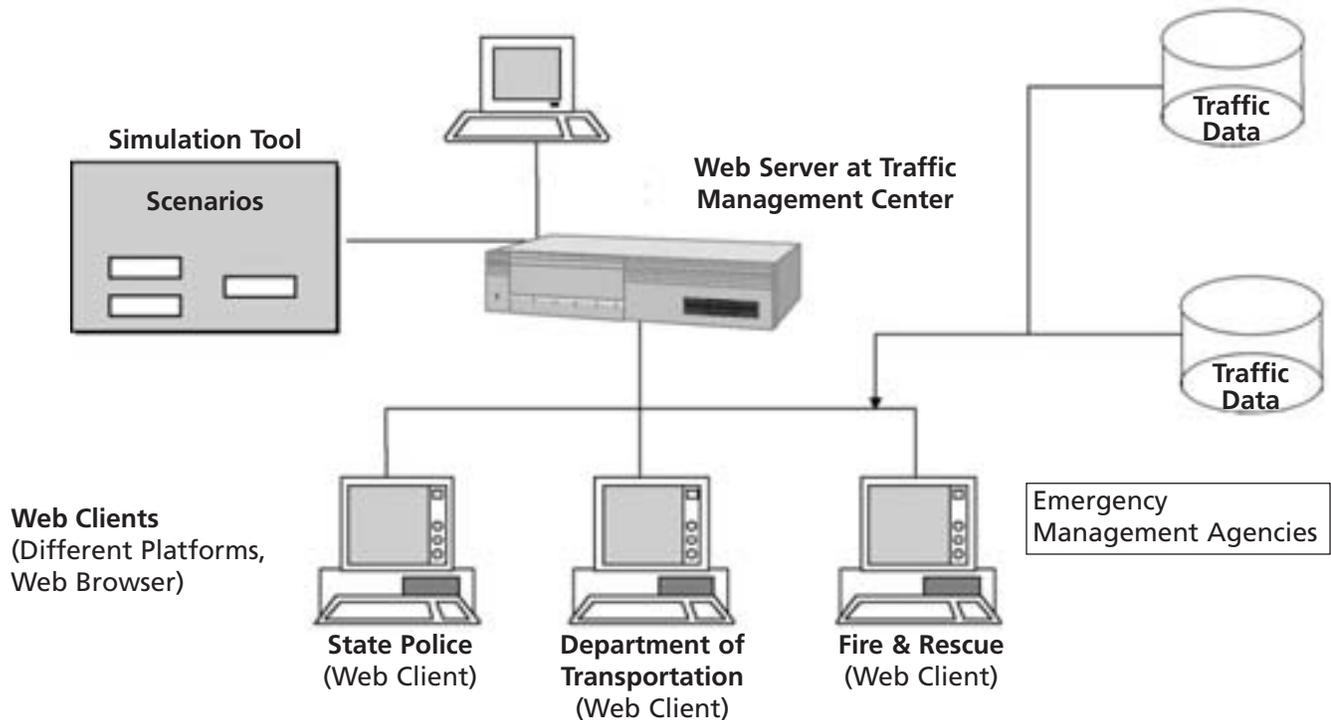


FIGURE 3 Conceptual architecture for an emergency management training and decision support tool.

the transportation network, the resources, and the control scenarios. The GUI should offer a high level of visualization, presenting a large amount of information cohesively and in context.

- ◆ A database management system to support the storage and retrieval of static and dynamic information about the road network and any incidents.

- ◆ A realistic representation of the transportation network conditions and the transportation management scenarios, including the location of variable message signs and the communication of route advisories.

- ◆ Adjustments for driver or evacuee behavior under emergency conditions in response to traffic demand and in compliance with warning messages.

- ◆ A variety of traffic control strategies, such as manual control by police and signal preemption for authorized or emergency vehicles.

- ◆ An interactive platform allowing communication, information exchange, and sharing between different working groups, coupled with a capability for building realistic scenarios.

This type of emergency simulation training tool would deal with large transportation networks. A geographic information system integrated with microscopic traffic simulation and a capability for building emergency scenarios may be the ideal combination.

Simulator Enhancements

The simulation tool and the incident and traffic databases would be accessible via the Internet by all participating agencies (Figure 3). The proposed architecture is similar to the system architecture developed for the wide-area incident management support system (9); a simple version of this architecture also has been tested (10). Given the advances in the development of tools for web-based applications, the implementation of this web-based architecture would not present a major challenge in time or funding.

A training simulator should include not only the simulation of traffic operations but also incident and emergency management operations such as detecting accidents, dispatching emergency vehicles, and modeling incident clearance activities. The simulator could be enhanced with capabilities for interactive and multiuser scenario building, as in military simulators—a vital function in the next-generation emergency training simulator.

Finally, a user-friendly GUI should incorporate the geographic information systems mapping software already familiar to emergency management professionals.

Evacuation modeling and simulation have been subjects of extensive research (11, 12). Civilian and military expertise can develop this kind of comprehensive, state-of-the-art training tool. The development would require the commitment of many players and a significant amount of resources. Such a tool would improve considerably the readiness and effectiveness of emergency management teams in saving lives and in minimizing the impact of major disasters.

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Transportation Security Training and Education

Developing and Expanding a Security Curriculum for Frontline Transportation Workers

The National Transit Institute's Programs

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Security concerns in the United States pre-date September 11, 2001 (9/11). At the end of World War II and the beginning of the Cold War, for example, the possibility of attacks, infiltration, and spying by Nazis and Communists was a concern, and corporations in the steel, mining, power generation, and manufacturing industries were watchful.

The Way It Was

The railroad industry also protected its system and service with due diligence. At that time, people and products moved throughout the country primarily by rail—transit bus and rail systems were independent or privately owned, the Interstate Highway System was being planned and paved, and airline travel was more a novelty than a means of common conveyance.

In 1945, a freight or passenger train began a journey somewhere in the United States every 3 seconds. Each train had more than 30 people working on the units, track, bridges, and tunnels, and in the shops, yards, and offices. Every train, therefore, had 30 pairs of eyes and ears attentive to things that could disrupt service or destroy assets and infrastructure.

As automation and technology progressed, however, labor-intensive jobs were reduced in number and eliminated. Railroad passenger service dwindled and freight car loads declined with the emergence of highways and airline travel. The perceived national security risks for railroads decreased. The 177 aircraft hijackings that occurred in a 10-year span starting in 1958 diverted the public, the media, and the federal government from concerns for the security of rail and other surface transportation modes.

By the 1970s, transportation security was defined as metal detectors and closed circuit television cameras in airports. This has evolved in the past 30 years into a routine of remote parking, three identification checks including a photo ID, metal detectors and wands, explosive residue detection, bag searches, pat-downs, and shoe inspections.

Appropriate Methods

Despite events such as the sarin gas attack in the Tokyo subway, bombings in the Moscow subway and on the rail systems in Spain and India, and an attack on an Amtrak train in Arizona—as well as hundreds of bus bombings in the Middle East—transportation security



Sheriff Britta Kjellstrand, Transit Services Bureau, Los Angeles County Sheriff's Department, reviews materials at NTI training session.

did not deviate from a focus on aviation. A few have tried to convince policy makers that some of the practices and equipment for airport security could be adapted for transit.

But shoe inspections before boarding a Bay Area Rapid Transit train, or metal detectors at every station gate on the light rail T in Boston, or bag searches on Chicago's Blue Line are not practicable. Neither can the Golden Gate Bridge authorities require a driver and ID match for every vehicle before crossing, nor can Baltimore's security personnel inspect every automobile going through the Fort McHenry Tunnel.

Although technology has provided effective solutions for highway, transit, and rail system security—such as closed-circuit television cameras—the two

measures that have been most effective are low tech. First, K-9 patrols, teaming a dedicated law enforcement officer with a well-trained dog in high-density areas such as terminals, depots, and on board trains, have been effective in detection and deterrence. The patrols also reassure security-conscious customers.

The second method looks back to 1945 and relies on a watchful and diligent workforce throughout the nation's rail, highway, and transit systems.

Methodical Program

After 9/11, the Federal Transit Administration (FTA) focused on securing U.S. transit systems. FTA dispatched technical assistance teams to the 30 largest systems; conducted vulnerability assessments, management-level workshops, and seminars; and launched the Transit Watch program to help systems enlist customers in security efforts.

Along with these initiatives, FTA and the National Transit Institute (NTI) at Rutgers University in New Jersey began a methodical program to provide training and materials at the front line. Following an accelerated development schedule, NTI released the course, System Security Awareness for Transit Employees, in June 2002. Supplementing the course was a program, Security Incident Management for Transit Supervisors. The courses serve frontline employees and their immediate supervisors and are essential in preventing and responding to security-related incidents.

To observe and report information effectively, employees need training in the basic skill sets of where to look, what to look for, and what to report. Their decisions and actions may determine the severity and extent of an incident. Knowledge of what to do—and of what not to do—is vital to a safe and effective response.



K-9 patrols are effective for deterrence and detection, especially in high-density areas, such as terminals. *Above, left*, passenger-friendly K-9 patrol assists Washington State Ferry. *Right*, K-9 training drill for transit police completes rounds on escalators at Washington, D.C., Metro station.

The 4-hour course uses a variety of techniques to present the fundamental concepts of transportation system security in a structured yet customizable format. In this way, agencies can make the course more relevant by incorporating system-specific graphics, policies, and concerns, while maintaining consistency and continuity on a national level.

In September 2002, NTI released a computer-based, self-paced, interactive version of the security awareness course. The 90-minute program presents the same material as the instructor-led course via an electronic-learning platform.

In both formats, the System Security Awareness for Transit Employees course has assisted 665 transit systems throughout the country in training more than 65,000 transit employees—including a total of 45,000 employees from 29 of the 30 largest systems. Within the first year, the Denver Regional Transportation District and San Francisco Municipal Railway had trained all of their employees with the NTI materials. In California, the Los Angeles Metropolitan Transit Authority (MTA), working with the Los Angeles County Sheriff's Office, used the NTI materials to train more than 200 transit-assigned law enforcement officers, as well as safety and security representatives from the 17 smaller interlinked transit systems.

Although systems within the security-sensitive, densely populated, urban areas of the country have received most of the attention, NTI also has worked with organizations responsible for smaller, rural properties. For example, NTI coordinated 3 weeks of system security training in June and August 2003 for the Wisconsin Urban and Rural Transit Association, preparing 457 employees from 29 state agencies. With the North Carolina Department of Transportation (DOT), NTI trained 329 transit employees from 109 systems in the state.

FTA and NTI also have produced a series of employee pocket guides on system security awareness, focusing on crime and terrorism prevention. Different versions reflect the modal and operational particulars of bus, light rail, and heavy rail systems. Approximately 500,000 guides have been distributed to transit workers by employers and labor unions. Los Angeles MTA incorporated emergency contact information into the bus and heavy rail pocket guides distributed to all employees.

Video and Adaptations

The next component in the FTA-NTI security training program was a 15-minute training video, *Warning Signs*, on system security awareness. The video covers the primary elements of the training course and can introduce the concept of system security measures as part of more traditional training or can refresh employ-



Customized brochures and pocket guides reinforce awareness training and security procedures for transportation agency personnel.

ees who have already received training. More than 3,500 copies of the video have been distributed to approximately 400 transit agencies.

Metropolitan Transit Authority of Harris County, Texas (METRO), adapted *Warning Signs* by adding a custom introduction by Shirley DeLibero, then president and CEO of METRO, along with a wrap-up by METRO Police Chief Tom Lambert. In 2004, TriMet of Portland, Oregon, used *Warning Signs* to retrain operations employees who had participated in the NTI course in 2002 and 2003.

FTA asked NTI to translate *Warning Signs* and three security pocket guides into Greek for the transit systems of Athens and the neighboring area for the 2004 Olympic Games. The final package included an introduction by FTA Administrator Jennifer Dorn and Chet Luner of the Transportation Security Administration (TSA).

Ferries to DOTs

NTI also worked with the Washington State Ferry (WSF) system and its parent organization, Washington State DOT, to develop specific training materials in response to heightened security concerns. The effort included development of a system security awareness course, pocket guide, and training video, following the model of the FTA-NTI materials.

Building on lessons learned in the project, NTI developed a course for ferry operations, System Security Awareness for Passenger Vessel Employees. The course is intended to comply with U.S. Coast Guard security training regulations. A train-the-trainer version of the course, released earlier this year, has prepared 348 people from 130 operations.



Train positioned for security X-ray. System security awareness training provides context for training in high-tech applications.

The Washington State DOT and WSF project raised an immediate recognition of the need for security training for state transportation employees. Under the direction of FTA and in collaboration with the American Association of State Highway and Transportation Officials (AASHTO) and several AASHTO member organizations, NTI developed System Security

Awareness for Transportation Employees.

After four pilot tests of the course, TRB's National Cooperative Highway Research Program (NCHRP) awarded NTI a grant for 20 additional deliveries, as well as for the development of computer-based interactive versions of the system security awareness course and a new incident management course for DOT employees. Transportation departments in 11 states have hosted train-the-trainer sessions for their employees, allowing the DOT training staff to implement internal training at their own schedule.

Railroad Security

Working with the Federal Railroad Administration (FRA) and several commuter rail operators across the country, FTA and NTI developed a course in system security and a pocket guide for commuter rail employees, adapted to the unique organizational and operational characteristics of railroads. Commuter rail operators in Massachusetts, New York, New Jersey, California, and Florida have used the course, released in June 2003.

In late 2003 representatives of Amtrak approached NTI about repurposing the commuter rail course to train more than 20,000 employees across the country. A partnership was formed among NTI, Amtrak, FRA, the Association of American Railroads—representing

Conducting a Mock Drill in Indiana

State and University Partnership Gauges Transportation Security Training Needs

S. Y. NOF, J. D. VELASQUEZ, B. K. PARTRIDGE, AND J. M. POTURALSKI

Universities can partner with and provide support to transportation agencies that are determining and filling needs for security training. An example is the Awareness and Alertness Training program, conducted by the PRISM Center and the Joint Transportation Research Program (JTRP) at Purdue University.* The program was started to help the Indiana Department of Transportation (DOT) handle threats to infrastructure, including terrorist attacks.

The program has analyzed Indiana DOT training and has itemized the components that need to be designed, developed, and enhanced. In collaboration with Indiana DOT employees, the research team delivered a full-day training workshop in July 2004 to more than 75 participants, mostly managers and supervisors from the agency's districts and subdistricts.

Through the workshop, participants gained acquaintance

* PRISM stands for Production, Robotics, and Integration Software for Manufacturing and Management; <http://gillbreth.ecn.purdue.edu/~prism/>. JTRP is a project of Indiana DOT and Purdue University; www.purdue.edu/jtrp.

with programs available in other states and through federal and other agencies. The session also provided the research team with information on how Indiana DOT might proceed to safeguard employees and the state's transportation infrastructure.

The workshop covered available programs on security awareness, security-related warning signs, lines of communication and command, roles and responsibilities of managers and supervisors, and alertness methods. The research team examined the programs that would address the security needs of Indiana DOT most effectively and then developed and tailored some of the programs to include content specific to Indiana DOT in the general safety training provided to all employees.

Designing the Mock Drill

The workshop participants recommended that Indiana DOT should prepare better for statewide mock drills in terrorism response and that interagency mock drills would be beneficial. Indiana DOT worked with the PRISM Center team to tailor a mock drill.

the nation's freight railroads—and TSA to develop a computer-based, interactive, security awareness training program for employees of all U.S. freight and passenger railroads. In September 2004, TSA awarded a contract to NTI to develop and deliver the interactive program by early 2005.

In the summer of 2004, with a supplemental grant from the state of Illinois, NTI trained all employees of the Chicago-based Metra rail system, as well as contract employees from the Union Pacific and BNSF freight railroads. Under a separate agreement, NTI trained all of the Northern Indiana Commuter Transportation District employees who operate the former South Shore Line into Chicago.

With the two national political conventions in 2004 in large East Coast cities, at security-sensitive venues built above railroad and subway stations, the need for security training was pressing. NTI provided instructors to train all of the MBTA bus and rail operations personnel before the start of the Democratic National Convention.

NTI also provided the commuter rail course to MBTA to train rail crews and other personnel. Finally, NTI held a train-the-trainer session in Boston for the passenger vessel course, attended by more than 50 representatives of local ferry operators, as well as U.S. Coast Guard personnel.

To prepare for the Republican National Convention in New York City, NTI worked on security training with all three commuter railroads. Metro North and Long Island Railroad continued using the original NTI course, but increased the frequency of the training sessions. In New Jersey, NTI worked with NJ Transit to conduct train-

ing sessions for train and engine crews operating in and out of New York City, as well as for the maintenance crews servicing the cars and locomotives. NJ Transit also reproduced and distributed *Warning Signs* to all of its rail operations employees.

On the Alert

At the same time, NTI released a new FTA-driven training program, Terrorist Activity Recognition and Reaction. The new course is consistent with the concepts in the original system security courses but was built from the ground up.

The primary audience consists of front-line employees and supervisors who have direct contact with customers—such as bus or rail operators, station agents, train operators, and supervisors, as well as maintenance personnel. The focus is on preventing terrorist attacks through the observation and reporting of preattack activity. A course video and pocket guide are in development.

As transit agencies and land and maritime transportation systems continue to build up their security efforts, training is essential. NTI will continue to provide training courses and materials to agencies at the direction of—and in collaboration with—FTA and other U.S. DOT offices; TSA and other DHS offices; and AASHTO and other organizations.

Decades of transportation security experience in London and the Middle East have proved that a workforce trained to be alert, observant, diligent, and conscientious in reporting unusual activities and objects is one of the most effective security measures in a system designed to be open, accessible, and reliable.

The project limited participation to two Indiana DOT districts, with support from the Indiana State Police, Indiana DOT Counter Terrorism and Security Council, and Indiana's State Emergency Management Agency (SEMA). The mock drill prototype consisted of a series of events that ranged from everyday occurrences such as snow removal to the serial detonation of stolen tankers.

The mock drill participants were divided into four groups: the two participating districts, the overseeing agencies, and a control group. All teams had a decision support system to obtain simulated real-time information about the unfolding events, a list of individuals with whom to communicate, other contact information, weather reports and state maps, and access to a database of all the emergency equipment available in a typical Indiana DOT district and subdistrict.

The mock drill was conducted in real time via the intranet of the Indiana DOT Research Division. The control group, which consisted of knowledgeable representatives from several agencies, provided immediate feedback and qualified the decisions made by the participants.

At the end of the mock drill, representatives from Indiana DOT and SEMA discussed the cumulative log of the decisions and the results with all participants. The lessons learned have contributed to the agency's preparedness, communi-

cations capability, and efficiency in response efforts.

Refining the Prototype

Although improvements have been recommended, the training workshop and mock drill prototype were well received by all participants. Indiana DOT will increase transportation security training, as well as safety training, in the coming year, developing more comprehensive training programs, with additional material specific to each target audience, and with enhanced interface and interaction.

The mock drill prototype will undergo further refinements and updates in response to feedback from participants. The program then will be deployed in all Indiana DOT districts. The training programs are being developed in conjunction with JTRP projects on vulnerability analysis and risk assessment and on intelligent transportation systems and security. These efforts will allow Indiana DOT to improve at handling emergencies of all types.

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Cooperative Research for Hazardous Materials Transportation

Defining the Need, Converging on Solutions

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The author, Senior Program Officer in TRB's Division of Studies and Information Services, served as study director for this project.

Hazardous materials are substances that are flammable, explosive, or toxic, or that, if released, produce effects that would threaten human safety, health, the environment, or property. Hazardous materials are moved throughout the country by all modes of freight transportation, including pipelines, ships, trucks, trains, and airplanes.

Hazardous shipments vary in size and type, from small parcels containing a few ounces of infectious or radioactive substances to barges and railroad tank cars

carrying tons of flammable, toxic, and corrosive materials. According to U.S. Department of Transportation (DOT) estimates, if movements by pipeline and ocean-going tankers are excluded, about 800,000 hazardous materials shipments, more than 5 million tons, are made daily in the United States—approximately 18 percent of the total freight shipped.

Shared Goal

The private sector and a diverse mix of government agencies at all levels are responsible for controlling the





TRB Special Report 283, *Cooperative Research for Hazardous Materials Transportation: Defining the Need, Converging on Solutions*, is available from the TRB online bookstore, www.TRB.org/bookstore; to view the book online, www.TRB.org/publications/sr/sr283.pdf.

transport of hazardous materials and for ensuring that hazardous cargoes move without incident. This shared goal has spurred the creation of several venues for organizations with related interests to work together in preventing and responding to hazardous materials incidents.

Trade associations from the freight transportation and chemical industries, government regulatory and enforcement agencies at the federal and state levels, and local emergency planners and responders routinely share information, resources, and expertise. At the federal level, the U.S. DOT Office of Hazardous Materials Safety develops uniform requirements for hazardous materials transportation and coordinates with international bodies.

Nonetheless, a longstanding gap in the system for ensuring hazardous materials safety and security occurs in the conduct of research. Industry organizations and government agencies have their own research programs to support their mission needs. Collaborative research to address shared problems takes place occasionally, but mostly occurs ad hoc or project by project.

Filling the Gap

Acknowledging this gap, the Office of Hazardous Materials Safety, the Federal Motor Carrier Safety Administration, the Federal Railroad Administration, and the U.S. Coast Guard pooled their resources for a study. Under the auspices of TRB, the National Research Council of the National Academies

appointed a committee to examine the feasibility of creating a cooperative research program for hazardous materials transportation, similar in concept to the National Cooperative Highway Research Program (NCHRP) and the Transit Cooperative Research Program (TCRP).

Led by Robert E. Gallamore, Director of the Transportation Center at Northwestern University, the study committee consisted of experts in hazardous materials risk analysis, shipping, transportation, enforcement, emergency planning, and research management (see box, below). The committee supplemented its own expertise and perspectives by convening a workshop, at which more than 50 individuals from the public and private sectors offered thoughts on the need for cooperative research in hazardous materials transportation. The committee concluded that the need for cooperative research in this field is significant and growing and offered ideas on establishing an ongoing program of cooperative research.

A Mounting Need

The safety, security, and environmental concerns associated with the transportation of hazardous materials are growing in number and complexity.

Federal involvement in the regulation of hazardous materials transportation began nearly a century ago to protect the public from the dangers of fires and explosions involving volatile liquids and solids transported by rail. Concern gradually expanded to include many other materials that posed risk mainly to the transportation workers and the emergency personnel responding to a crash or an accidental release.

During the past three decades, the scope of concern has expanded to include materials that, if released, may harm the environment or that may present long-term risks to human health. Today, the concern goes beyond accidental releases to include the possibility that terrorists may target hazardous materials to harm public health, safety, and the economy. The committee concluded that cooperative research can help manage these complex risks comprehensively and systemwide.

Managing the risks associated with the transportation of hazardous materials is necessarily a joint effort involving many entities from industry and government.

Ensuring the safe and secure transportation of hazardous materials requires the efforts of carriers in nearly all modes, shippers of a range of products, and government agencies at all jurisdictional levels. Shippers and carriers bear the main responsibility, by following their own good practices and the longstanding rules and standards of industry, the federal government, and international bodies.

Because releases sometimes occur in transporta-

Committee for a Study of the Feasibility of a Hazardous Materials Cooperative Research Program

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Example Projects for a Hazardous Materials Transportation Cooperative Research Program

The committee report identifies nine example projects that a hazardous materials transportation cooperative research program could undertake. The topics illustrate the kinds of problems that a program may address and are not offered as a priority list:

Data and Analysis for Policy Making and Regulation

- ◆ Assessment of opportunities to integrate and supplement safety and security measures for hazardous materials transportation;
- ◆ Data on predominant traffic and highway geometric characteristics in large-truck crashes for use in risk analysis;
- ◆ Recommendations for development of conditional release probabilities for bulk containers involved in transportation accidents;
- ◆ Development of correlations between

incident risks and consequences to aid in decision-making models;

- ◆ Development of an environmental hazard assessment system for the transport of hazardous materials; and
- ◆ Recommendations for commercial transportation incident and commodity flow data collection and reporting.

Planning and Preparing for Emergencies

- ◆ Detailed information for conducting hazardous materials commodity flow studies; and
- ◆ National hazardous materials emergency response capability assessment.

Supporting First Response

- ◆ Transportation emergency response guidelines for hazardous materials.

tion, this responsibility extends to state and local police and fire officials, who are often the first to arrive on the scene of a release and who must act quickly to minimize harm. Moreover, state and local authorities must work with industry and federal agencies to ensure security as the shipments pass through critical infrastructure and population centers.

More than one dozen federal agencies have regulatory, enforcement, operational, and other responsibilities related to hazardous materials transportation. All of these entities have much at stake in providing a safe and secure system for transporting hazardous materials.

Few means are available for the parties responsible for hazardous materials transportation to work together in seeking solutions to shared and related problems.

All parties responsible for the transportation of hazardous materials require information to support their decisions. Which routes and modes of transportation are safest, most secure, and pose the least risk to the environment? Which materials are suited for which type of packaging? Which emergency preparations are most prudent, considering the nature of the materials crossing the transportation system? Which shipments merit extra security?

These questions indicate the kinds of decisions that industry and government must make regularly, often independently. The ramifications can be far-reaching.

Good decisions demand good information. Good decisions require data and analytic tools for weighing

options and understanding the causal relationships and the systemwide effects.

A cooperative research program would address these problems from a wider range of perspectives. The program would allow the consolidation of resources to seek solutions more efficiently, avoiding piecemeal and duplicative efforts. The program would lead to greater acceptance of research results by the entities involved, because each would participate in the process.

Finally, the program would lead to more widespread dissemination of the results and to more applications of the results in the field. By cooperatively setting the research agenda and guiding individual research projects, the parties responsible for hazardous materials safety and security would have a dependable way to work together in solving problems.

Program Structure

The experience of cooperative research programs, such as NCHRP and TCRP, suggests that a successful program for hazardous materials transportation should involve an array of the likely users of the research, who would guide and govern the program, set the research agenda, oversee individual research projects, and disseminate the end products of the research.

End users of the research—carriers, shippers, and emergency responders—must have a sense of ownership in the program. The users must be convinced that the program is addressing their problems and research



PHOTO: CHRIS KADLEC

needs and that the program is incorporating their expertise and perspectives. The research results then are more likely to gain acceptance and application.

Simply offering stakeholders an advisory capacity or other indirect role in program development and guidance, however, does not convey a sense of ownership, as the experience of other cooperative research programs has shown. A more comprehensive approach is required, from the way the program is financed and governed to how it is managed. The study committee offered the following advice for financing, governing, and managing a cooperative research program for hazardous materials transportation.

Financing

Because of the diversity of stakeholders in hazardous materials transportation, no single industry segment is likely to have incentive to fund cooperative research, and many do not have the financial means. Federally appropriated funds, therefore, would provide core financing for the overall program of research, perhaps coupled with supplemental funds contributed at the discretion of stakeholders to individual projects.

The committee observed that a cooperative research program comparable in magnitude to TCRP—that is, with a budget of \$5 million to \$10 million per year—may be justified to ensure the safety and security of hazardous materials in transportation. The committee noted that if the program proves successful in the first 3 to 5 years, an increasing portion of program funding may be derived more directly from stakeholders and users of the research.

Increasing stakeholder financing of the program, even if discretionary, is key to fostering a sense of ownership in the program by stakeholders, the committee emphasized. The measure would ensure that the research products remain useful.

Governance by Stakeholders

The program should be guided by a governing board that is independent and composed primarily of the end users of research. The governing board would be responsible for soliciting research needs, setting research priorities, and shaping the research agenda. The governing board should ensure that the products of the research are useful and well disseminated within the array of stakeholder communities.

The majority of the board members should be shippers, carriers, suppliers, and emergency managers and responders—that is, the significant end users of the research. The board also should include representatives from the federal agencies that have programmatic, operational, and regulatory responsibilities for hazardous materials transportation safety, security, and

environmental protection. These agencies will gain from cooperating in research with one another as well as with other segments of the industry.

Management Model

The committee found that certain management features of cooperative research programs have proved integral to success:

- ◆ Individual research projects should be conducted by contractors selected on a competitive basis. Contract research allows greater flexibility than investing in specialized research facilities and the hiring of in-house staff. A competitive process for selecting contractors by qualifications and cost encourages quality and efficiency, builds program credibility, and enables more research projects within the limited research budget.

- ◆ Technical panels should define the scope of individual research projects, developing requests for proposals from researchers, selecting the researchers to perform the work, overseeing and reviewing the work, and assisting in the dissemination of the final product. The technical panels should include end users of the research as well as technical experts from academia, the private sector, and government.

- ◆ The organization managing the process should be independent and should be focused on research as its main organizational mission. These characteristics are essential for building trust.

Piloting the Concept

The program would require a dedicated effort not only from research advocates but also from stakeholder communities. The benefits of research, however, are not always apparent to those who are focused on day-to-day operations and concerns.

Recognizing this practical problem and the challenge of securing support without tangible evidence that a cooperative research program would be useful, the committee noted that a smaller-scale demonstration could yield some early and useful research results.

The committee therefore advised initiating a pilot program. The value of the research should speak for itself. If the results of the research from the pilot program are useful, the cooperative research concept can be expected to generate stakeholder interest in pursuing a larger-scale program.

The successful cooperative research programs in other fields suggest that stakeholder involvement and interest in cooperative research are essential from the inception. The committee noted that a pilot program can help to establish this stakeholder ownership from the start.

Marine Salvage Capabilities

Responding to Terrorist Attacks in U.S. Ports— Actions to Improve Readiness

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The author is Senior Program Officer, TRB Division of Studies and Information Services, and was study director for this project.

Federal officials and industry leaders have focused national attention on the security of U.S. seaports and are assessing how best to prevent future terrorist incidents in and around these facilities. Equally important, however, are considerations about U.S. capabilities to respond adequately to a terrorist incident.

Ports and waterways are vital to the nation's economic well-being, and the closing of a major harbor would have enormous impact on commercial and military operations. The response to such an incident would involve many government agencies and organizations at the federal, state, and local levels.

The U.S. Navy Office of the Supervisor of Salvage and Diving (SupSalv) therefore asked the National Research Council of the National Academies to appoint a committee to convene a workshop, under

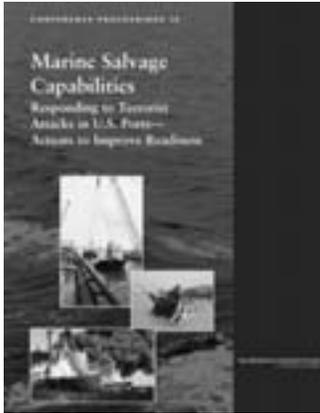
the auspices of the Transportation Research Board's Marine Board (see box, page 35). The committee designed a workshop for marine transportation and salvage professionals, as well as for organizational stakeholders in government and industry, to explore and evaluate the nation's capabilities for responding to terrorist incidents in major seaports and to report on readiness and on strategies to improve deficiencies.

Changing Emphases

Since September 11, 2001, the U.S. Coast Guard (USCG) has increased its emphasis on maritime homeland security, while continuing its responsibilities for maritime safety, protection of natural resources, maritime mobility, and national defense—for example, securing ports and waterways. USCG usually takes the federal responsibility for handling maritime incidents—

Rescue and salvage of a tanker on fire at sea provides possible salvage scenarios for response to an attack on ships in a U.S. harbor.





TRB Conference Proceedings 30, *Marine Salvage Capabilities: Responding to Terrorist Attacks in U.S. Ports—Actions to Improve Readiness*, is available from the TRB online bookstore, www.TRB.org/bookstore; to view the book online, www.TRB.org/publications/conf/reports/cp_30.pdf

such as collisions, groundings, and shipboard fires.

For incidents requiring salvage, however, the party involved typically must seek commercial service. If the party involved does not take adequate action, USCG calls on the U.S. Navy, which maintains the ability to respond to maritime accidents that require professional marine salvage services. Commercial salvors provide additional assets, personnel, and cutting-edge technology as needed.

In 1982, the Marine Board conducted a comprehensive study of U.S. salvage needs and capabilities, published as *Marine Salvage in the United States*, which was followed by a 1994 Marine Board report, *A Reassessment of the Marine Salvage Posture of the United States*.¹ The 1994 report described the Navy's salvage resources and contributions to the nation's salvage capabilities and found that marine salvage needs could not support a commercial industry dedicated to traditional salvage work. The same conditions continue today.

Since the 1994 study, substantial changes have occurred in public and private salvage capabilities as well as in public expectations for the nation's ability to respond to major incidents at sea. Nevertheless, the number and the capabilities of domestic salvage vessels have not increased significantly.

Marine casualties in U.S. waters are at an historic low. Recent events, however—notably the terrorist attacks on the World Trade Center overlooking New York harbor and the attack on the USS *Cole* in the Port of Yemen—suggest that national salvage capability has importance, not only in terms of transportation, economic, and environmental concerns, but also for homeland security.

Goals and Approach

The principal goals of the workshop were to share information about marine salvage response capabilities and to determine major gaps or concerns about the capabilities and about agency roles. Before the workshop, the committee developed two scenarios involving terrorist incidents—one in the Port of Houston, Texas, and the other in the Port of New Orleans, Louisiana. The scenarios reflected the committee's assumptions about what terrorists could accomplish with sufficient assets.

The two ports are major, world-class commercial shipping complexes—both along the U.S. Gulf Coast—and handle significant international and domestic waterborne commerce. The Port of Houston is the second largest in the United States in terms of tonnage carried. The port conducts a major trade in petroleum, chemicals, and hazardous cargoes, with large refineries

and petrochemical plants along the waterway. The Port of New Orleans and other ports along the Mississippi River from Baton Rouge south handle more combined tonnage than any other U.S. port and accommodate a variety of oceangoing ships, barges, tugboats, and other vessels.

The workshop, held at the National Academies in Washington, D.C., August 5–6, 2003, brought together experts in salvage response, government officials responsible for incident response, and representatives of stakeholder organizations. Participants discussed the role of salvage and the response to potential terrorist incidents affecting U.S. ports and waterways, including issues of organizational and interagency coordination.

Exploring the Topics

Two panels—one of government and one of industry experts—assessed the likely salvage responses to the scenarios. Representatives of federal agencies identified their agency's role and described procedures for managing and implementing a coordinated response and for providing necessary resources. Industry representatives commented on the problems and then discussed the salvage response that could be expected.

The panel presentations set the stage for detailed discussions in four breakout groups: (a) physical salvage and harbor clearance issues; (b) financial, economic, and political issues; (c) legal, forensic, and human casualty issues; and (d) environmental issues. Each of the four breakout groups considered the scenario results, responses, and likely impacts and examined whether the salvage assets were adequate for response to the hypothetical scenarios.

Many participants from the salvage industry maintained that past performance on marine salvage problems of similar magnitude showed that the industry can supply the needed capabilities. They were not able, however, to specify the physical capabilities that would be available to government responders and planners under the hypothetical scenarios.

As a result, industry participants were not able to provide a time frame for the response, which is a critical component of readiness. One participant noted that physical salvage capabilities in the United States have not been documented or evaluated in sufficient detail to determine if the nation has an adequate readiness posture for responding to terrorist incidents in major seaports.

The workshop also addressed the status of organizational capabilities for salvage response—the make-up of intra- and interagency planning groups, the adequacy of response plans, the expertise of the planners and responders, and the methods of implementing response actions. Many participants believed that organizational

¹ <http://books.nap.edu/catalog/4783.html>

readiness is improving but requires sustained attention. Suggestions were offered to enhance salvage industry input into planning efforts, to improve readiness and the ability to deploy salvage assets.

Participants discussed the value of drills and exercises to assess capabilities and to identify needs. Such exercises may help in determining where improvements in salvage readiness would yield concrete results. Tabletop and field exercises could be designed to answer questions about salvage assets, as well as about organizational issues.

Participants also identified regulatory and policy issues that could affect the ability of government and industry to maintain readiness. These included questions about funding, liability, planning processes, and protocols for addressing issues that indirectly affect salvage operations. All of these topics could not be covered during the workshop but remain important considerations.

Areas for Improvement

After reviewing the workshop results, the committee concluded that work is needed in four areas to improve the nation's marine salvage capabilities and readiness:

- ◆ Maintaining an inventory and evaluation of available physical salvage assets;
- ◆ Conducting tabletop exercises to test physical and organizational readiness;
- ◆ Improving salvage expertise and input into the planning and response networks; and
- ◆ Conducting further studies of related legal, regulatory, and policy issues.

TRB Conference Proceedings 30, *Marine Salvage Capabilities: Responding to Terrorist Attacks in U.S. Ports—Actions to Improve Readiness*, presents the committee's recommendations in these four areas, as well as summaries of the group discussions, observations about key issues, and recommendations for actions that the responsible agencies should take to improve marine salvage readiness to respond to seaport terrorist incidents.

Marine Salvage Assets

Because the workshop did not have the time or resources to conduct a comprehensive review of physical assets in the marine salvage industry and the relevant government agencies, definitive conclusions about readiness were not possible. In addition, many workshop participants believed that the adequacy of response or readiness depends on the specific incident.

Nevertheless, according to the committee, response planners need to have access to an inventory of salvage assets maintained by responsible government agen-

Committee for Marine Salvage Response Capability: A Workshop

Malcolm MacKinnon III, MacKinnon-Searle Consortium, LLC, Alexandria, Virginia, Chair
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cies and the salvage industry. Moreover, a gap analysis—assessing salvage needs against available assets—should be conducted, taking into account the timeliness of a response.

◆ SupSalv, in consultation with USCG and the commercial salvage industry, should maintain an inventory of available marine salvage and firefighting assets. The inventory should be updated at regular intervals.

◆ SupSalv should conduct a series of gap analyses by comparing available assets with those required to respond effectively to a range of potential marine terrorist activities as well as other major marine salvage incidents. The analyses should consider all critical salvage response measures including rescue towing, harbor and channel clearing, dredging, search and recovery, patching and refloating of vessels, and marine firefighting. The gap analyses should address the adequacy of the anticipated response times for each region.

◆ USCG should promulgate final rules for vessel response plans to provide necessary guidance on effective response times for salvage operations.

◆ If the gap analyses show that current marine salvage assets are insufficient, responsible federal agencies should revise the national salvage policy to provide for the necessary salvage capability.

Response Exercises

According to the committee, a logical next step in evaluating marine salvage readiness is to conduct detailed exercises with plausible terrorist incidents, deploying response systems, equipment, and the complete response organizational structure. Such an exercise would be designed to assess U.S. readiness in a terrorist act affecting U.S. harbors and waterways, with particular focus on marine salvage.



- ◆ The responsible federal agencies should plan and conduct a high-level tabletop salvage response exercise. Participants should be senior members from the relevant agencies and private organizations. The exercise could follow scenarios similar to those used in the workshop, should be carefully planned, and should be led by an experienced facilitator. Additional exercises should follow to test different scenarios in different locations.

- ◆ Responsible agencies should conduct a supplemental exercise with the same scenarios to test the interactions necessary to identify and mobilize the salvage assets to clear harbors and channels so that the ports can be reopened efficiently. This exercise should include representatives from the Navy, the salvage industry, and other related stakeholders.

- ◆ Individual agencies should conduct their own exercises, to test the responses necessary to open the port efficiently. For example, the Federal Bureau of Investigation could conduct an exercise to determine the most efficient handling of the crime scene, allowing clearance operations to proceed in a timely way. Other agencies might include the U.S. Army Corps of Engineers, USCG, the National Transportation Safety Board, and local fire and police departments.

- ◆ Public affairs specialists from the various federal entities also should be involved, to gain acquaintance with salvage efforts and the related public affairs challenges.

Organizational Networks

The committee considered the workshop discussions and concerns about how organizational structures are implemented within the federal agencies and how these organizations receive and use expertise and advice about marine salvage operations and capabilities. The committee concluded that response readiness could be improved with more interagency coordination. Organizational structures must be revised at several levels to include salvage expertise in planning and in response operations.

- ◆ The membership of the Secretary of Homeland Security's National Maritime Security Advisory Committee should include a marine salvage expert.

- ◆ The USCG Director of Homeland Security should develop a liaison position with SupSalv.

- ◆ The structure of the National Response Plan should provide for the inclusion of salvage expertise in the National Incident Management System.

Legislative and Policy Issues

The workshop participants identified many unresolved legislative, regulatory, and policy issues associated with marine salvage operations in response to

terrorist acts. For example, marine salvage companies are not guaranteed immunity during response operations, creating a potential for civil or criminal liability if pollution incidents occur during salvage operations.

Several industry participants termed this a serious disincentive for undertaking some salvage operations. Other participants were concerned that funding methods are not adequate to cover effective salvage response to a terrorist attack. Several funding options could be explored.

Some workshop participants pointed out that other nations have relied on standby salvage—stationing a vessel in the harbor for emergency salvage operations. The strategy may help to fill the gap in U.S. salvage capacity and to ensure timely response to emergencies.

Another issue identified by workshop participants was the lack of a process for designating places of refuge or safe havens when a vessel has experienced serious damage. This can present a critical obstacle to effective salvage operations.

The workshop also identified other issues that may influence salvage operations, such as environmental impacts and public health considerations. Participants noted the lack of a clearly defined protocol for addressing the public health impacts of a terrorist event or of the consequent salvage operations; this contributes to the potential vulnerability of the public during a terrorist event. In addition, the lack of a protocol for addressing human casualties in maritime incidents could cause confusion over jurisdictions and logistics.

Because these policy issues need to be resolved before salvage response readiness can be ensured, the committee recommends that a study should be conducted to determine how best to address the following legal, regulatory, and policy issues:

- ◆ The development of an appropriate process within the emergency response organizations to fund salvage operations after a terrorist event;

- ◆ The development of a process to designate places of refuge or safe havens for the conduct of salvage operations;

- ◆ The need for responder immunity from civil liability for nonnegligent salvage operations that result in pollution or other unintended or unavoidable damages;

- ◆ The establishment of a protocol for addressing the public health impacts of a terrorist event and consequent salvage operations;

- ◆ The establishment of a protocol for addressing human casualties; and

- ◆ The establishment of standby salvage capability in vulnerable and busy ports and harbors.

TRB Meetings

2005

July

- 8–9 Commodity Flow Survey Conference
Boston, Massachusetts
- 10–12 TRB 2005 Summer Conference
Boston, Massachusetts
- 10–12 30th Annual Summer Ports, Waterways, Freight, and International Trade Conference
Boston, Massachusetts
- 10–16 Traffic Signal Systems Committee and Highway Capacity and Quality of Service Committee Midyear Meetings
Las Vegas, Nevada
Richard Cunard
- 11–13 Symposium on Stormwater Management for Highways
Sanibel Island, Florida
- 17–19 Environmental Stewardship in Transportation Through Waste Management, Materials Reuse, and Environmental Management Systems
Charlotte, North Carolina
- 17–20 6th International Bridge Engineering Conference: Reliability, Security, and Sustainability in Bridge Engineering
Boston, Massachusetts
- 17–20 44th Annual Workshop on Transportation Law
Portland, Oregon

August

- 13–18 8th International Conference on Concrete Pavements*
Colorado Springs, Colorado

September

- 11–14 Northeast Community Impact Assessment Workshop*
Trenton, New Jersey
Martine Micozzi
- 11–14 Environmental Stewardship and Streamlining: Fact or Fiction*
Santa Fe, New Mexico
- 22–23 Workshop on Role of the Driver in Vehicle-Infrastructure Integration and Cooperation (VII/C)—Research Needs
Reston or Arlington, Virginia
Richard Cunard
- 22–24 3rd International SIIV Congress: People, Land, Environment, and Transport Infrastructures—Reliability and Development*
Bari, Italy

October

- 2–5 SmartRiver21: International Symposium on Global Commerce and Strategies for Inland Navigation and Economic Development*
Pittsburgh, Pennsylvania
Joedy Cambridge
- 2–5 Plastic Pipes XIII Conference*
Washington, D.C.
G. Jayaprakash
- 5–7 Road Safety on Four Continents*
Warsaw, Poland
- 31–Nov. 1 First National Conference on Roadway Pavement Preservation
Kansas City, Missouri

November

- 1–3 6th National Conference on Transportation Asset Management: Making Asset Management Work in Your Organization*
Kansas City, Missouri
- 14–16 2005 International Truck and Bus Safety and Security Symposium*
Alexandria, Virginia
Richard Pain

2006

January

- 22–26 TRB 85th Annual Meeting
Washington, D.C.
Linda Karson

May

- Spring-Fall 2006 Freight Demand Modeling: A Conference on Improving Analysis and Forecasting Tools for Public-Sector Decision Making
TBD
Elaine King

June

- 4–7 North American Travel Monitoring Exposition and Conference (NATMEC)
Minneapolis, Minnesota
Thomas Palmerlee

July

- 16–19 Third International Conference on Bridge Maintenance, Safety, and Management*
Porto, Portugal
- 16–19 11th AASHTO/TRB Maintenance Management Conference*
Charleston, South Carolina

Additional information on TRB conferences and workshops, including calls for abstracts, registration and hotel information, lists of cosponsors, and links to conference websites, is available online (www.TRB.org/trb/calendar). Registration and hotel information usually is available 2 to 3 months in advance. For information, contact the individual listed at 202-334-2934, fax 202-334-2003, or e-mail lkarson@nas.edu. Meeting listings without TRB staff contacts have direct links from the TRB calendar web page.

*TRB is cosponsor of the meeting.



Supporting Construction Loads on Steel Bridges

Kansas Team Develops Tool for Design and Analysis

JOHN PATRICK JONES, W. M. KIM RODDIS,
ERIC ANDERSON, AND PAUL KULSETH

Jones, Anderson, and Kulseth are bridge designers with Kansas Department of Transportation, Topeka. Roddis is chair, Department of Civil and Environmental Engineering, George Washington University, Washington, D.C.; she formerly was on the faculty of the Civil, Environmental, and Architectural Engineering Department, University of Kansas, Lawrence.

Steel is commonly used for bridge members in spans over traffic, particularly if restrictions apply to what are called false work bents—the temporary supports for construction—or if the length of the span exceeds the reach of conventional prestressed concrete members. Steel is more flexible and less massive than its concrete counterpart and offers the advantage of a high strength-to-weight ratio.

Contractors may decide to deploy overhang brackets, which are temporary supports placed outside the bridge's exterior girder, for the concrete forms on a bridge deck (Figure 1). Overhang brackets can speed construction without reducing the clearance under the structure. For this reason, the Kansas Department of Transportation (DOT) almost always uses overhang brackets for placing cantilevered slabs on bridges.

Construction loads, however, can cause eccentric effects or twisting in the exterior girders that support the cantilevered portion of the slab. Although efficient for the contractor, the overhang bracket system is a challenge for the engineer, who must conduct an analysis to

ensure that excessive stresses or deflections do not occur from construction loading. According to Kansas DOT specifications, a licensed professional engineer must design and stamp the form work and the false work drawings with a professional seal for the construction of any structure that either spans or carries traffic.

To assist in this task, Kansas DOT and the University of Kansas (KU) have created a design tool, Torsional Analysis for Exterior Girder (TAEG), to aid in evaluating and designing a contractor's false work system.

Problem

During the placement of a concrete deck on a steel bridge with I-shaped beams or girders, the loads from the construction equipment, combined with the overhang geometry, create eccentric forces or torsions. These forces cause stresses and deflections in the bridge girders and cross frames.

The eccentric effects can be difficult to control. Excessive deflections can cause the falsework system to fail, producing a rough-riding bridge deck. In designing the construction support scheme, the contractor's engineer must account for the torsional



FIGURE 1 Typical overhang support (above) and installation on bridge (left).

loading, as must the Kansas DOT bridge engineers who review the adequacy of the design.

Understanding the bridge and the falsework as a single system acting in three dimensions can be difficult. Torsional analysis of the bridge's I-shaped members will reveal warping stresses that are overlooked in the structural analysis performed by most software packages.

An inherent assumption in calculating stresses using elementary mechanics is that plane sections remain plane; in this case, they do not. As a consequence, determining the torsional response of the exterior girders to the loads on the deck overhang during the placement of the concrete—while also taking into account the construction support scheme—is a complicated task for the bridge engineer.

Solution

Kansas DOT, KU, and Kansas State University have established a cooperative research program, K-TRAN. Through K-TRAN, Kansas DOT and KU worked to address the torsion problem, creating TAEG to be an easy-to-use design tool, available at no charge to all state DOTs and their consultants and contractors. The Microsoft Windows-based, Visual Basic software program includes an extensive help file and a user's manual with working examples, as well as a report documenting the development, the sustaining theory, and the assumptions that led to the program.

First the project researchers measured the strain on full-sized steel bridges in the field to document the effects of the construction loads. Models were created from the strain data for finite element analyses, to develop an appropriate set of mathematical models. The parameters of these models were then varied to determine the effects.

The last step was to write, review, and test the TAEG program code. Refinements then were made, including the ability to add temporary support members to resist the imposed loads.

Application

Designers and engineers now are able to investigate the proposed structure of a new bridge during the design stage, determining if the permanent and temporary systems will work together under the construction loading conditions for the deck placement. Previously, the review had to wait until the contractor had submitted the plans for the falsework.

For rehabilitation work, such as redecking, the designer can consider the applicability of temporary supports, such as tension tie rods and timber compression struts, to augment the system (Figure 2). In the past, permanent connection stiffeners and cross frames

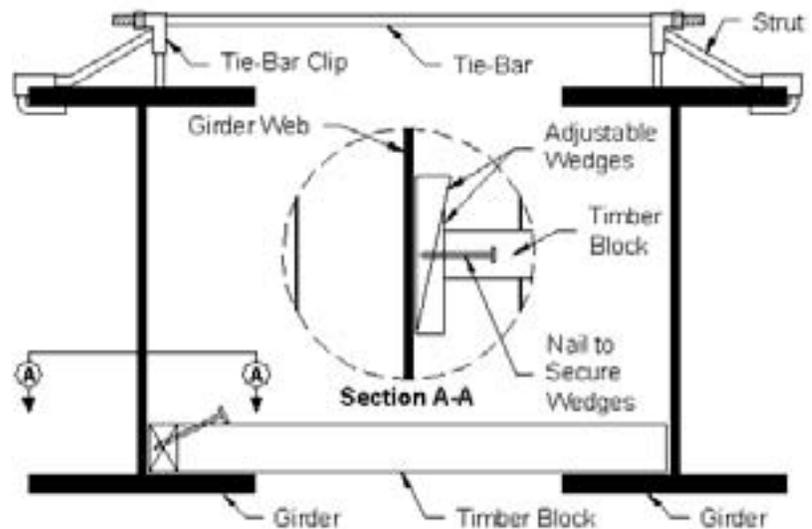


FIGURE 2 Temporary lateral support systems for rehabilitation work are design options in the software package.

sometimes had to be added for temporary loads.

Because these calculations are complex, a computer design tool is useful and valuable to bridge engineers. TAEG specifically evaluates stresses and deflections of the girder flanges, forces in the brackets, forces in the diaphragms and cross frames, and the effect of tension tie rods and timber compression struts on temporary supports. The software enables the engineer to make adjustments to the bridge members as a system under many variations.

Benefits

The TAEG software has reduced the number of hours that engineers had to spend in analyzing the design of falsework. The accuracy of the calculations has produced bridge decks with increased levels of riding smoothness and has increased safety for contractors and for the public.

According to Kansas DOT estimates, the TAEG software has saved the agency approximately \$570,000 over 3 years. More than 60 organizations—state DOTs, consulting firms, and contractors—have acquired the program and are using it for the torsional analysis of exterior girders. The software is available online.

For further information, contact John Patrick Jones, 785-296-0799, jjones@ksdot.org; or Paul Kulseth, 785-296-0549, kulseth@ksdot.org; Kansas DOT, 700 SW Harrison, Topeka, KS 66603-3754.

EDITOR'S NOTE: Appreciation is expressed to David Beal, Transportation Research Board, for his efforts in developing this article.

Suggestions for "Research Pays Off" topics are welcome. Contact G. P. Jayaprakash, Transportation Research Board, Keck 488, 500 Fifth Street, NW, Washington, DC 20001 (telephone 202-334-2952, e-mail gjayaprakash@nas.edu)

Steven R. Ditmeyer

Industrial College of the Armed Forces

In the early days of railroading, a person who changed jobs periodically was called a “boomer.” A modern-day example, Steven R. Ditmeyer has served in many capacities during his 45-year career in the railroad and transportation industries.

In the private sector, Ditmeyer has worked for six railroads and a railroad supplier. He also has served in the public sector as a military officer, a federal civil servant, and an international civil servant. His work has spanned several disciplines and endeavors, including engineering, economics, research and development (R&D), policy, marketing, management, and education. Throughout his career, Ditmeyer has remained dedicated to railroads and committed to the value of research.



“The future of the railroad industry lies with intelligent railroad systems and network-centric railroading.”

“Freight, intercity passenger, and commuter trains should play a larger role in the U.S. economy,” says Ditmeyer, who teaches economics and directs the transportation industry study at the Industrial College of the Armed Forces (ICAF), National Defense University, Washington, D.C. “The railroad industry and the federal government must invest more resources to develop and implement the new technologies that will enable railroads to play a larger role.”

Ditmeyer earned a bachelor’s degree in industrial management from Massachusetts Institute of Technology (MIT) in 1963, and he received a master’s degree in economics and the certificate in transportation from Yale University in 1965. During summers and after college, he learned practical railroading by working for several railroad companies. A graduate of the Army ROTC program at MIT, Ditmeyer served his active tour of duty with the Office of the Special Assistant for Strategic Mobility in the Organization of the Joint Chiefs of Staff.

In 1968, Ditmeyer joined the Federal Railroad Administration (FRA) in the Office of High-Speed Ground Transportation, where he managed the preliminary engineering and economic studies for the Northeast Corridor Project and participated in the creation of Amtrak and the establishment of the Transportation Technology Center in Pueblo, Colorado. He contracted with TRB to create the Railroad Research Information Service.

Between 1974 and 1977, Ditmeyer worked for the World Bank as a transportation economist, supervising railway, port, and pipeline projects. His duties included managing loans for infrastructure and rolling stock rehabilitation on railroads in Turkey, Tunisia, Algeria, Spain, and Portugal.

Ditmeyer returned to FRA in 1977 as associate administrator for policy. He coauthored “A Prospectus for Change in the Freight Railroad Industry,” conducted hearings, and helped develop federal legislation, known as the Staggers Act, that deregulated the railroad industry and improved the financial health of freight railroads.

In 1979, Ditmeyer moved to Anchorage and served as acting general manager of Alaska Railroad, which was then federally owned. He made the operation profitable and initiated transfer of the railroad to the state. Ditmeyer returned to FRA headquarters in 1980 as associate administrator for R&D. He oversaw the publication of “Railroad Freight Traffic Flows 1990,” the first commodity-specific, route-specific econometric forecast of railroad freight traffic flows.

In 1981 Ditmeyer joined Burlington Northern (BN) Railroad, where he established an R&D department. He served as director of R&D for 12 years, including 6 years as chief engineer of communications and control systems. Important projects initiated during his tenure at BN include the first communications-based positive train control system (known as ARES), natural gas-fueled locomotives, locomotive health monitoring, acoustic bearing detectors, heavy axle loads, radio frequency identification tags, and the first “glass cabs” that used CRTs and LCDs to display information to locomotive crew members.

Ditmeyer spent 2 years as vice president in the locomotive division of Morrison Knudsen Corporation, where he promoted new high-horsepower and natural gas-fueled locomotives and roll-on, roll-off intermodal train sets. He then rejoined FRA for a third stint in 1995 as R&D director, overseeing programs in system safety and security, human factors, rolling stock, track and structures, track–train interaction, train control systems, grade crossings, train occupant protection, and hazardous materials. Ditmeyer was instrumental in establishing the TRB Committee for Review of the FRA Research, Development, and Demonstration Programs. In addition, he managed FRA’s Year 2000 outreach activities and oversaw publication of FRA’s 5-year strategic plan for R&D.

He left FRA to assume the Department of Transportation faculty chair at ICAF in 2003. Ditmeyer believes that the future of the industry lies with intelligent railroad systems and what he calls “network-centric railroading.”

“All other modes of transportation are implementing digital data link communication networks, positioning systems, sensors, computers, and related technologies,” he explains. “If railroads follow suit, they could increase their traffic and improve their financial health, along with their safety, efficiency, and security.”

Jeffrey L. Western

Wisconsin Department of Transportation

Jeffrey L. Western considers research to be essential for producing technological and system enhancements that maintain a quality of life in an ever-changing world. Western notes that the world changed after the September 11, 2001 (9/11), terrorist attacks, and that the transportation community responded by forming the Cooperative Security Research Program. The \$8.5 million program has conducted more than 60 research, development, and technology projects under the guidance of the American Association of State Highway and Transportation Officials (AASHTO) and TRB.

“We need to adjust to the post-9/11 world by researching and developing new systems, processes, and technologies that improve safety and security,” Western says. “The Cooperative



“We need to adjust to the post-9/11 world by researching and developing new systems, processes, and technologies that improve safety and security.”

Research Security Program provides a wealth of information and tools to assist transportation agencies in planning and responding to incidents—whether a tornado, an earthquake, a traffic accident, or a terrorist attack.”

After 9/11, the Wisconsin Department of Transportation (DOT) named Western to the newly created post of director of infrastructure security. He manages the DOT’s security assessments of highway, railway, maritime, and aviation infrastructures; in addition, he conducts mitigation planning and continuity of operations planning. Western recommends that all transportation agencies—no matter how large or small—should have a plan to ensure that processes and procedures are in place in the event of an incident, so that operations can continue.

Western is active in the statewide, regional, and national coordination of security efforts of the Department of Homeland Security, the Transportation Security Administration, AASHTO, and TRB. He is a member of security workgroups and committees that support Wisconsin Emergency Management and the Office of Justice Assistance in setting and implementing state security strategies.

In addition, Western has taken a lead in TRB’s security research activities as a member of the Policy and Organization Group and as chair of the Critical Transportation Infrastructure Protection Committee. He also serves on the AASHTO Special Committee on Transportation Security.

Western chairs the National Cooperative Highway Research Program Project, Guide to Risk Management of Multimodal Transportation Infrastructure, which will provide an assessment tool for measuring vulnerability and assessing critical intermodal transportation infrastructures, including rail, maritime, general aviation airports, and transportation facilities.

Western notes that agencies should take advantage of intelligent transportation systems (ITS) to improve security. ITS technologies, such as cameras, intrusion equipment, motion detectors, lights, traffic controls, and messaging signs, can be applied as countermeasure solutions to mitigate security vulnerability. He recommends that agencies develop long-range voice, and data communication plans so that agencies can correspond during an incident.

Western joined Wisconsin DOT in 1994 as director of engineering operations for information technology (IT), project management, and research coordination. He conceived the Council on Research, a departmental workgroup that provides guidance in selecting the DOT’s research projects. Western also worked with the University of Wisconsin to form the Midwest Regional University Transportation Center, which opened in 2000.

In 1996, Wisconsin DOT selected Western as deputy chief information officer, to oversee IT application and infrastructure design, development, implementation, and support. He coordinated the launching of the DOT’s Internet, intranet, and extranet.

Western received a bachelor’s degree in civil engineering from the University of Wisconsin, Madison, and a master’s degree in civil engineering from the Illinois Institute of Technology. He is a registered professional engineer in Wisconsin and Illinois and a registered structural engineer in Illinois.

Western began his career in 1975 by conducting structural and mechanical design for the power industry. He performed seismic and earthquake analysis of fossil fuel and nuclear power facilities for the Chicago firm, Sargent and Lundy Engineers.

In the 1980s, Western supported high-energy research for Fermilab National Accelerator Laboratory in Illinois. He engineered structural and mechanical equipment for the high-energy physics community. Western received the Fermilab Energy Conservation Award for the design of a physics toroid, which extracts stray muons from a proton beam field.

While working for the Superconducting Super Collider Laboratory between 1992 and 1994, Western oversaw the design of highways, railways, surface facilities, and underground tunnels for a \$10 billion, high-energy physics underground colliding proton ring facility. Western presented two security-related papers at the 2005 TRB Annual Meeting with coauthor Yuko Nakanishi, on advanced vehicle identification and biometric technologies.



Traffic Congestion Rises in Intensity, Cost

Traffic congestion is increasing across the nation despite slow growth in jobs and travel, costing Americans \$63.1 billion a year, according to the 2005 Urban Mobility Study published by the Texas Transportation Institute (TTI). The report measures traffic congestion trends from 1982 to 2003, reflecting the most recent data available. According to the report, if today's higher fuel prices are factored in, the cost of congestion would increase by another \$1.7 billion.

The leading city for traffic delays is Los Angeles, California, where motorists are delayed an average of 93 hours a year. San Francisco, California, is next with 72 hours, followed by Washington, D.C., 69 hours; Atlanta, Georgia, 67 hours; and Houston, Texas, 63 hours.

The TTI study ranks areas according to several measures, including annual delay per peak-period traveler, which has grown from 16 hours to 47 hours since 1982; number of urban areas with more than 20 hours of annual delay per peak traveler, which has grown from only 5 in 1982 to 51 in 2003; total amount of delay, which reached 3.7 billion hours in 2003, and wasted fuel, which totaled 2.3 billion gallons lost to engines idling in traffic.

"There is no single solution that can reverse the growth in congestion," concludes study author Tim Lomax, a research engineer at TTI. "Congestion is a complicated issue....We need to think about how policies and programs enacted at the federal, state, and local levels affect congestion."

For more information, go to <http://mobility.tamu.edu/ums/>.

Wild Animals Try Out Tunnel Crossings

Wild animals and some birds are using specially constructed tunnels under several Virginia roadways, according to a study by the Virginia Transportation Research Center (VTRC). The tunnels enable wildlife to cross pavements without becoming roadkill and without endangering traffic.

VTRC scientist Bridget Donaldson reports that more than 2,000 infrared photos taken in seven Virginia Department of Transportation (DOT) tunnels show deer, coyotes, a bear, and a Great Blue Heron crossing under the highways.

About 200 of the nearly 44,000 annual U.S. traffic fatalities are caused by collisions with animals. The Centers for Disease Control and Prevention estimates that 247,000 crashes in the United States in 2000 involved animals.

Donaldson's preliminary results show nearly 1,000 instances of deer crossing at three of the sites, plus more than 1,000 crossings by other animals, including raccoons, opossums, coyotes, ground-hogs, cats, and squirrels.



Infrared camera captures black bear approaching underpass below I-64 in Virginia.

"Money spent on wildlife crossings may seem an unnecessary addition to construction costs; however, the savings associated with reduced human injury and mortality and vehicular damage as a result of effective wildlife crossings can offset the cost of crossing installations," Donaldson notes. VTRC is a joint partnership of Virginia DOT and the University of Virginia.

To view photographs from the VTRC study, go to <http://www.virginiadot.org/infoservice/news/is-newsCritters.asp>.

Quiet Pavement Website Debuts

Julius Caesar banned wheeled vehicles in Rome in 44 B.C. during daylight hours to reduce noise on the city's cobblestone roads, according to a new interactive website, quietpavement.com, sponsored by the Asphalt Pavement Alliance to demonstrate "the impact of road noise in our lives, as well as methods for reducing road noise using hot-mix asphalt."



The site includes videos and sound recordings, research and resource files, and links to related sites, as well as a section on how noise is measured and another called “Sound Town USA,” which suggests ways to reduce road noise near homes. For example, the website offers decibel readings to show that trees and shrubs do little to muffle the sound of road noise for homeowners; only a “football field of trees between [a] house and [a] road [can] begin reducing noise,” according to the text.

For more information, <http://www.quietpavement.com/home.html>.

Maritime Administration Certifying Security Courses

The U.S. DOT Maritime Administration (MARAD) is evaluating and certifying maritime security training courses to promote high-quality, uniform training of professionals. To be eligible for certification, training providers must be authorized to conduct business under federal law and must conduct the training in the United States or aboard a U.S. flag vessel.

Initially, the voluntary course approval program is evaluating only instructor-led maritime security officer training courses. The courses were developed by staff at the U.S. Merchant Marine Academy (MMA), in collaboration with counterparts in India and in coordination with the U.S. Coast Guard, and include Vessel Security Officer, Company Security Officer, and Facility Security Officer.

The U.S. MMA is also developing courses on maritime security for vessel personnel; facility personnel; military, security, and law enforcement personnel; and on maritime security awareness.

For more information, contact program coordinator Christopher E. Krusa, 202-366-2648, chris.krusa@marad.dot.gov.

PEOPLE IN TRANSPORTATION

Boardman Becomes FRA Administrator

Joseph H. Boardman was confirmed by the U.S. Senate as the new administrator of the Federal Railroad Administration (FRA) on April 29. He has served as commissioner of transportation for New York since July 1997 and had begun a one-year term as chair of the TRB Executive Committee in January 2005.

Before becoming commissioner, Boardman was first deputy commissioner and assistant commissioner for the Office of Public Transportation. He came to New York State DOT after holding several transportation management positions in the state, including chief operating officer of Progressive Transportation Services in Elmira; commissioner of Public Transportation in Broome County; manager of Rome Transportation and Rome Parking Authority; and general manager of Utica Transit Authority. In 1983, he helped found the New York Public Transit Association and was president from 1987 to 1989.

Boardman has served as president of the Northeast Association of State Transportation Officials and chair of the American Association of State Highway and Transportation Officials Standing Committee on Rail Transportation. For TRB, Boardman has served on the Transit Fleet Maintenance Committee, the Transit Cooperative Research Program Project Panel on Reliability-Based Procedures for Maintenance of Transit Vehicles, the Subcommittee on Planning and Policy Review, and the Subcommittee for National Research Council Oversight.

He received a master of science degree in management science from the State University of New York at Binghamton and a bachelor's degree in agricultural economics from Cornell University.



Boardman

INTERNATIONAL NEWS

Low Macrottexture Raises Accident Risk

The risk of crashes increases on roadways with low macrottexture, according to a report by the Australian Transport Safety Bureau. Macrottexture refers to a roadway's large-scale roughness, that is, the variations in the road surface, which can range from 0.5 mm to 50 mm. The report does not identify the precise value of macrottexture at which the crash risk begins to rise.

For two highway sections, the study found that 30 percent and 36.5 percent of crashes occurred at low macrottexture sites, and that an estimated 13 to 17 percent decrease in crashes might occur by treating all low macrottexture sites. The study found that 21 percent of one section and 29 percent of the

other would need to be resurfaced to achieve this safety level. Improvements could target high-risk sites, such as intersections and curves.

The study recommends that additional research examine the relationship between crash risk and macrottexture in detail, taking into account intersections, road geometry, and road-surfacing materials and techniques. A study of vehicle braking distance on surfaces with different macrottexture also would provide practical guidance for situations that may require increased macrottexture.

For more information about the findings, go to <http://www.atsb.gov.au/road/res-exec/cr223ex.cfm>.



Njord

Njord to Chair TRB Executive Committee

John R. Njord, Executive Director of the Utah Department of Transportation (DOT), succeeded Joseph H. Boardman as Chair of the TRB Executive Committee in May, after Boardman was confirmed as administrator of the U.S. Department of Transportation's Federal Railroad Administration.

Njord will complete the chair's 2005 term, which runs through January 25, 2006; he has been a member of the TRB Executive Committee since 2004. Before becoming executive director of Utah DOT in 2001, Njord served as the department's deputy director and chief engineer. As director of transportation planning for the Salt Lake Organizing Committee, he held responsibility for transportation planning for the 2002 Winter Olympic Games.

Njord also was Utah's Engineer for Urban Plan-

ning, Local Government Liaison, and Construction Field Engineer. He is the immediate past President of the American Association of State Highway and Transportation Officials (AASHTO) and has served as Chair of the AASHTO Standing Committee on Environment. He chairs the National Cooperative Highway Research Program Project Panel on How State DOTs and Other Transportation Agencies Need to Respond to Changing Customer Needs.

Njord was named Utah Communicator of the Year by the Public Relations Society of America in 2002. He is a graduate of the University of Utah with a bachelor's degree in civil engineering. He is a registered professional engineer and a member of the American Society of Civil Engineers.

State Representatives Share Research Updates

TRB representatives from 43 state DOTs gathered for their biennial meeting, May 23–24, at the Keck Center of the National Academies in Washington, D.C. The reps serve as TRB liaisons to the state DOTs.

In addition to receiving updates on TRB activities and on research-related legislation, attendees participated in discussions on sharing information and communications and on strengthening the TRB–state DOT partnership. Attendees were briefed on the plans of the American Association of State Highway and Transportation Officials and TRB to commemorate the 50th anniversary of the Interstate Highway System and heard reports on the latest research news from several states.

The agenda also included a tour of the Federal Highway Admin-



Michael Shea, Missouri DOT, briefs the biennial meeting of TRB state representatives, May 23, on the new Missouri Transportation Institute. Seated, left to right: Ahmad Ardani, Colorado DOT; and Lieska Halsey, Nebraska Department of Roads.



TRB Executive Director Robert E. Skinner, Jr. (right) and staff meet with state representatives between sessions. Left to right: Matthew Moore, Idaho Transportation Department; TRB Senior Program Officer Kimberly Fisher; TRB Technical Activities Director Mark Norman; and Richard McReynolds, Kansas DOT.

istration's Turner-Fairbank Highway Research Center in McLean, Virginia. Eric Peterson, Deputy Administrator of the U.S. DOT's newly formed Research and Innovative Technology Administration, described the mission of the new organization, composed of staff from the former Research and Special Programs Administration's Office of Innovation, Research, and Education, as well as the Volpe National Transportation Systems Center in Cambridge, Massachusetts; the Transportation Safety Institute in Oklahoma City, Oklahoma; the Office of Intermodalism; and the Bureau of Transportation Statistics.

The meeting concluded with reports from the research offices of the modal administrations of the U.S. DOT, the Department of Energy's Argonne National Laboratory, the Environmental Protection Agency, and the U.S. Army Corps of Engineers.



WHERE THE RUBBER MEETS THE ROAD—The Committee for the National Tire Efficiency Study examined the relationships among traction, tread life, and rolling resistance of light-duty passenger vehicle tires during its first meeting, April 4–5. This study will consider how passenger car tires with lower rolling resistance can affect motor vehicle fuel consumption, safety, tire longevity, and tire disposal rates. Mike Wischhusen (far right), Michelin North America, gave a presentation on the tire’s main structural components, role in handling and traction, and energy use.



CONSIDERING INITIATIVES—The TRB Executive Committee’s Subcommittee on Planning and Policy Review conducted its semiannual meeting in March to review proposals for new TRB studies and conferences and to discuss and approve other policy and program initiatives. Left to right: TRB Cooperative Research Programs Director Bob Reilly, Technical Activities Director Mark Norman, and Executive Committee Vice Chair Michael D. Meyer of Georgia Institute of Technology listen to comments by Maryland State Highway Administrator Neil Pedersen, Chair of the Technical Activities Council.

Academy Inducts Marine Board Member

The National Academy of Engineering (NAE) elected 74 new members and 10 foreign associates in February, including a member of the TRB Marine Board, Kenneth E. Arnold. Election to NAE is among the highest professional distinctions accorded an engineer, acknowledging outstanding contributions to “engineering research, practice, or education, including...significant contributions to the engineering literature.”

Arnold, a member of the Marine Board since 2004, is CEO of Paragon Engineering Services, Inc., Houston. He previously served for 16 years as an engineer and engineering group manager for Shell Oil Company. Arnold was the first director of facilities and construction on the board of the Society of Petroleum Engineers (SPE) and was executive editor of the *SPE*

Production and Facilities Journal. He is coauthor of a two-volume textbook series and of many technical articles and has taught facilities design at the University of Houston.

Arnold is the second Marine Board member named to NAE in two years—Charles R. Cushing, president of C.R. Cushing & Co., Inc., a firm of naval architects, marine engineers, and transportation consultants, was inducted into NAE in 2004. Cushing has been responsible for preparation of the U.S. Coast Guard *Tanker-man’s Manual* and holds several patents in maritime and intermodal technology. He is currently a visiting professor at the World Maritime University and a member of the Naval Reserve.

The list of 2005 NAE inductees also includes R. Shankar Nair, Principal and Senior Vice President, Teng & Associates, Chicago, who served as a member of the TRB Concrete Bridges Committee, 1981–1990.



FUNDING HIGHWAY RESEARCH—The American Association of State Highway and Transportation Officials Standing Committee on Research (SCOR) held a three-day meeting in Washington, D.C., in March to allocate funding for NCHRP projects for FY 2006. Out of 163 project requests totaling \$58 million, the committee provided \$10.3 million to continue 22 projects, \$17.3 million to fund 38 new projects, and \$4.9 million for 13 contingent projects. The highway research areas assigned the most projects include traffic safety, bridge engineering, transportation planning, and environment. From left: TRB Executive Director Robert E. Skinner, Jr.; SCOR Vice Chair Wesley Lum, California Department of Transportation; and SCOR Chair Victor Mendez, Arizona Department of Transportation.

Perspectives on Intelligent Transportation Systems

Joseph Sussman. Springer, New York, 2005; 229 pp.; \$125 hardcover; 0-387-23257-5.

The book contains a collection of the author's writings on intelligent transportation systems topics, including the history and future of the field, organizational issues involving regionalism and transportation-information infrastructure, and implications for the transportation profession and for education. Sussman, a professor of civil and environmental engineering at Massachusetts Institute of Technology, is a former chair of the TRB Executive Committee.



The High Cost of Free Parking

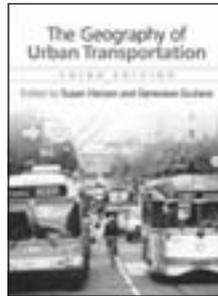
Donald Shoup. American Planning Association, Illinois, 2004; 734 pp.; \$59.95 hardcover; 1-884829-98-8.

Free parking carries indirect costs to consumers, distorts transportation choices, warps urban form, and degrades the environment, the author maintains. Shoup proposes that cities regulate parking by charging fair market prices for curb parking, using the resulting revenue to pay for neighborhood services, and removing zoning requirements for off-street parking. The author is a member of the Transit Cooperative Research Program Project Panel to Evaluate the Impact of New Transit, Vanpool, and Qualified Parking Tax Benefits Under TEA-21.

The Geography of Urban Transportation, Third Edition

Edited by Susan Hanson and Genevieve Giuliano. The Guilford Press, New York, 2004; 419 pp.; \$60 hardcover; 1-59385-055-7.

Hanson and Giuliano, both members of the TRB Executive Committee, have revised a classic publication to update coverage of key research questions in urban planning, including travel trends by people, goods, and information; links between urban form and travel behavior; environmental impacts; and technical, political, and financial aspects of the planning process. Updated throughout with an emphasis on policy, the third edition contains new chapters on intercity travel and transportation finance.



ASTM Standards on Transportation Applications: Volumes 1-3

ASTM International, Pennsylvania, 2004; 4,349 pp.; \$795 for United States and \$875 for International; 0-8031-3337-5.



Compiled from nine volumes of the *Annual Book of ASTM Standards*, this publication provides 743 standards relevant to transportation and highway engineering. Developed by 11 ASTM technical committees, the standards apply to cement, concrete and concrete aggregates, mortars and grouts for unit masonry, concrete pipe, manufactured masonry units, road and paving materials, soil and rock, geosynthetics, vehicle-pavement systems, environmental assessment, risk management and corrective action, and plastic piping systems.

The books in this section are not TRB publications. To order, contact the publisher listed.

TRB PUBLICATIONS

Safety of U-Turns at Unsignalized Median Openings

NCHRP Report 524

Guidelines are traced for locating and designing openings in unsignalized medians. A methodology is included for comparing the relative safety performance of different designs.

2004; 133 pp.; TRB affiliates, \$18; TRB nonaffiliates, \$24. Subscriber category: highway and facility design (IIA).



Surface Transportation Security—Responding to Threats: A Field Personnel Manual

NCHRP Report 525, Volume 1

This report provides a draft template for basic secu-

rity-awareness training in a workbook format, which can be redesigned according to user needs. The manual is designed to assist transportation officials and others responsible for establishing and communicating employee practices for observing and reporting security threats.

2004; 17 pp.; TRB affiliates, \$13.50; TRB nonaffiliates, \$18. Subscriber categories: planning and administration (IA); safety and human performance (IVB); public transit (VI); rail (VII); aviation (V); freight transportation (VIII); marine transportation (IX).

Surface Transportation Security—Information Sharing and Analysis Centers: Overview and Supporting Software Features

TRB PUBLICATIONS (continued)**NCHRP Report 525, Volume 2**

Transportation organizations are looking for ways to organize and share security threat information with one another. This report compares existing software that can be used, presents concerns to be considered, and offers other necessary background information.

2004; 228 pp.; TRB affiliates, \$21; TRB nonaffiliates, \$28. *Subscriber categories: planning and administration (IA); energy and environment (IB); transportation law (IC).*

Snow and Ice Control:**Guidelines for Materials and Methods****NCHRP Report 526**

Guidelines are traced for selecting roadway snow and ice control strategies in a range of winter maintenance operating conditions.

2004; 39 pp.; TRB affiliates, \$14.25; TRB nonaffiliates, \$19. *Subscriber category: maintenance (IIIC).*

Integral Steel Box-Beam Pier Caps**NCHRP Report 527 with appendix on CD-ROM**

This report contains recommended details, design methodologies, specifications, and a design example for integral connections of steel superstructures to concrete intermediate piers. The accompanying CD-ROM provides information from the laboratory testing.

2004; 89 pp.; TRB affiliates, \$24; TRB nonaffiliates, \$32. *Subscriber category: bridges, other structures, and hydraulics and hydrology (IIC).*

Access Management on Crossroads in the Vicinity of Interchanges**NCHRP Synthesis 332**

Freeway and highway interchanges provide access to major activity centers and developments. Maintaining interchange operations requires maintaining operations of crossroads in the vicinity. This synthesis documents the current state of the practice in locating and controlling access on crossroads near interchanges. It describes, analyzes, and synthesizes pertinent literature; summarizes access management practices by states, provinces, toll authorities, and local agencies; and provides case studies and examples that illustrate access management practices.

2004; 82 pp.; TRB affiliates, \$12.75; TRB nonaffiliates, \$17. *Subscriber categories: planning and administration (IA); transportation law (IC); highway and facility design (IIA); highway operations, capacity, and traffic control (IVA).*

Concrete Bridge Deck Performance**NCHRP Synthesis 333**

The deterioration of concrete bridge decks through

concrete distress and reinforcement corrosion is one of the leading causes of structural deficiency. This synthesis provides information on design and construction practices to improve the performance of concrete bridge decks. Also discussed are North American practices for cast-in-place reinforced concrete bridge decks on steel beams and concrete beams, barrier systems designed to protect primary concrete and reinforcement from deterioration, factors that contribute to durability, specific successes and failures, cracking, and life-cycle costs.

2004; 101 pp.; TRB affiliates, \$13.50; TRB nonaffiliates, \$18. *Subscriber categories: pavement design, management, and performance (IIB); bridges, other structures, and hydraulics and hydrology (IIC); materials and construction (IIIB); maintenance (IIIC).*

Traveler Response to Transportation System Changes: Chapter 13—Parking Pricing and Fees
TCRP Report 95, Chapter 13

The TCRP Report 95 series comprehensively documents transportation system changes, policy actions, and alternative land use and site development design approaches. This third edition covers 18 topic areas to be published as stand-alone chapters.

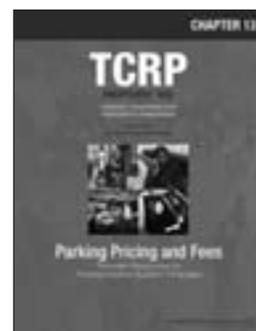
Chapter 13 addresses traveler response to the introduction of parking pricing and fees and to changes in the level, structure, or method of application of parking fees. Actions that can change the costs to users of parking even without fee changes—such as eliminating employer parking subsidies—also are examined.

2005; 49 pp.; TRB affiliates, \$15; TRB nonaffiliates, \$20. *Subscriber categories: planning and administration (IA); highway operations, capacity, and traffic control (IVA); public transit (VI).*

Strategies to Increase Coordination of Transportation Services for the Transportation Disadvantaged**TCRP Report 105 with appendix on CD-ROM**

Strategies useful to practitioners and policy makers in agencies and organizations that plan, provide, administer, and fund transportation services for persons with disabilities, clients of human services agencies, and others who can be described as transportation disadvantaged are presented in this report. An accompanying CD offers case studies, a guide to funding resources, and other documentation.

2004; 77 pp.; TRB affiliates, \$23.25; TRB nonaffiliates, \$31. *Subscriber categories: planning and administration (IA); public transit (VI).*



TRB PUBLICATIONS (continued)



**Geographic Information Systems
Applications in Transit**

TCRP Synthesis 55

This overview of geographic information systems in transit planning and operations focuses on bus systems. The report addresses data collection and maintenance; schedule reviewing; infrastructure, operations, and planning; human capital, hiring, training, professional development, and organizational structures; information technology; vehicle and facility management; route and facility planning; safety, security, and incident response; and customer relations and real-time customer information.

2004; 60 pp.; TRB affiliates, \$12; nonaffiliates, \$16.
Subscriber category: public transit (VI).



**Smart Growth and Transportation:
Issues and Lessons Learned**

Conference Proceedings 32

This report summarizes the highlights of a conference—Providing a Transportation System to Support Smart Growth: Issues, Practice, and Implementation—held September 8–10, 2002, in Baltimore, Maryland. The conference was designed to address how transportation policy makers and frontline professionals can support the diverse goals that different communities associate with smart growth.

2005; 174 pp.; TRB affiliates, \$41.25; nonaffiliates \$55; Subscriber category: planning and administration (IA).



**Transit: Intermodal Transfer Facilities, Rail
Transit, Commuter Rail, Light Rail, Ferry, and
Major Activity Center Circulation Systems**

Transportation Research Record 1872

Authors examine integrating capacity, access, and land use planning at rail transit stations in the San Francisco Bay Area; a geographic information system–based disaggregate modeling approach to assess transfer penalty; a data analysis method for the U.S. heavy rail industry; and rail access pricing for suburban services in Europe.

2004; 79 pp.; TRB affiliates, \$30.75; nonaffiliates, \$41.
Subscriber category: public transit (VI).

**Intermodal Freight Transportation:
Freight Transportation Planning**

Transportation Research Record 1873

The volume presents preliminary results of an experimental economics application to urban goods modeling research, methodology for modeling a road network with high truck volumes generated by vessel freight activity from an intermodal facility, formulas for estimating the average distance traveled in

vehicle routing problems in elliptic zones, and the challenges for intermodal freight logistics in Europe and the United States.

2004; 125 pp.; TRB affiliates, \$33; nonaffiliates, \$44.
Subscriber category: freight transportation (VIII).

**Geology and Properties of Earth Materials 2004
Transportation Research Record 1874**

This four-part volume presents research on aggregate properties and unbound aggregate base materials, waste and recycled materials, soil properties and geological engineering issues, and seasonal variations and spring load restrictions. Papers highlight a novel approach for the characterization of unbound materials; the use of recycled and waste materials in Indiana; the correlation between resilient modulus, moisture variation, and soil suction for subgrade soils; and a framework for analyzing effects of spring load restrictions.

2004; 188 pp.; TRB affiliates, \$39; nonaffiliates, \$52. Subscriber category: soils, geology, and foundations (IIIA).

Bituminous Binders 2004

Transportation Research Record 1875

The volume gathers papers on a variety of topics, including the essential and plastic work of ductile fractures in asphalt binders, a new criterion for Superpave® high-temperature binder specification, initial validation of a new surface performance-graded binder specification, and an evaluation of a modified German rotating flask to age polymer-modified binders.

2004; 88 pp.; TRB affiliates, \$32.25; nonaffiliates, \$43. Subscriber category: materials and construction (IIIB).

**Calibration and Validation of
Simulation Models 2004**

Transportation Research Record 1876

Papers assembled in this volume focus on traffic simulation models, including the calibration of microscopic traffic simulation models with aggregate data, an analysis of distribution and calibration of car-following sensitivity parameters in microscopic traffic simulation models, a systematic validation of a microscopic traffic simulation program, and the development and calibration of a large-scale microscopic traffic simulation model.

2004; 158 pp.; TRB affiliates, 37.50; nonaffiliates, \$50.
Subscriber category: highway operations, capacity, and traffic control (IVA).

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FEATURES are timely articles of interest to transportation professionals, including administrators, planners, researchers, and practitioners in government, academia, and industry. Articles are encouraged on innovations and state-of-the-art practices pertaining to transportation research and development in all modes (highways and bridges, public transit, aviation, rail, and others, such as pipelines, bicycles, pedestrians, etc.) and in all subject areas (planning and administration, design, materials and construction, facility maintenance, traffic control, safety, geology, law, environmental concerns, energy, etc.). Manuscripts should be no longer than 3,000 to 4,000 words (12 to 16 double-spaced, typewritten pages). Authors should also provide appropriate and professionally drawn line drawings, charts, or tables, and glossy, black-and-white, high-quality photographs with corresponding captions. Prospective authors are encouraged to submit a summary or outline of a proposed article for preliminary review.

RESEARCH PAYS OFF highlights research projects, studies, demonstrations, and improved methods or processes that provide innovative, cost-effective solutions to important transportation-related problems in all modes, whether they pertain to improved transport of people and goods or provision of better facilities and equipment that permits such transport. Articles should describe cases in which the application of project findings has resulted in benefits to transportation agencies or to the public, or in which substantial benefits are expected. Articles (approximately 750 to 1,000 words) should delineate the problem, research, and benefits, and be accompanied by one or two illustrations that may help readers better understand the article.

NEWS BRIEFS are short (100- to 750-word) items of interest and usually are not attributed to an author. They may be either text or photographic or a combination of both. Line drawings, charts, or tables may be used where appropriate. Articles may be related to construction, administration, planning, design, operations, maintenance, research, legal matters, or applications of special interest. Articles involving brand names or names of manufacturers may be determined to be inappropriate; however, no endorsement by TRB is implied when such information is used. Foreign news articles should

describe projects or methods that have universal instead of local application.

POINT OF VIEW is an occasional series of authored opinions on current transportation issues. Articles (1,000 to 2,000 words) may be submitted with appropriate, high-quality illustrations, and are subject to review and editing. Readers are also invited to submit comments on published points of view.

CALENDAR covers (a) TRB-sponsored conferences, workshops, and symposia, and (b) functions sponsored by other agencies of interest to readers. Notices of meetings should be submitted at least 4 to 6 months before the event.

BOOKSHELF announces publications in the transportation field. Abstracts (100 to 200 words) should include title, author, publisher, address at which publication may be obtained, number of pages, price, and ISBN. Publishers are invited to submit copies of new publications for announcement.

LETTERS provide readers with the opportunity to comment on the information and views expressed in published articles, TRB activities, or transportation matters in general. All letters must be signed and contain constructive comments. Letters may be edited for style and space considerations.

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Alert to Security

Since September 11, 2001, citizens and government have looked to the scientific and engineering research community to develop faster and more effective ways to detect, thwart, and respond to terrorist attacks on the transportation system. The Transportation Research Board (TRB) has assembled and published extensive information on ways to enhance the nation's transportation security. In addition to a wide-ranging transportation system security website (www4.TRB.org/trb/homepage.nsf/web/security), TRB has developed a bookshelf of resources and guides for transportation professionals, decision makers, and members of the general public. Select TRB publications of interest are listed below—a more comprehensive list of security publications produced by TRB and other parts of the National Academies is available on the web at www.TRB.org/SecurityPubs.

Incorporating Security into the Transportation Planning Process

National Cooperative Highway Research Program (NCHRP) Report 525, Vol. 3, ISBN 0-309-08803-8, 58 pages, 8.5 x 11, paperback, \$20 (2005)

Information Sharing and Analysis Centers: Overview and Supporting Software Features

NCHRP Report 525, Vol. 2, ISBN 0-309-08803-8, 228 pages, 8.5 x 11, paperback, \$28 (2004)

Responding to Threats: A Field Personnel Manual

NCHRP Report 525, Vol. 1, ISBN 0-309-08803-8, 17 pages, 8.5 x 11, paperback, \$18 (2004)

Marine Salvage Capabilities: Responding to Terrorist Attacks in U.S. Ports—Actions to Improve Readiness

TRB Conference Proceedings 30, ISBN 0-309-09459-3, 38 pages, 8.5 x 11, paperback, \$29 (2004)

Security-Related Customer Communications and Training for Public Transportation Providers

Transit Cooperative Research Program (TCRP) Report 86, Vol. 5, 0-309-06760-X, CD-ROM, \$40 (2004)

Security Measures in the Commercial Trucking and Bus Industries

Commercial Truck and Bus Safety Synthesis Program (CTBSSP) Synthesis 2, ISBN 0-309-08755-4, 48 pages, 8.5 x 11, paperback, \$15 (2003)

Cybersecurity of Freight Information Systems: A Scoping Study

TRB Special Report 274, ISBN 0-309-08555-1, 80 pages, 6 x 9, paperback, \$21 (2003)

Transportation Security and Infrastructure Protection

Transportation Research Record: Journal of the Transportation Research Board, No. 1822, ISBN 0-309-08554-3, 55 pages, 8.5 x 11, paperback, \$37 (2003)

Deterrence, Protection, and Preparation:

The New Transportation Security Imperative

TRB Special Report 270, ISBN 0-309-07710-9, 84 pages, 6 x 9, paperback, \$20 (2002)

K9 Units in Public Transportation:

A Guide for Decision Makers

TCRP Report 86, Vol. 2, ISBN 0-309-06760-X, 120 pages, 8.5 x 11, paperback, \$18 (2002)



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