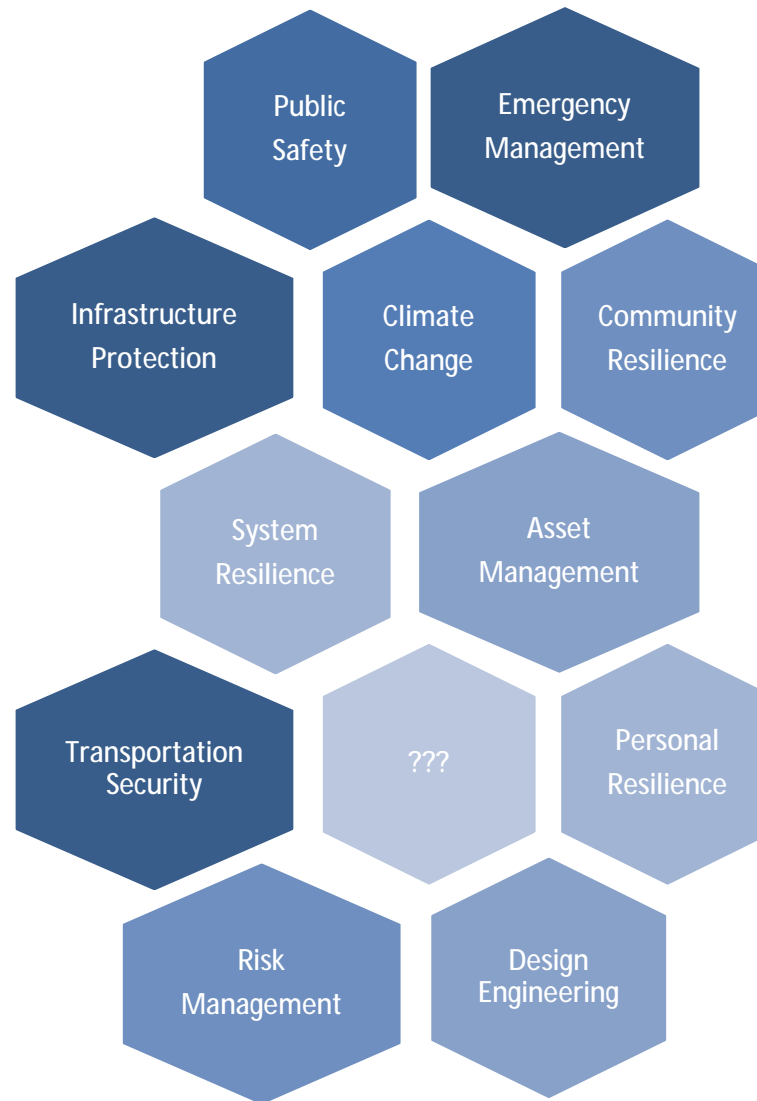




Resilience: Key Products & Projects

May 2017



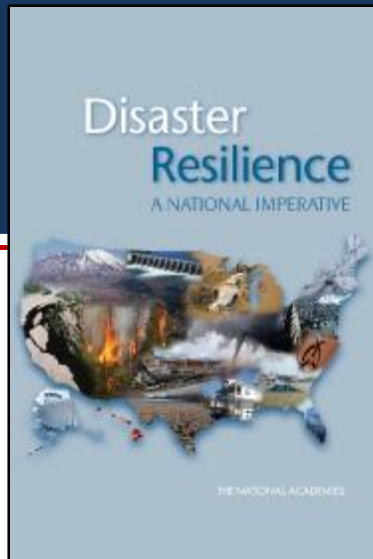
The Transportation Resilience Honeycomb.

Source: Understanding Transportation Resilience: A 2016-2018 Roadmap, Fletcher and Ekern (August 2016)

TRANSPORTATION RESEARCH BOARD

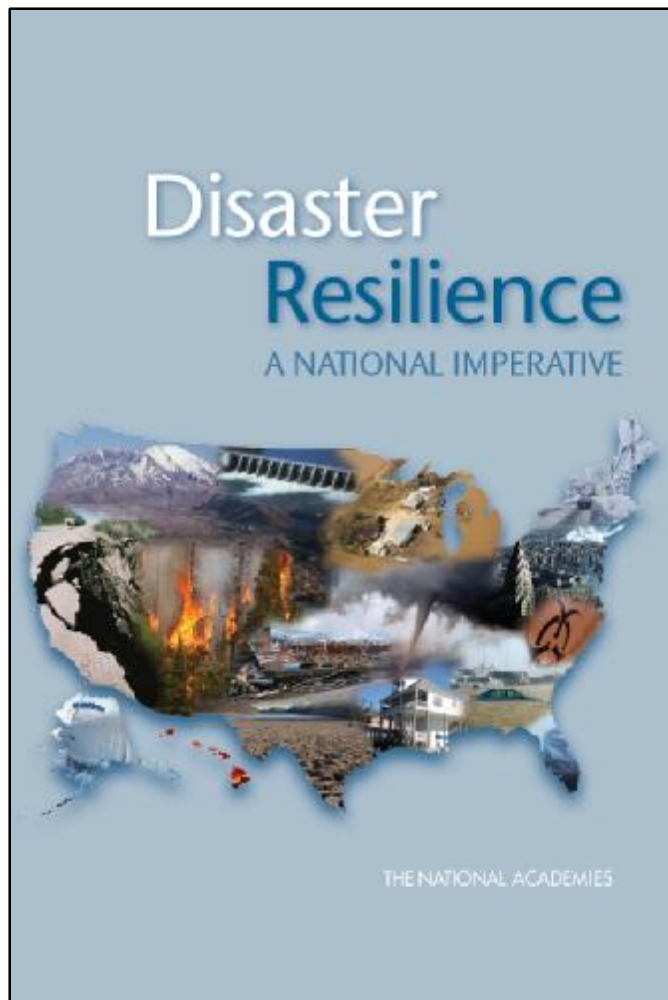
Presentation Outline

- Definition and context for resilience
- Introduction to TRB & hot topics
- Overview of TRB work in resilience
- Key products for all hazards, all modes
- Catalog of completed work and work in progress



The ability to **prepare** and **plan for**,
absorb, recover from, or more
successfully **adapt** to actual or potential
adverse events.

DISASTER RESILIENCE: A NATIONAL IMPERATIVE



Four major recommendations

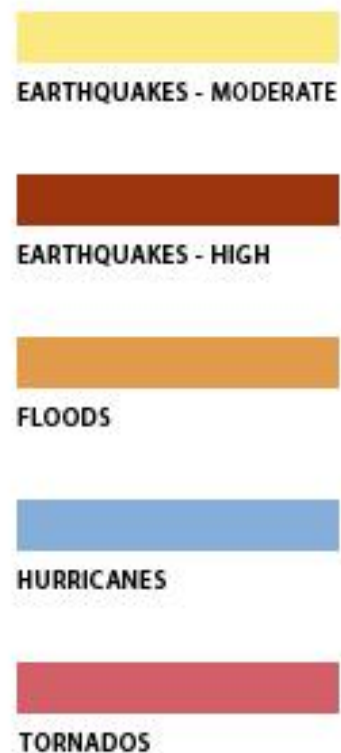
- **Manage and communicate** risk
- **Measure resilience** in communities
- Build community partnerships and **coalitions**
- **Share information and data** to build **resilient communities**

FOUR WORKSTREAMS

1. Community Pilot Program
2. Workshops, Expert Meetings, and Activities
3. Measures and Metrics of Resilience
4. Economic Supply Chain Resilience

Seattle, Washington

Cedar Rapids, Iowa



Tulsa, OK

Charleston, SC

The Hazards and Disaster Management System

Pre-Impact Interventions

Mitigation Practices
Emergency Preparedness Practices
Recovery Preparedness Practices

Post-Impact Responses

Emergency Activities
(planned and improvised)
Recovery Activities
(planned and improvised)

Hazard Vulnerability

Hazard Exposure
Physical Vulnerability
Social Vulnerability

EVENTS

Disaster Impacts

Physical
Social

Disaster Event Characteristics

Frequency	Magnitude of Impact
Predictability	Scope of Impact (spatial and social)
Controllability	Duration of Impact
Length of Forewarning	

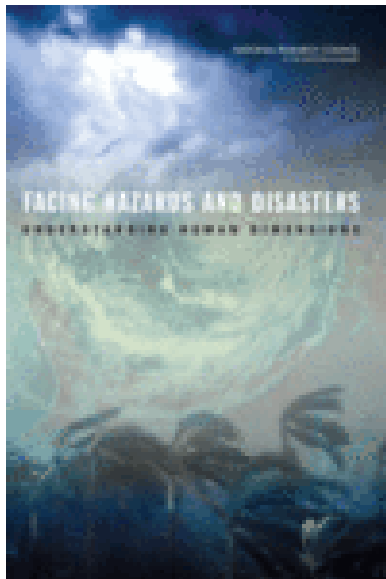
CHRONOLOGICAL TIME

Pre-Impact

Trans-Impact

Post-Impact

SOCIAL TIME



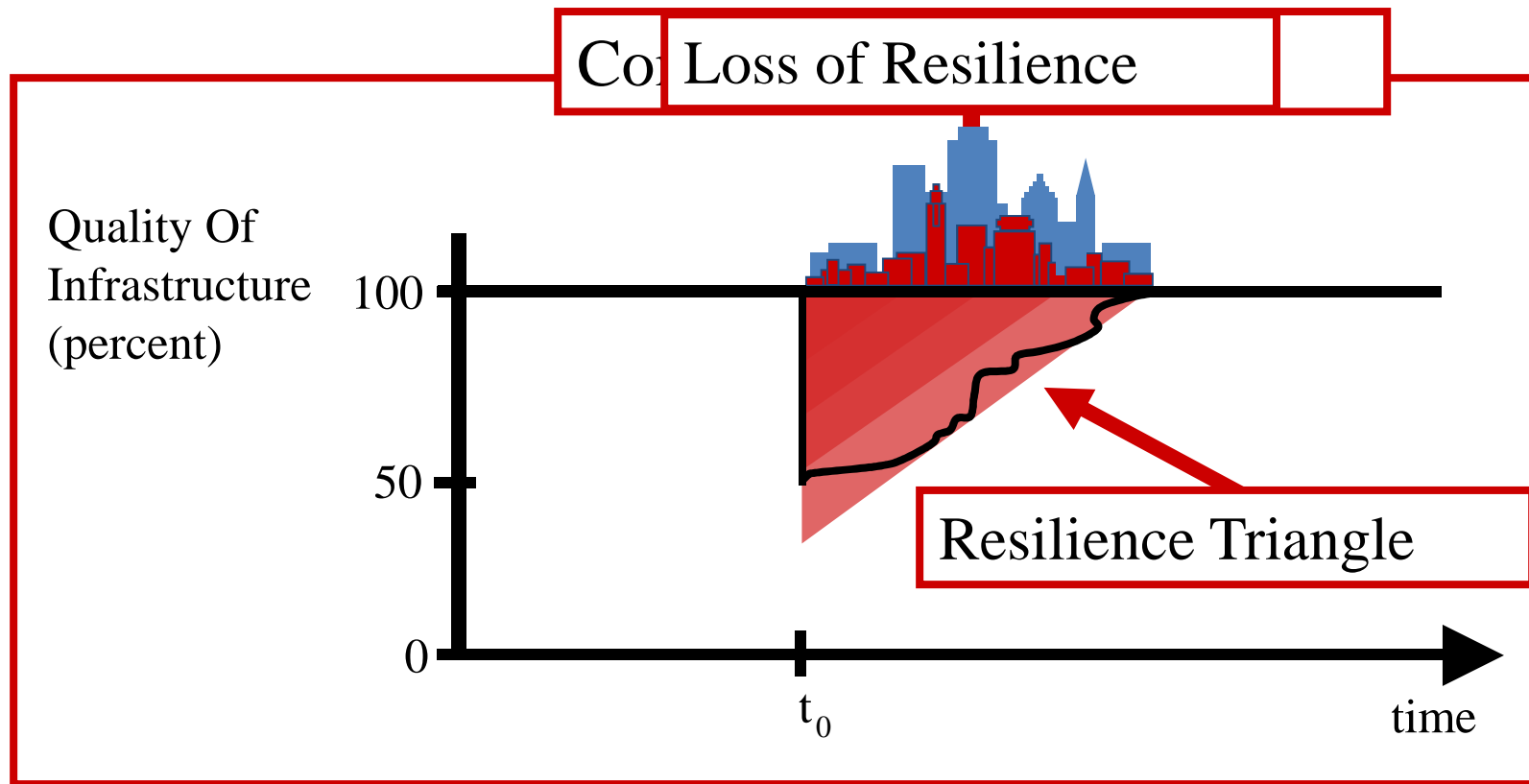
Source: Facing Hazards and Disasters (NAS, 2006), adapted from Kreps (1985), Cutter (1996), Lindell and Prater (2003)

Organization of Federal Disaster, Civil Defense, and Defense Mobilization Functions, 1950-2006

Function	1950	1951	1952	1953	=====	====>	1957	1958	1959	1960	1961	=====	=====	====>	1972	1973	=====	====>	1978	1979	=====	=====	====>	2002	2003	2004	2005
Disaster Relief	Housing and Home Finance Administration (independent)																										DHS (FEMA becomes part)
Civil Defense	Federal Civil Defense Administration (Independent)																										DHS
Defense Mobilization	Office of Defense Mobilization (Executive Office of the President [EOP])																										DOD

Source: Facing Hazards and Disasters (National Academy of Sciences, 2006)

Multidisciplinary Center for Earthquake Engineering Research (MCEER)
General Framework for Quantification of Resilience:
Extent of Disruption and Recovery Time



Source: Bruneau & Tierney, Resilience: Defining and Measuring What Matters (MCEER 2006)
<http://mceer.buffalo.edu/>

Further Elaboration: MCEER Resilience Domains

Technical: Physical Systems—Location-Based & Distributed Critical Facilities

Organizational: Attributes, Dynamics of Organizations & Institutions

Social: Attributes, Dynamics of Communities and Populations

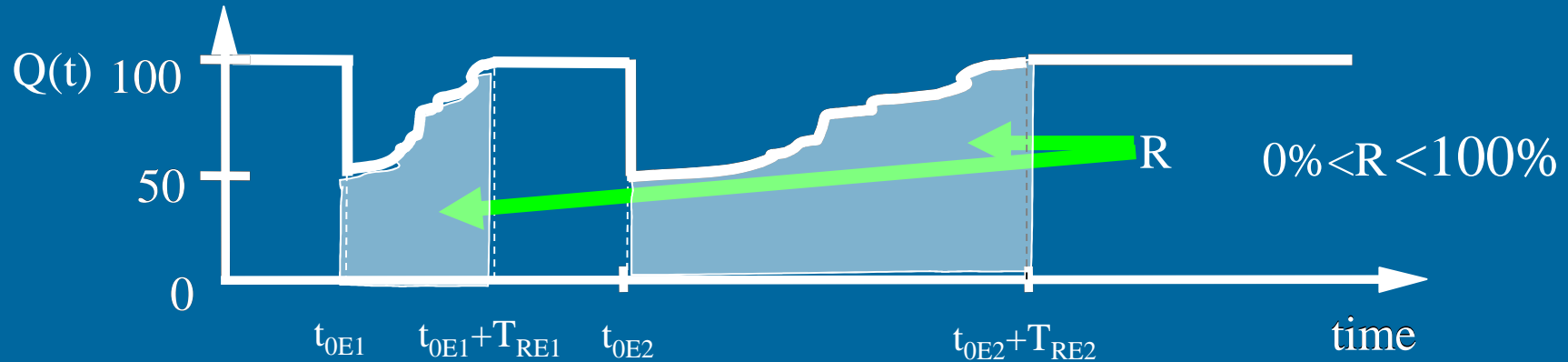
Economic: Attributes, Dynamics of Local and Regional Economies & Their Constituent Units (e.g. Businesses)

Source: Bruneau & Tierney, Resilience: Defining and Measuring What Matters (MCEER 2006)
<http://mceer.buffalo.edu/>

Resilience Property Space & Examples

Dimension/ Domain	Technical	Organizational	Social	Economic
Robustness	Newer Structures, Built to Code	Extensiveness of Emergency Operations Planning	Social Vulnerability/ Resilience Indicators	Extent of Economic Diversification
Redundancy	Capacity for Technical Substitutions, "Work-Arounds"	Alternate Sites for Managing Disaster Operations	Availability of Housing Options for Disaster Victims	Ability to Substitute, Conserve Needed Inputs
Resourcefulness	Availability of Materials for Restoration, Repair	Capacity to Improvise, Innovate, Expand	Capacity to Address Human Needs	Capacity to Improvise, Innovate
Rapidity	System Downtime, Restoration Time	Time Between Impact & Early Recovery	Time to Restore Life-line Services	Time to Regain Capacity, Lost Revenue

Resilience quantification



$$\bar{R} = \frac{1}{N_I} \sum_{I=1}^{N_I} \left\{ \frac{1}{N_E} \cdot \sum_{E=1}^{N_E} \frac{1}{T_{RE}} \cdot \int_{t_{0E}}^{t_{0E}+T_{RE}} \left\{ 1 - L(I, T_{RE}) \left[H(t_{0E}) - H(t_{0E} + T_{RE}) \right] \cdot \alpha_R \cdot f_{Rec}(t, t_{0E}, T_{RE}) \right\} \cdot dt \cdot p_E(0, T_{LC}) \right\} \cdot P(I)$$

Where:

N_E Number extreme events expected during the lifespan (or control period) T_{LC} of the system

N_I Number of different extreme events intensities expected during the lifespan (or control period) expected during the T_{LC} of the system

T_{RE} Recovery time from event E

t_{0E} Time of occurrence of event E

$f_{rec}(t, t_{0E}, T_{RE})$ Recovery function

$H(t_{0E})$ is a step function (=0 for $t < t_{0E}$; =1 otherwise)

α_R Recovery factor =1 for full recovery

$L_I(I, T_{RE})$ Normalized loss function

$P(I)$ Probability that an event of given intensities happens in a given time interval T_{LC}

$p_E(0, T_{LC})$ probability that an event happens E times in a given time interval T_{LC}

Source: Bruneau & Tierney, Resilience: Defining and Measuring What Matters (MCEER 2006)

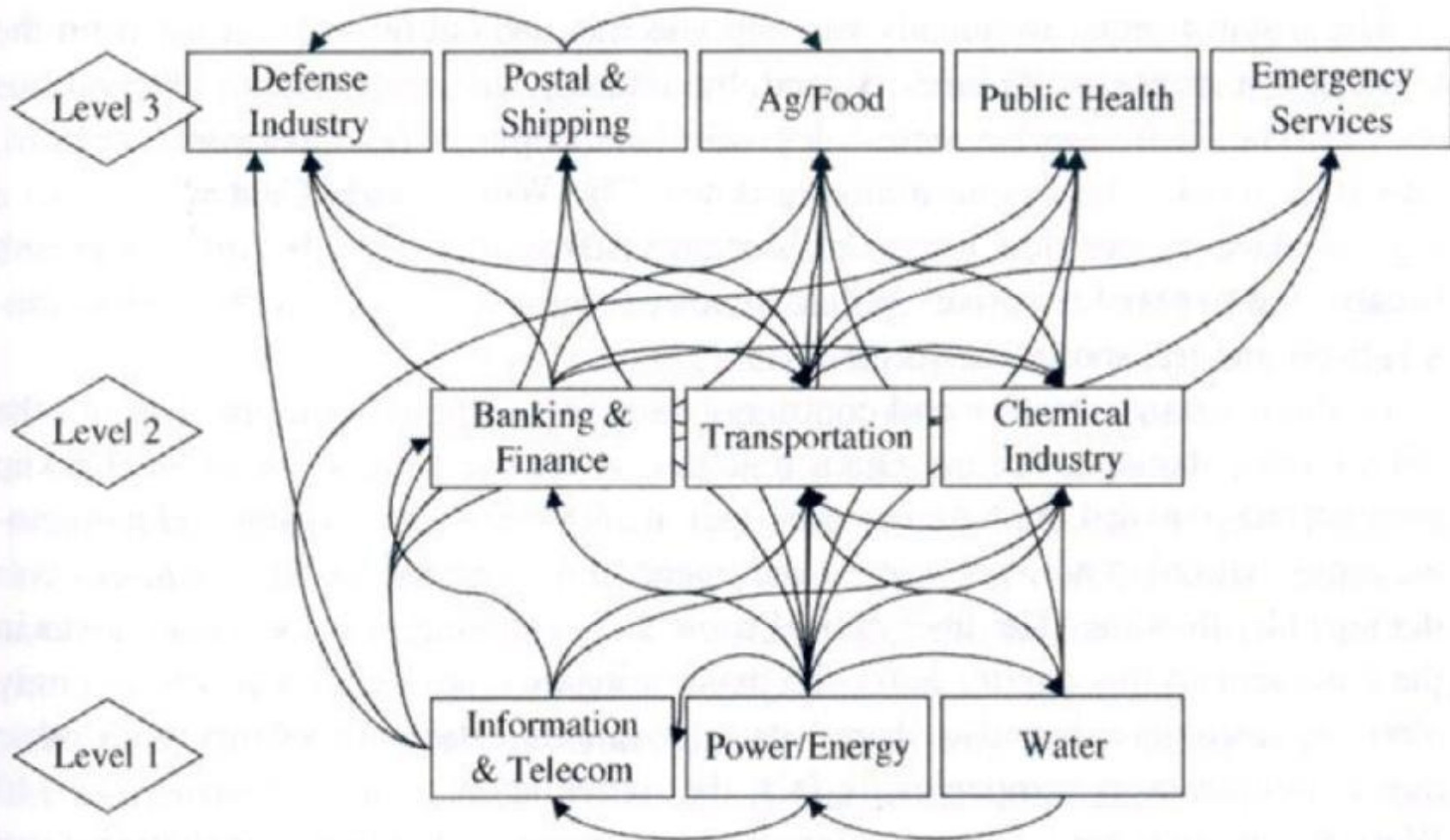
THREE KEY THEMES FOR RESILIENCE

- **Measure**--Figure out way/s to measure resilience
- **Communicate**—new ways to talk about risk and resilience in ways that people can understand and take action
- **Connect**—long-term change and impact with short-term decision making

Transportation Context

- Multiple modes; multiple industries
- People and freight
- Massive network – central to economy
- International in scope
- Decentralized
- Public-private mix
- *No one in charge*

The Transportation Sector is Central to Enabling Operability in All Other Sectors

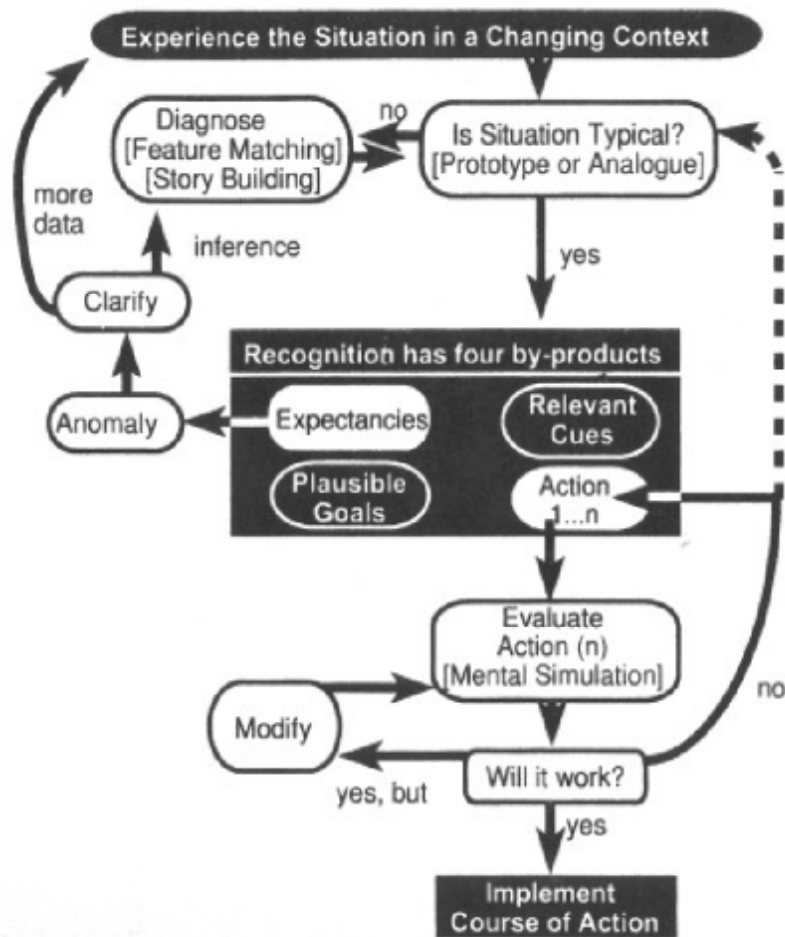


Levels and dependencies among the 11 critical infrastructure sectors.

Source: Transportation System Sector-Specific Plan Research and Development Working Group Year in Review Progress Report and Next Steps (2008), adapted from Critical Infrastructure Protection in Homeland Security: Defending a Networked Nation by Ted G. Lewis, Wiley (2006).

Research explains how uncertainty leads to doubt

(a) Integrated Recognition-Primed Decision model

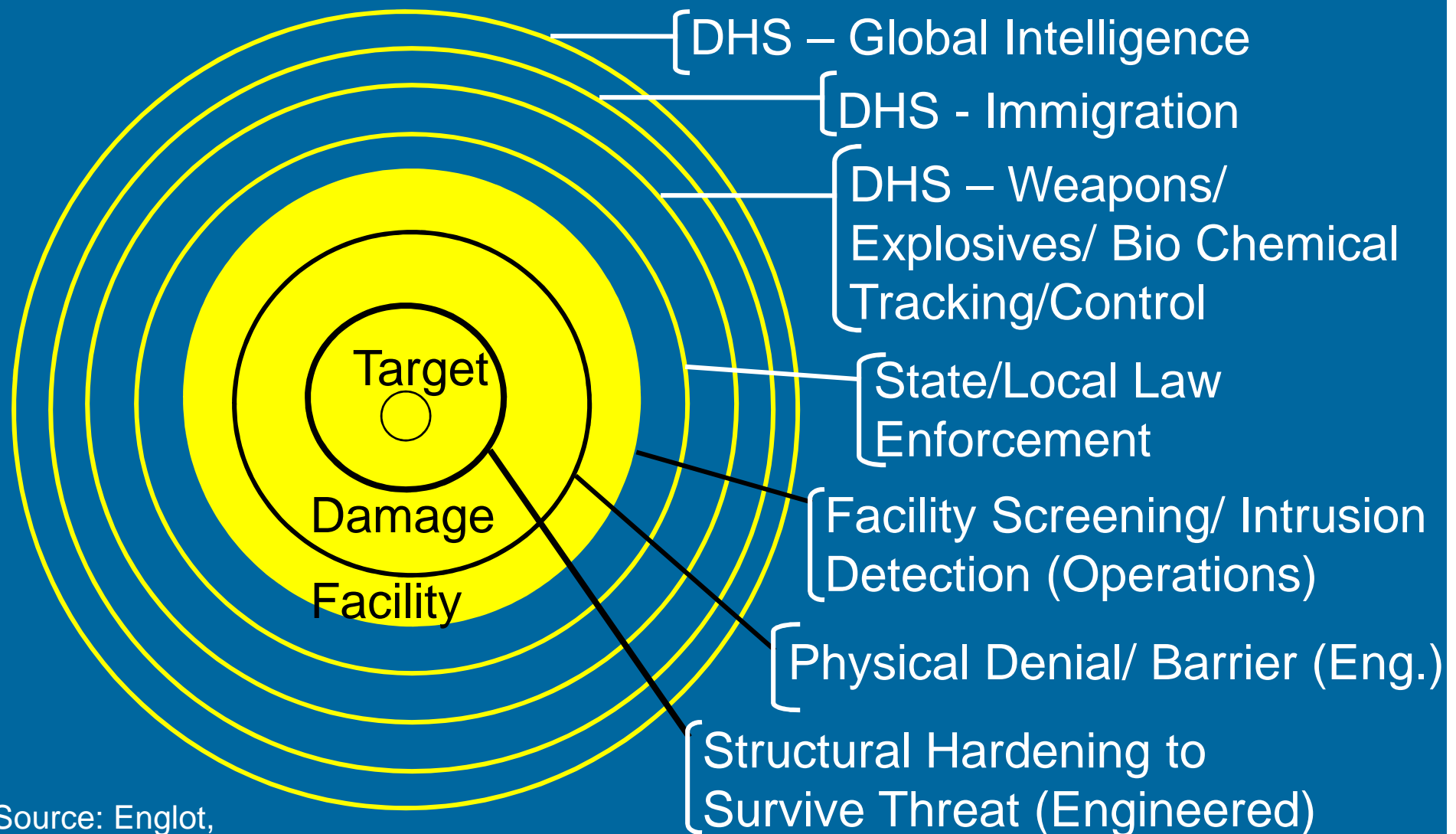


(b) Uncertainty as a barrier to action

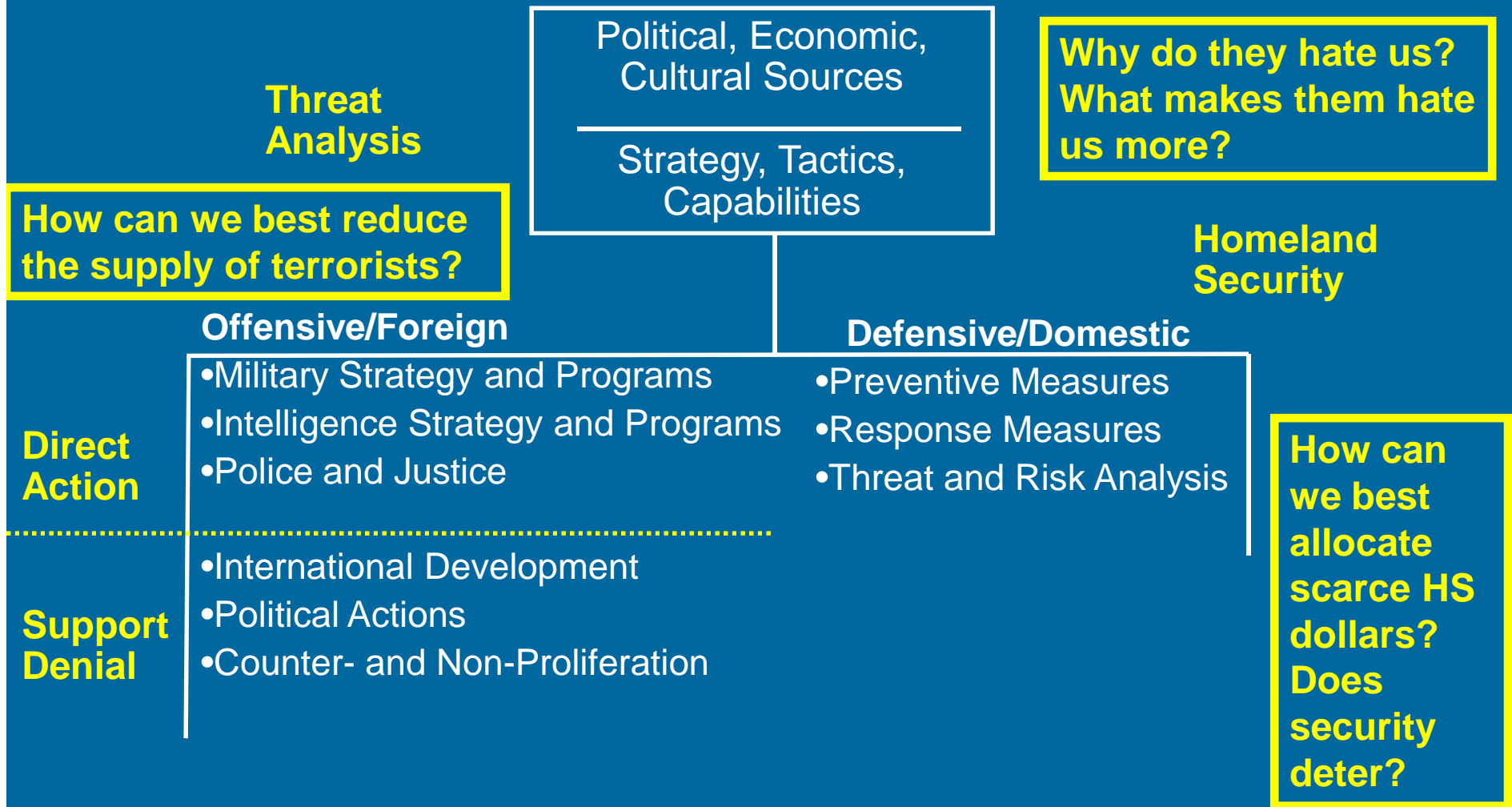


Source: Klein, *Sources of Power* (1998)

An Infrastructure Owner's View of a Layered, Integrated Security System

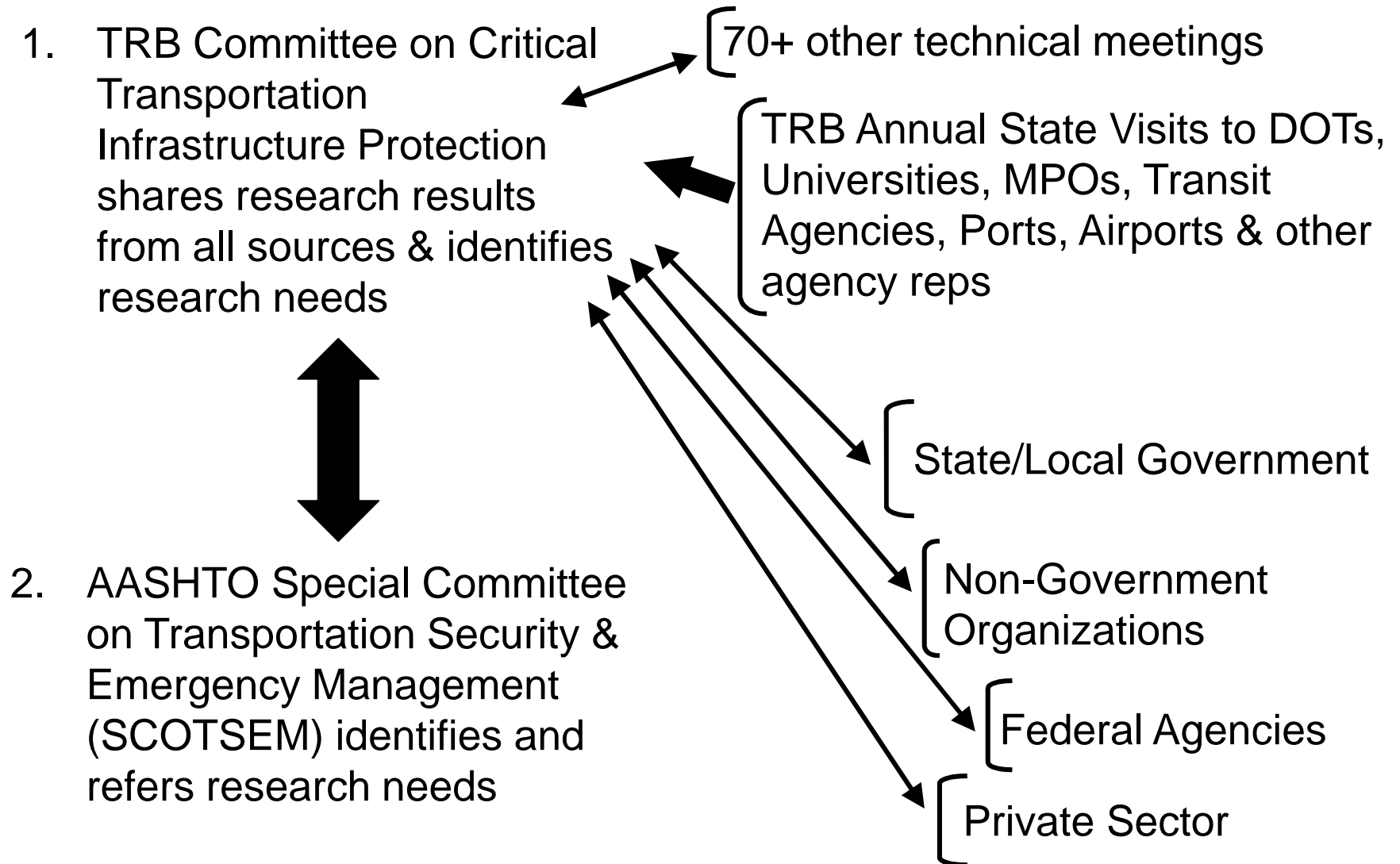


Developing a Strategy to Counter Terrorism Requires a Roadmap; Each Component of the Roadmap Requires Research



Source: Riley, (2004), Reducing the Risks and Consequences of Terrorism, CREATE Conference

Identification of R&D Gaps & Needs



NCHRP Research Results Digest 333 / TCRP Research Results Digest 90

Natural Hazards Informer Number 4

A Guide to Planning Resources on Transportation and Hazards (2009)

Chapter 1: Introduction to the Disaster Cycle

Chapter 2: Overview

Chapter 3: The Economy and Hazards

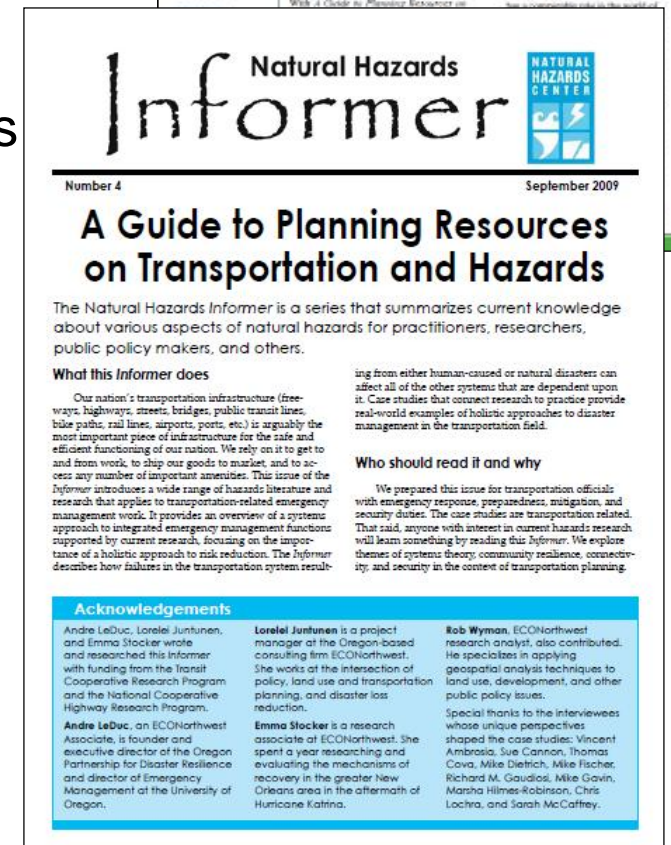
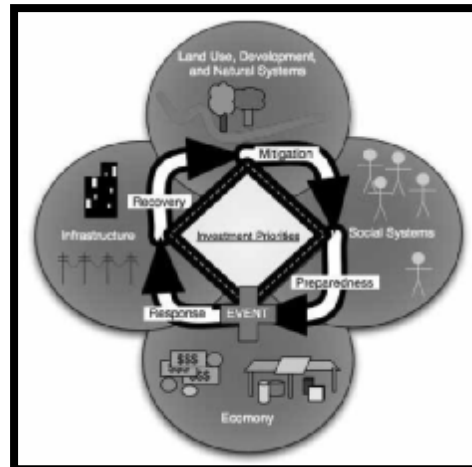
Chapter 4: People and Hazards

Chapter 5: Infrastructure: Lifelines During Disasters

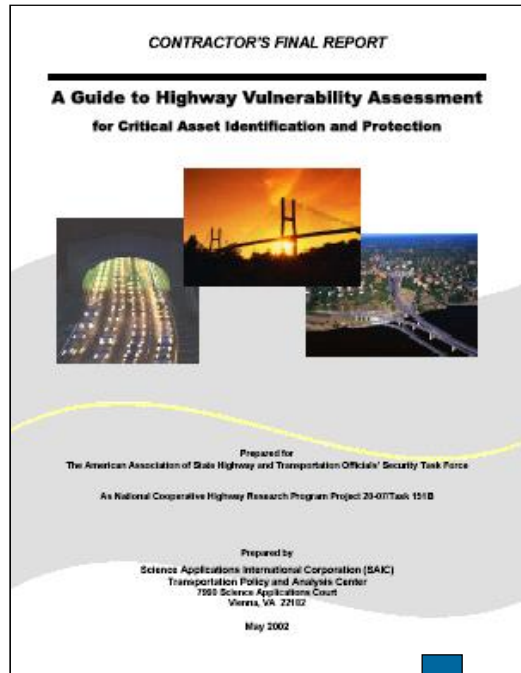
Chapter 6: Land Use, Development,
and Natural Systems

Chapter 7: From Theory to Practice: Case Studies

Chapter 8: Conclusion



Continuous Development of Risk Management and Emergency Response Planning Guidance



Published 2009:



NCHRP Report 525, Vol. 14

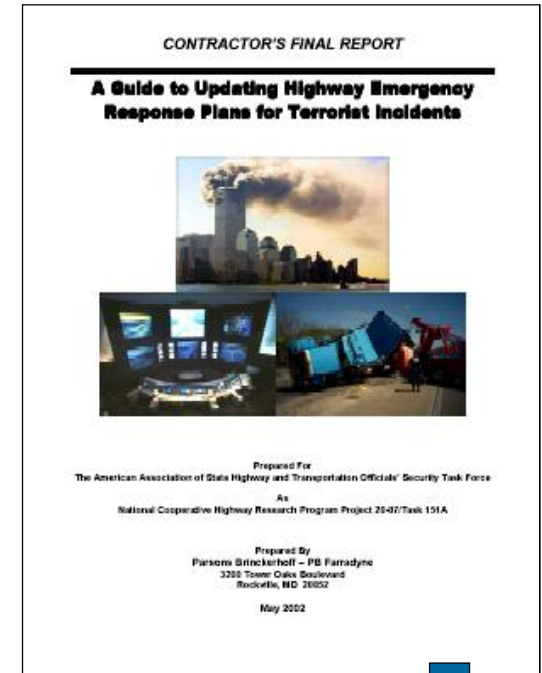
Security 101: A Physical Security
Primer for Transportation Agencies

2002: Guides to
Vulnerability Assessment
& Emergency Response
Planning

2002-2003: workshops

2004-2005: publications
that anticipated NIMS,
NRP/NRF, and NIPP.

2012: publications
adopted by AASHTO



Published 2010:



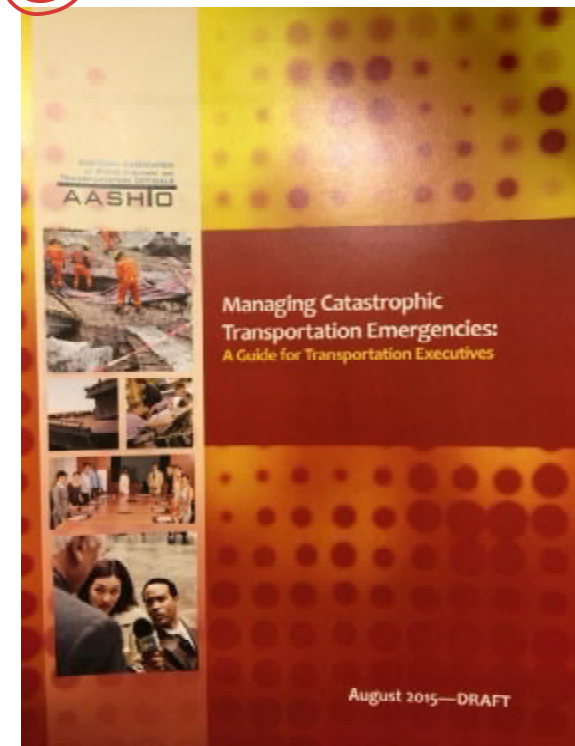
NCHRP Report 525, Vol. 16

A Guide to Emergency
Response Planning at State
Transportation Agencies

NCHRP Project 20-59(36)

Managing Catastrophic Transportation Emergencies: A Guide for Transportation Executives (2015)

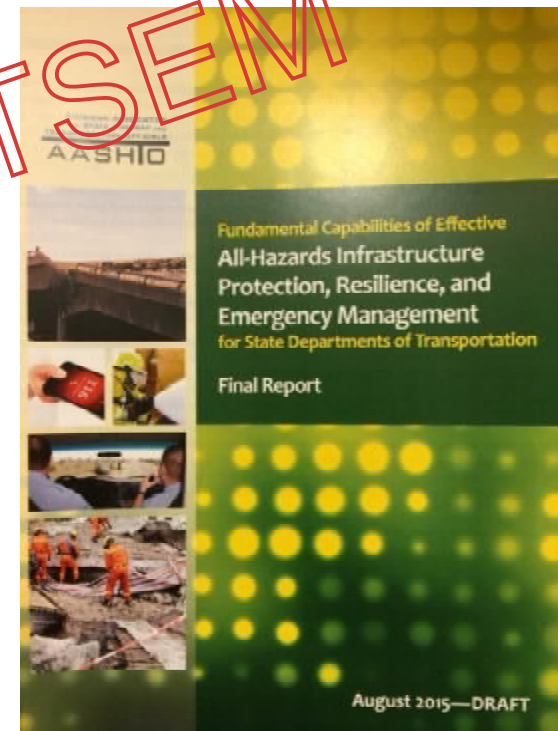
Adopted by SCOTSEM



NCHRP Project 20-59(14B)

***Fundamental Capabilities of Effective All-Hazards
Infrastructure Protection, Resilience, and Emergency
Management for State Departments of Transportation
(2015)***

Adopted by SCOTSEM



All Hazards Planning Fundamentals

- Prevention: Capabilities necessary to avoid, prevent, or stop a threatened or actual act of terrorism.
- Protection: Capabilities necessary to secure against acts of terrorism and manmade or natural disasters.
- Mitigation: Capabilities necessary to reduce loss of life and property by lessening the impact of disasters.
- Response: Capabilities necessary to save lives, protect property and the environment, and meet basic human needs after an incident has occurred.
- Recovery: Capabilities necessary to assist communities affected by an incident to recover effectively.

Source: AASHTO. Fundamentals of Effective All Hazards Security and Resilience for State DOTs, 2015.

Transportation Agency Resilience: Fundamental Capabilities

Prevention	Protection	Mitigation	Response	Recovery
Planning				
Public Information and Warning				
Operational Coordination				
Intelligence & Information Sharing Screening, Search, & Detection	Access Control Physical Protective Measures Risk Management Supply Chain Integrity & Security	Long-Term Vulnerability Reduction Risk & Disaster Resilience Assessment Threat & Hazard Identification	Critical Transportation Operational Communications Situational Assessment	Infrastructure Systems
Cybersecurity				
Training and Exercises				

Source: AASHTO, Fundamentals of Effective All Hazards Security and Resilience for State DOTs, 2015

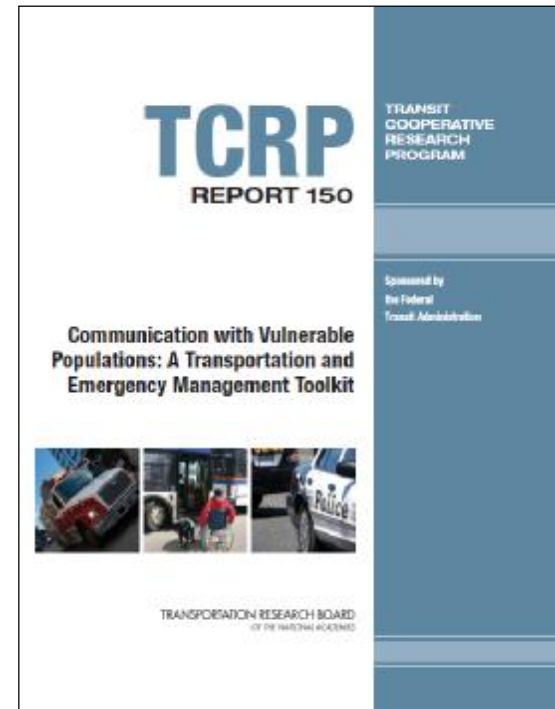
Transportation Agency Resilience: CRP Resources for Fundamental Capabilities

Prevention Protection Mitigation Response Recovery				
Planning: Guide to Emergency Response Planning at State Transportation Agencies				
Public Information and Warning: Communication with Vulnerable Populations FloodCast				
Operational Coordination: A Guide to Regional Transportation Planning for Disasters, Emergencies, and Extreme Events				
Intelligence & Information Sharing Screening, Search, & Detection	Access Control Physical Protective Measures Risk Management Supply Chain Integrity & Security	Long-Term Vulnerability Reduction Risk & Disaster Resilience Assessment Threat & Hazard Identification	Critical Transportation Operational Communications Situational Assessment	Infrastructure Systems
Cybersecurity: Effective Practices for the Protection of Transportation Infrastructure from Cyber Incidents Security 101, Second Edition				
Training and Exercises: Guidelines for Transportation Emergency Training Exercises ICS Training for Field Level Transportation Supervisors and Staff Transportation Emergency Response Application				

TCRP Report 150

***Communication with Vulnerable Populations:
A Transportation and Emergency Management
Toolkit (2011)***

Objective
to develop a toolkit of
communications strategies,
policies, and practices for
transportation agencies and
emergency management
agencies that focuses on
communicating with
vulnerable populations prior
to, during, and after all-hazards
emergencies.



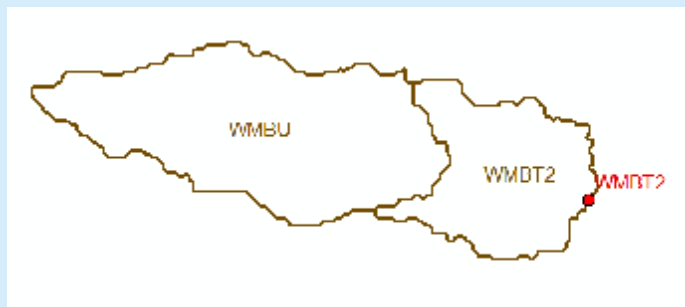
Graphic: Cover for TCRP Report 150, Communication with Vulnerable Populations:
A Transportation and Emergency Management Toolkit

NCHRP 20-59(53) FloodCast: Real Time Flood Forecast & Warning Application Built on National Flood Interoperability Experiment (NFIE) System

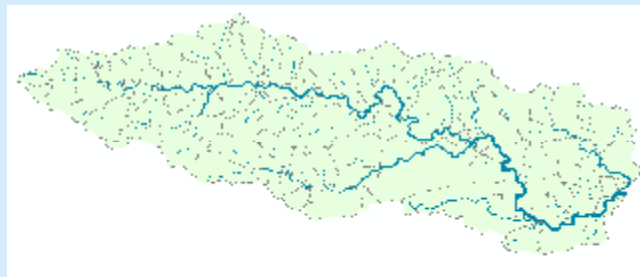
Blanco River at Wimberley

Current: 6600 basins and 3600 forecast points

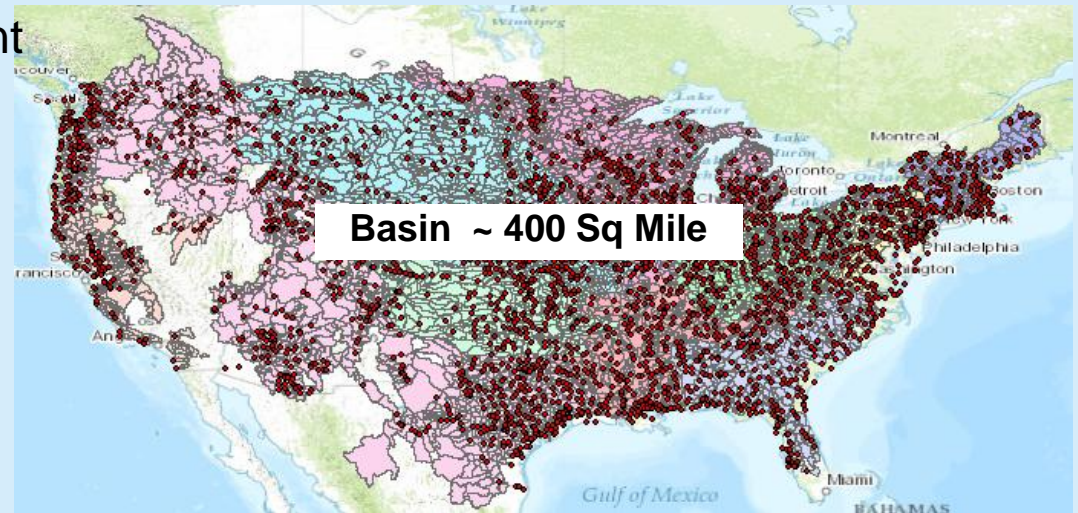
Two basins and one forecast point



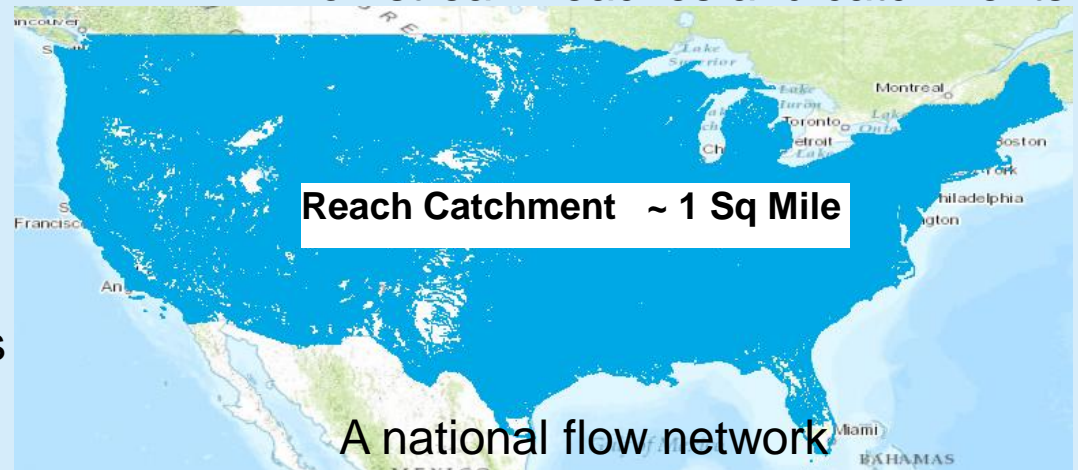
becomes ↓



130 Catchments and Flowlines
uniquely labelled



NFIE: 2.7 million stream reaches and catchments



Source: Maidment, Current and NFIE Forecast Systems, 9 September 2015.

ADAPTING TO CHANGE IN URBAN FLOODING

Rokstrom Natural Systems	Snowden & Boone Leader's Framework for Decision-making	Milly et al Stationarity is Dead	Types of Resilience
Resist	Complicated	Stationarity	Engineered resilience (Probabilities of failure)
Adapt	Complex (test- bed for innovation)	Stationarity is Dead	Socio-Ecological Resilience -capacity to adapt -attributes of resilience
Transform	Chaos (openness to innovation)		

Source: Steve Moddemeyer, "New Ideas around the Old Problem of Urban Flooding," ResilientAmerica Roundtable, February 17, 2017

NCHRP Project Panel 20-59

Surface Transportation Security & Resilience Research

- NCHRP 20-59(117) Deploying Transportation Resilience Practices in State DOTs (2017-2019)
- Resilience Research Roadmap (Pre and Post Summit versions) (2017-2019)
- Transportation Resilience White Papers (2017)
 - Understanding Transportation Resilience:
A Cyber Perspective
 - Understanding Transportation Resilience:
An Economic Perspective
 - Understanding Transportation Resilience:
An Environmental Perspective
- CEO Primer on Transportation Resilience (2017-2019)
- CEO Engagement Forums (2017-2018)

NCHRP Project 20-117

Deploying Transportation Resilience Practices in State DOTs (2019)

The objective of this research is to develop a set of implementation support tools and services to assist transportation organizations in deploying resilience-based innovations and effective practices based on the implementation recommendations contained in completed resiliency research.

The scope of these services shall encompass those activities involving (1) organizational/institutional implementation (e.g., governance, business process/data, performance measures, work plans); (2) employee learning (grounded in modern adult learning theory and centered on facilitating learning in the workplace); and (3) stakeholder outreach and engagement. A significant component of the this project will be to organize **a national summit and peer exchange on transportation resiliency to be held in 2018 and co-sponsored by TRB, AASHTO (SCOTSEM, Standing Committee on the Environment, and Resilient and Sustainable Transportation Systems), FHWA, Federal Emergency Management Agency, Department of Homeland Security, and other interested parties.**

TRB

Who We Are and What We Do


Promoting Innovation and Progress in Transportation TRB.org

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The National Academies of
**SCIENCES
ENGINEERING
MEDICINE**

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TRANSPORTATION RESEARCH BOARD

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Participate in the 70+ meetings and 100+ webinars TRB hosts each year.

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- [Respond to Requests for Proposals](#)

Publications

**NCRPP**
Web Only Document 4

**Legal Research Digest 49**

**FHWA Research Report 10-011—Subject to Revision**
An Expanded Functional Classification



1863

- National Academy of Sciences

1964

- National Academy of Engineering

1970

- National Academy of Medicine

Making the Nation Safer: The Role of Science and Technology in Countering Terrorism



NRC Policy Study released June 25, 2002

- Predict: Intelligence and surveillance of targets and means
- Prevent: Disrupt networks, contain threats
- Protect: Harden targets, immunize populations
- Interdict: Frustrate attacks, manage crisis
- Response & Recovery: Mitigate damage, expedite cleanup
- Attribute: Identify attacker to facilitate response

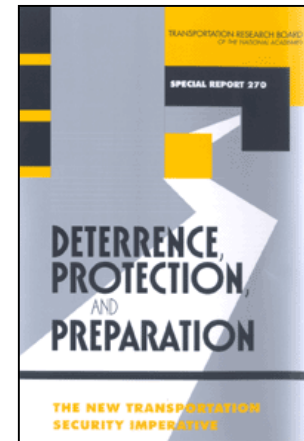
Source: Downey, TRB Annual Meeting 2003

Making the Nation Safer

General Strategies and Research Needs



- §Biological Research, prepare, distribute response to pathogens
- §Chemical/Explosives Sensors & filters
- §Info Technology Network security/ER communications
- §Energy SCADA controls/adaptive grid/vulnerabilities
- §Cities/Infrastructure Emergency responder support
- §Transportation Layered system security
- §People Trusted spokespersons
- §Complex Systems Data fusion/data mining/red-teaming
- §Cross-Cutting Technology Sensors/robots/SCADAs/systems analysis
- §Deployment Homeland Security Institute, Partnerships among feds/states/locals/universities
- §Nuclear Control weapons & materials at source



Source: Downey, TRB Annual Meeting 2003

Review of DHS' s Approach to Risk Analysis (2010)

This Congressionally-mandated study by the National Academies reviewed how the Department of Homeland Security (DHS) is building its capabilities in risk analysis to inform decision-making. More specifically, the study addressed the following tasks:

- a) Evaluate the quality of the current DHS approach to estimating risk and applying those estimates in its many management, planning, and resource-allocation (including grant-making) activities, through review of a committee-selected sample of models and methods;
- b) Assess the capability of DHS risk analysis methods to appropriately represent and analyze risks from across the Department' s spectrum of activities and responsibilities, including both terrorist threats and natural disasters;
- c) Assess the capability of DHS risk analysis methods to support DHS decision-making;
- d) Review the feasibility of creating integrated risk analyses covering the entire DHS program areas, including both terrorist threats and natural disasters, and make recommendations for best practices, including outreach and communications;
- e) Recommend how DHS can improve its risk analyses and how those analyses can be validated and provide improved decision support.

National Academies of Sciences, Engineering, and Medicine Transportation Policy Studies: Resilience

- Special Report 294: The Role of Transit in Emergency Evacuation (2008)
- Special Report 290: The Potential Impacts of Climate Change on U.S. Transportation (2008)

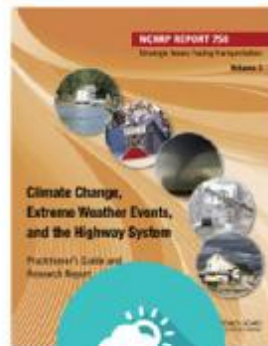
Foresight NCHRP Report 750 Series: Informing Transportation's Future



VOLUME 1: FREIGHT

Economic Changes Driving Future Freight Transportation

Explore and plan for the future of freight with a scenario planning toolkit.



VOLUME 2: CLIMATE CHANGE

Climate Change and the Highway System: Impacts and Adaptation Approaches

How to prepare for extreme weather events.



VOLUME 3: TECHNOLOGY

Expediting Future Technologies for Enhancing Transportation System Performance

Select the right technology investments at the right time.



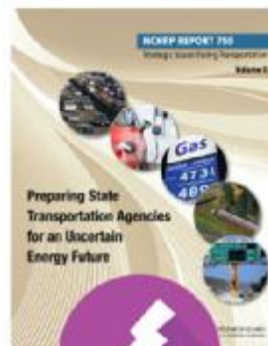
WEBINAR: A recorded webinar on Vol. 3 is available [here](#)



VOLUME 4: SUSTAINABILITY

Sustainability as an Organizing Principle for Transportation Agencies

Organize transportation agencies to support a sustainable society.



VOLUME 5: ENERGY

Preparing State Transportation Agencies for an Uncertain Energy Future

Identify and assess strategic responses to a variety of future energy scenarios.



VOLUME 6: SOCIO- DEMOGRAPHICS

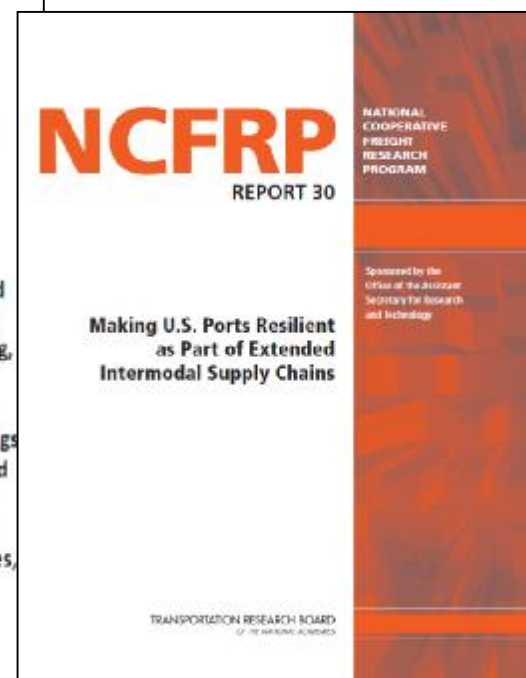
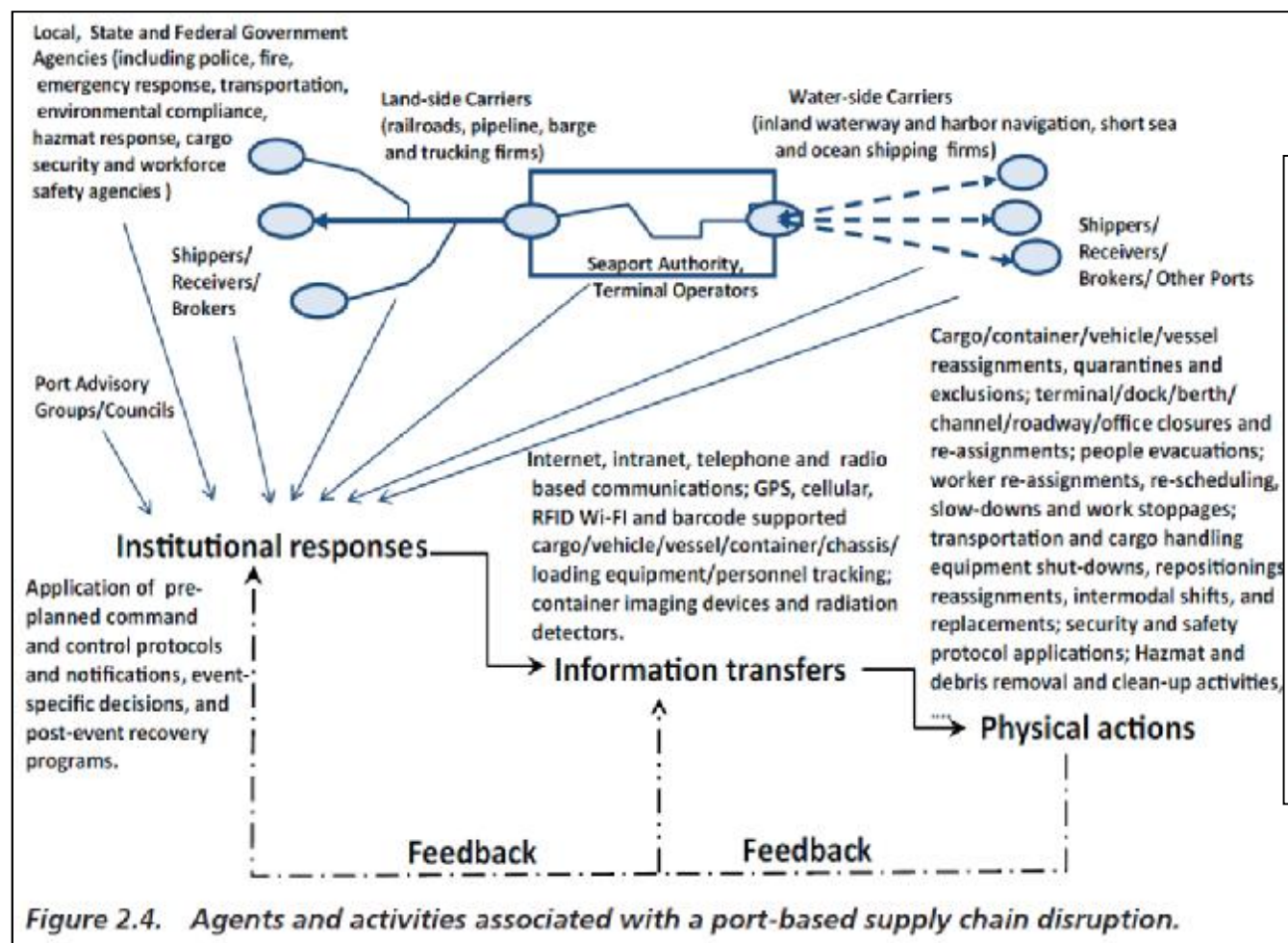
The Effects of Socio-Demographics on Future Travel Demand

Envision and model the transportation impacts of shifting demographics.



NCFRP Report 30

Making U.S. Ports Resilient as Part of Extended Intermodal Supply Chains (2014)



TCRP Project A-41 (2017)

Improving the Resiliency of Transit Systems Threatened by Natural Disasters

The objectives of this research are to develop (1) **a handbook** with an associated suite of digital presentation materials to address planning principles, guidelines (including metrics), strategies, tools, and techniques to enable public transit systems to become more resilient to natural disasters and climatic events; and (2) **a draft recommended practice** for public transit resilience to natural disasters and climatic events suitable as input to the APTA Standards Program. The handbook and its associated suite of digital presentation materials should be appropriately designed for use by public transit agency executive staff to plan, budget, and institutionalize effective practices to improve resilience, addressing (a) capital project planning and asset management (including financial planning and risk assessment for natural disasters and climatic events), (b) operations and maintenance, and (c) administration. They should provide sufficient detail to allow users to adapt them to their individual entities.

NCHRP Project 20-101 (2017)

Guidelines to Incorporate the Costs and Benefits of Adaptation Measures in Preparation for Extreme Weather Events and Climate Change

The objectives of this research are to develop (a) a stand-alone document providing **guidance** for practitioners on methods and tools, including illustrative case studies where applicable, to: (i) efficiently mine, manage, and document existing data sources; (ii) acquire and use data from new and innovative sources; and (iii) apply, and communicate the results from, a flexible and scalable framework for analyzing the costs and benefits of adaptation measures in preparation for extreme weather events and climate change conducted by various transportation organizations; (b) a **final report** that documents the entire research effort and includes the research team's recommendation of research needs and priorities for additional related research; and (c) an updated PowerPoint **presentation** describing the research and results suitable (upon revision) for posting on the TRB website.

ACRP Project 2-74 (2018)

Integrating Climate Resiliency into Airport Management Systems

The objective of this research is to develop a **handbook** incorporating climate adaptation into airport asset, risk, and emergency management systems.

Airports need a streamlined method to address climate vulnerability and planning as a part of risk and asset management and a way to align emergency planning with major climate related events. A quantification of risk factors, including airport and regional economic impact, can help inform asset management plans, emergency plans, and capital plans. Research is needed to help airports understand how climate risks add uncertainty to maintenance and capital budgets, and how this exposure can be mitigated and addressed through changes to airport asset management and capital planning.

NCHRP Project 15-61 (2018)

Applying and Adapting Climate Change Models to Hydraulic Design Procedures

The objectives of this research are to: (1) identify the needed levels of precision, accuracy, and confidence for climate models to be compatible with that of the data used in current hydrologic/hydraulic analysis and design techniques, identify downscaling strategies to move climate models closer towards these levels of precision, accuracy, and confidence, and develop science-based strategies and methodologies to advance engineering in extending climate predictions when the limits of downscaling of climate models are reached; (2) identify and quantify resiliency in existing hydraulic design practices due to current safety factors and conservative assumptions/techniques; and (3) identify cost-effective adaptation solutions that extend existing infrastructure to continue to function to the end of its service life despite not having been designed for climate change. An outcome of this research will be a **guidance** document with a list of available and achievable hydraulic resiliency in design for retrofits.

Criteria for Selecting TRB “Hot Topics”

- Identified in TRB *Critical Issues in Transportation*
- Timely
- Sustainable
- Diverse
- Key to helping to achieve multiple TRB strategic objectives

TRB Hot Topic: Transformational Technologies

*Transformational, or “disruptive” technologies, are those that can be expected **to completely displace the status quo**, forever changing the way we live and work.*

- General examples: internet, personal computer, email, smartphone, GPS, big data
- Transportation: Connected/automated vehicles, shared vehicles, advanced versions of on-demand shared ride and micro-transit services, NextGen, cog in “internet-of-things”

TRB Hot Topic: Resilience

Resilience is the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.

- Natural disasters: blizzards, tornadoes, floods, hurricanes, wildfires, heat waves, earthquakes, and other natural hazards
- Human-induced disasters: acts of terrorism, financial crises, social unrest, cyber attacks

TRB Hot Topic: Transportation and Public Health

*All aspects of public health that affect,
or are affected by, transportation*

- Public health impacts on transportation: public health laws and policies, medical advances, aging population
- Transportation impacts on health: crash fatalities and injuries, access to health care, emergency response, active transportation, transportation-induced pollution, accessibility for people with transportation disabilities

TRB Annual Meeting 1920s



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TRANSPORTATION RESEARCH BOARD

TRB Today

- Manage Research
- Delivering Policy Analysis & Advice
- Information Exchange: Meetings, Publications, Website, Dissemination, Outreach



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- American Public Transportation Association
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- U.S. DOT: OST, FHWA, FTA, FRA, FMCSA, FAA

Research Management Cooperative Research Programs

- Highway
- Transit
- Airport
- Freight
- Hazardous Materials
- Rail

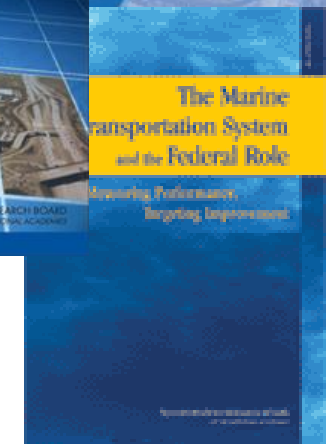
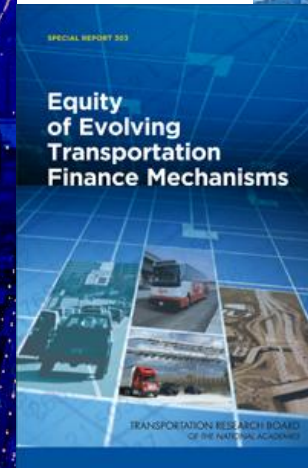
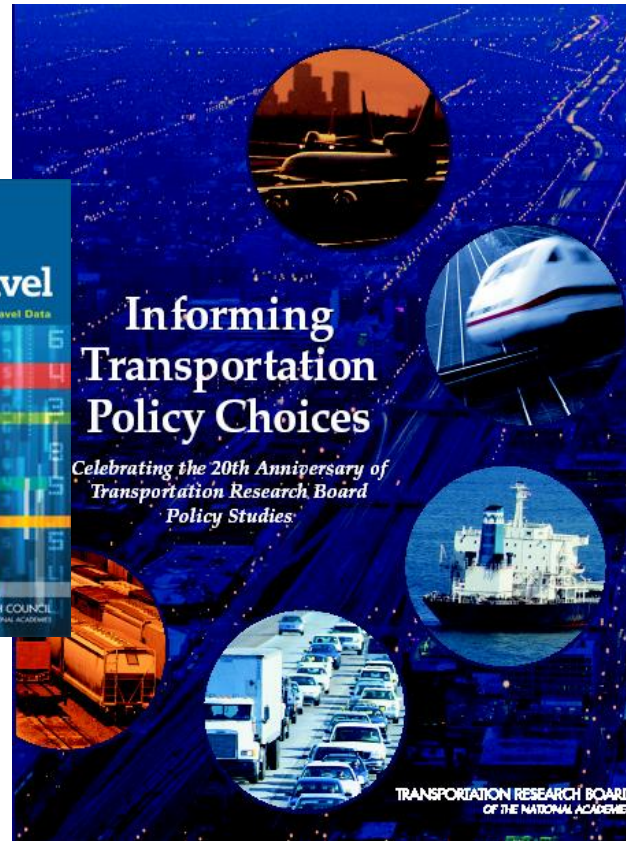
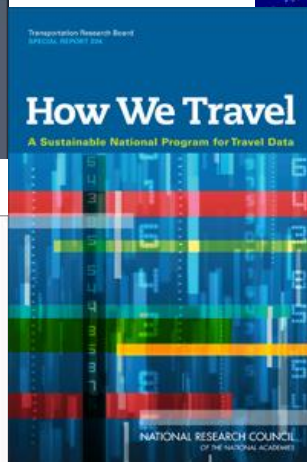
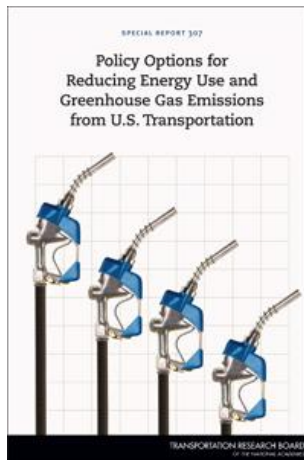
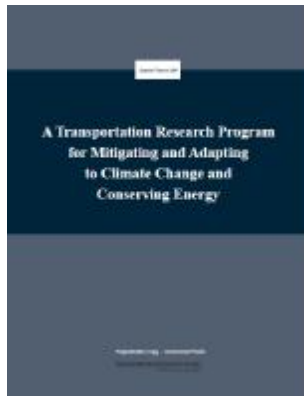


Characteristics of Cooperative Research Programs

- Sponsors own programs
- Practitioners select projects
- Emphasis on solving problems; short-term results
- Panels oversee each project
- Consultants, universities conduct research
- 200+ reports each year



Policy Analysis and Advice



TRB Convening Events and Standing Committees



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TRB
TRANSPORTATION RESEARCH BOARD

TRB “Professional Society” Functions

- 200 Standing Technical Committees – about 4,000+ people
- Constitute communities of interest
- Identify research needs
- Sponsor sessions, conferences, and meetings – 50+ events in addition to Annual Meeting
- Review and publish papers and reports
- Share information

TRB Annual Meeting Today



TRB Annual Meeting Events

- 750 workshops & sessions
- 5,000 technical papers and presentations
- 500 TRB committee meetings
- 150+ other meetings by affiliated groups





TRB NEWS

[2017 TRB Annual Meeting: Papers Due August 1, 2016](#)

TRB is accepting papers for consideration as part of the program for the **96th TRB Annual Meeting**, January 8–12, 2017, in Washington, D.C., and for publication in the *Transportation Research Record: Journal of the Transportation Research Board (TRR)*. All papers—whether for presentation at the 2016 TRB Annual Meeting or publication in the *TRR*—must...

[International Conference on Demand Responsive Transportation: Early Bird Registration Expires July 29](#)

TRB is sponsoring the International Conference on Demand Responsive Transportation on September 26–28, 2016 in Breckenridge, Colorado. Register by July 29, 2016 to qualify for Early Bird Registration rates. The conference will provide an opportunity for paratransit professionals from around world to discuss ideas and trends in the areas of...

[15th International Conference on Managed Lanes - PowerPoint Presentations Available](#)

TRB is sponsoring the 15th International Conference on Managed Lanes from May 4–6, 2016 in Miami, Florida. The workshop will explore planning, design, and operations of managed lanes as well as emerging research needs related to integrating managed lanes into the transportation system. [PowerPoint presentations](#) are now available.

[TRB Webinar: Controlling Corrosion of Infrastructure Systems](#)

TRB will conduct a webinar on Thursday, August 4, 2016 from 2:00PM to 3:30PM ET that discusses corrosion control. Corrosion poses a risk to public safety and the environment; the annual direct cost of corrosion in the United States is estimated to be more than 3 percent of national GDP. This webinar will help engineers bridge the gap between...

[TRB Webinar: The Evolving Surface Transportation Operations and Maintenance Workforce: Challenges and Opportunities](#)

TRB will conduct a webinar on Thursday, August 18, 2016 from 1:00PM to 2:30PM ET that focuses on the rapid changes in the surface transportation maintenance and operations workforce. Factors such as increasing retirement rates, downsizing staff, recruiting and retaining qualified employees, shifting responsibilities, and expanding the use of...

[TRB Webinar: Moisture and Compaction Measurement during Unbound Aggregate](#)**UPDATE YOUR INTERESTS**

Remember you can [update your interests](#) at any time to help us deliver only the most relevant information to you each week.

[Update my interests](#)

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96th Annual Meeting**

January 8–12, 2017 • Washington, D.C.

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TRB Research Databases



What is TRID?

Available for Free at trid.trb.org

The Transportation Research International Documentation (TRID) Database is the **world's largest, most comprehensive bibliographic resource** on published and ongoing transportation research. TRID contains more than 1.1 million records with 200,000+ links to free and fee-based full text.

Produced and maintained by TRB

What is in TRID (trid.trb.org)?

- Federal and state department of transportation reports
- Ongoing, recently completed, or soon-to-start transportation research projects
- TRB publications back to 1920
- University Transportation Centers reports
- Commercial and academic journal literature
- Monographs

TRID also includes international research: the ITRD Database (Europe), the ATRI Database (Australia and New Zealand), and select records from the J-STAGE Database (Japan).

Benefits of Using TRID

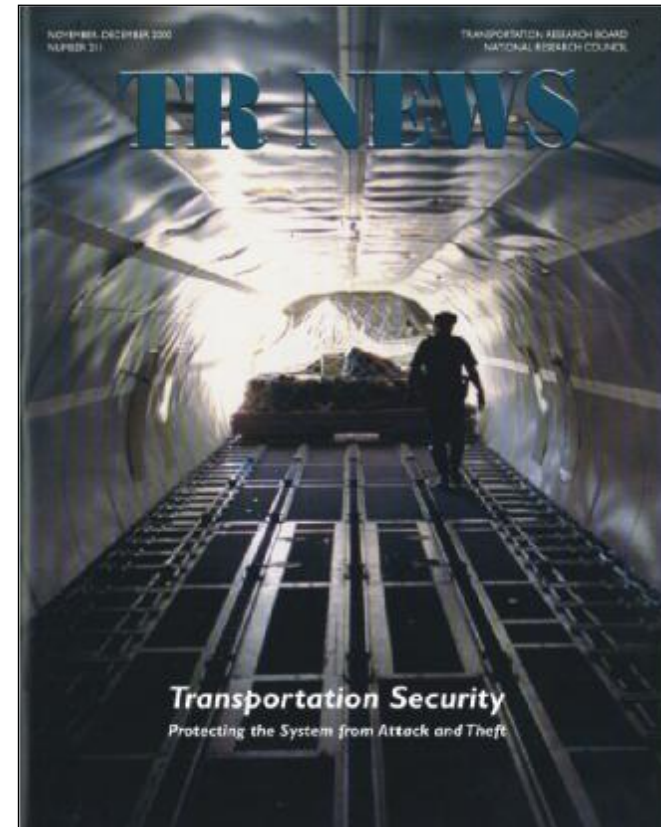
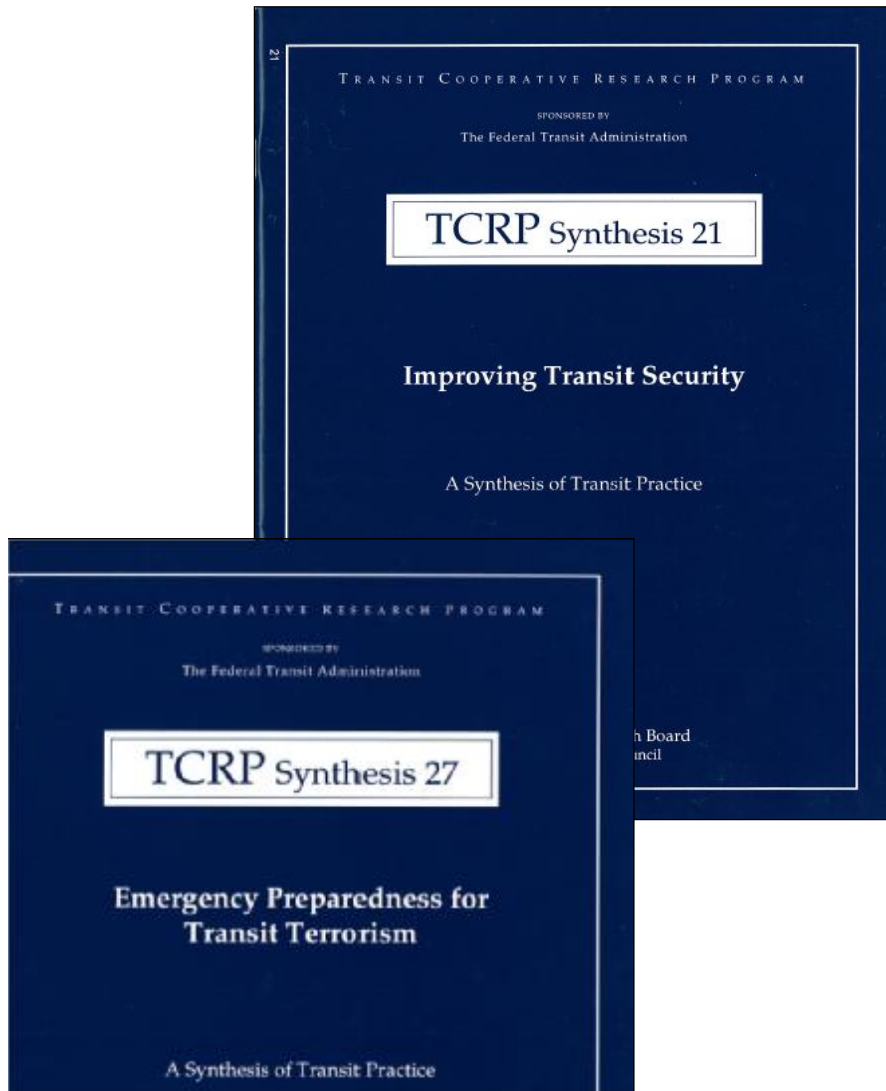
- Locate solutions to problems
- Avoid duplication of work and save resources
- Encourage and facilitate cooperation and partnership
- Identify practitioners and experts in specific research areas

Please contact the TRB Library ([**TRBLibrary@nas.edu**](mailto:TRBLibrary@nas.edu)) with questions about using TRID.

Cooperative Research Programs

TRB Publications in 1997 & 2000 - Security and Terrorism

- **Improving Transit Security (1997)**
- **Emergency Preparedness for Transit Terrorism (1997)**



November-December 2000, TR News 211
Transportation Security: Protecting the System from Attack and Theft

2002 APTA/FTA Transit Security Workshops

APTA/FTA Transit Security Workshops

January 2002 – May 2002

1. New York City
2. San Francisco, California
3. Atlanta, Georgia
4. Chicago, Illinois

CONTRACTOR'S REPORT ON THE 2002 APTA/FTA SECURITY WORKSHOPS

NEW YORK CITY
SAN FRANCISCO
ATLANTA
CHICAGO

Requested by:

American Public Transportation Association
Executive Committee Security Task Force

Prepared by:

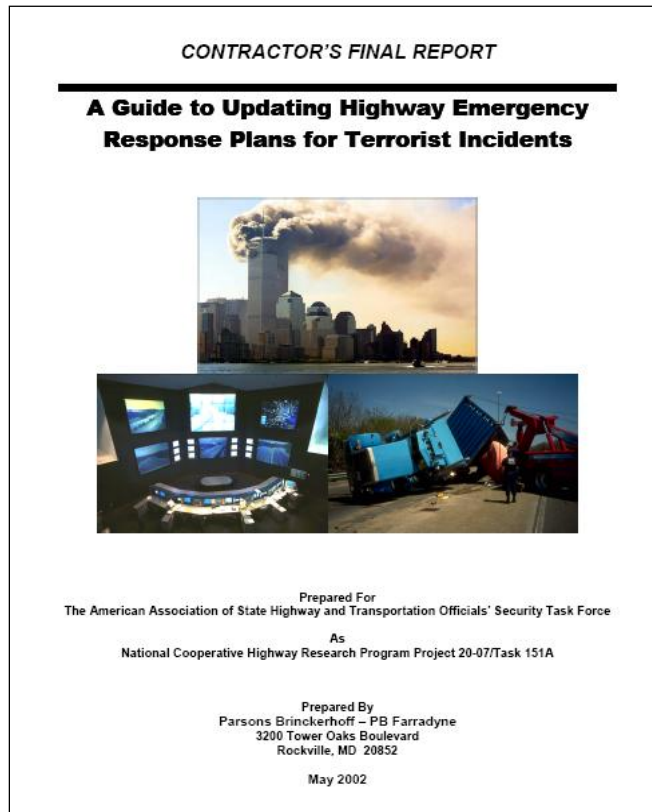
Nicholas J. Bahr
Booz | Allen | Hamilton
8283 Greensboro Drive
McLean, Virginia 22102-3838

DECEMBER 11, 2002

The information contained in this report was prepared as part of TCPRP Project J-10, Task J-10 (1),
Transit Cooperative Research Program, Transportation Research Board

APTA International Transit Security Workshop September 2002 –
Leads to Transit Security Exchange Plans

A Guide to Updating Highway Emergency Response Plans for Terrorist Incidents available May 2002



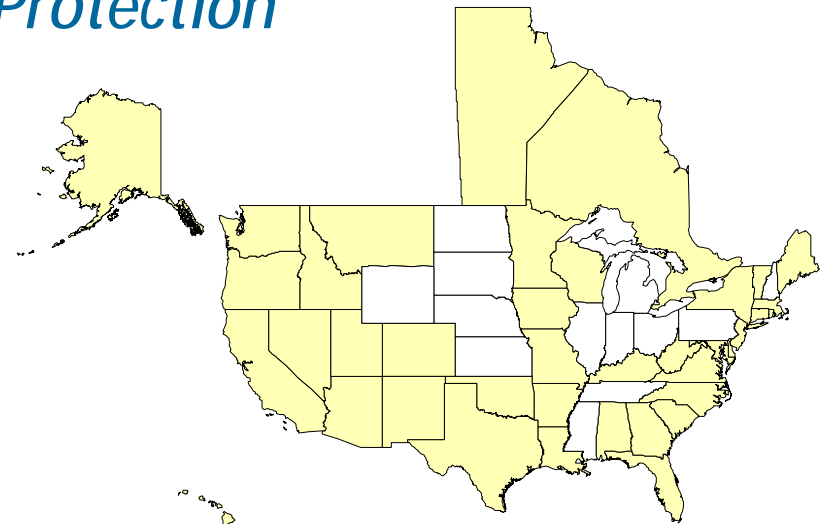
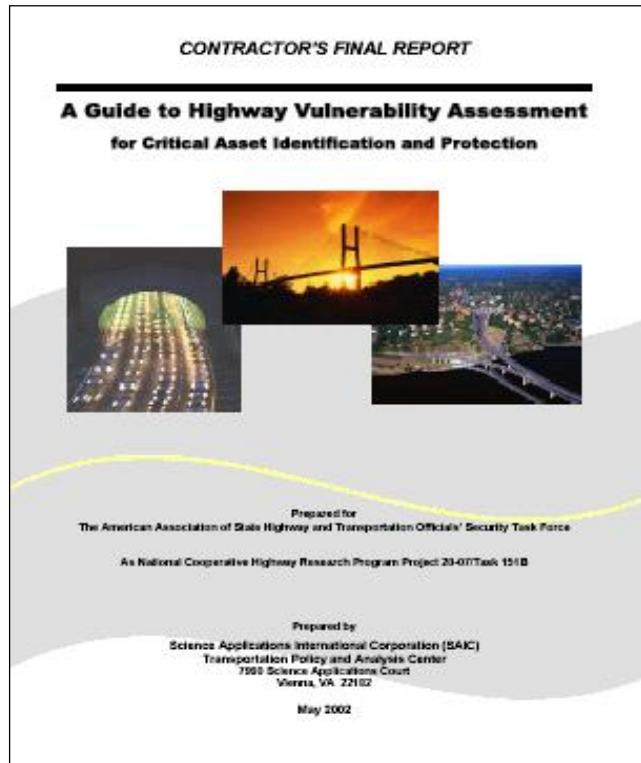
Emergency Transportation
Operations Preparedness
& Response Workshops
For Statewide Applications

June – November 2003

1. New Mexico
2. Minnesota
3. Washington
4. Idaho

<http://security.transportation.org/sites/security/docs/guide-ResponsePlans.pdf>

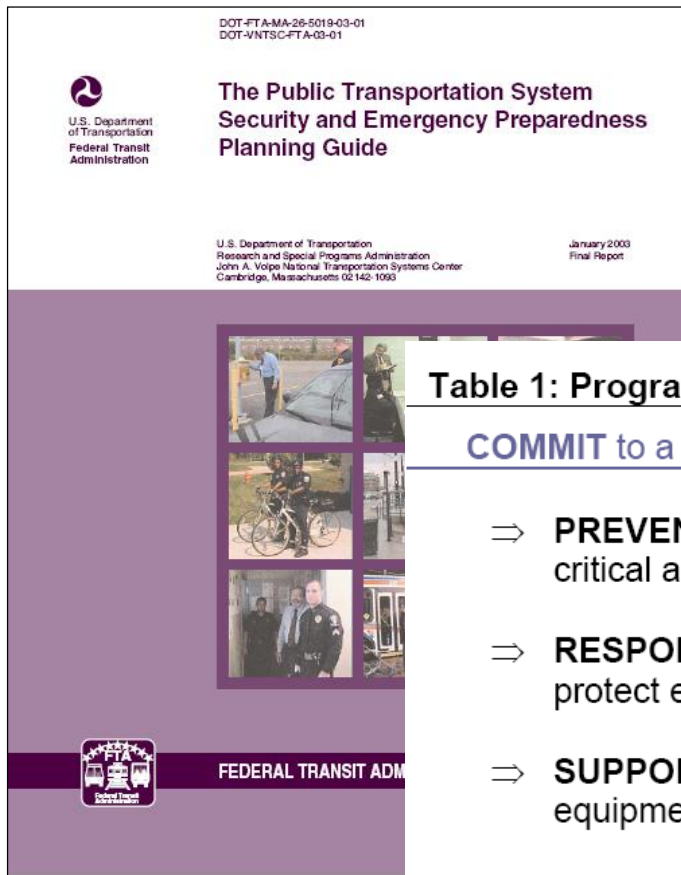
A Guide to Highway Vulnerability Assessment for Critical Asset Identification and Protection



Bridge/Tunnel/Highway Infrastructure Vulnerability Workshop Attendees February-March 2003

1. Sacramento, California
2. Albany, New York
3. Austin, Texas

http://security.transportation.org/sites/security/docs/guide-VA_FinalReport.pdf
http://security.transportation.org/sites/security/docs/guide-VA_Appendices.pdf



The Public Transportation System Security and Emergency Preparedness Planning Guide (2003)

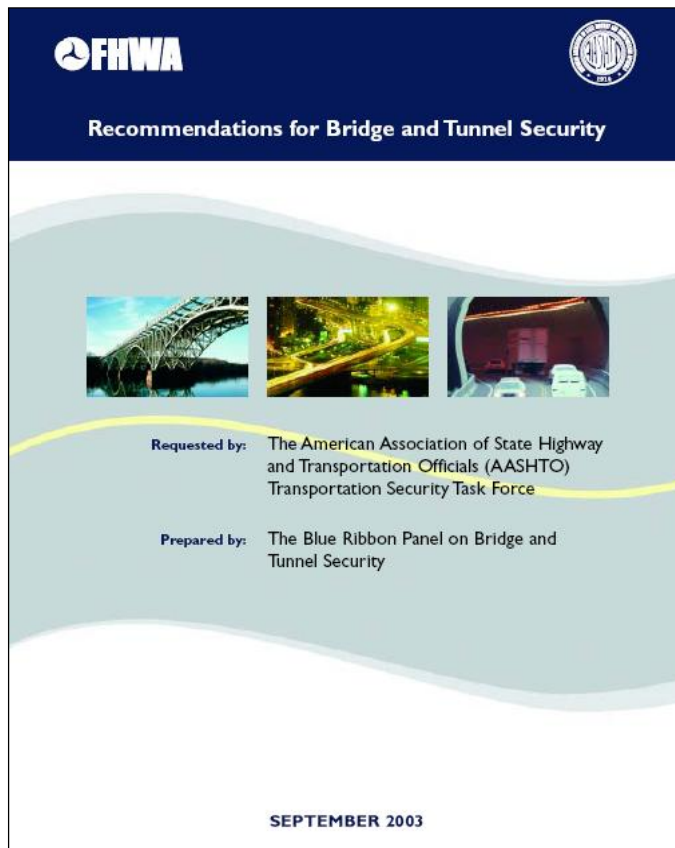
Table 1: Program of Commitments

COMMIT to a program that enables the public transportation system to:

- ⇒ **PREVENT** incidents within its control and responsibility, effectively protect critical assets;
- ⇒ **RESPOND** decisively to events that cannot be prevented, mitigate loss, and protect employees, passengers, and emergency responders;
- ⇒ **SUPPORT** response to events that impact local communities, integrating equipment and capabilities seamlessly into the total effort; and
- ⇒ **RECOVER** from major events, taking full advantage of available resources and programs.

<http://www.transit-safety.volpe.dot.gov/Publications/security/PlanningGuide.pdf>

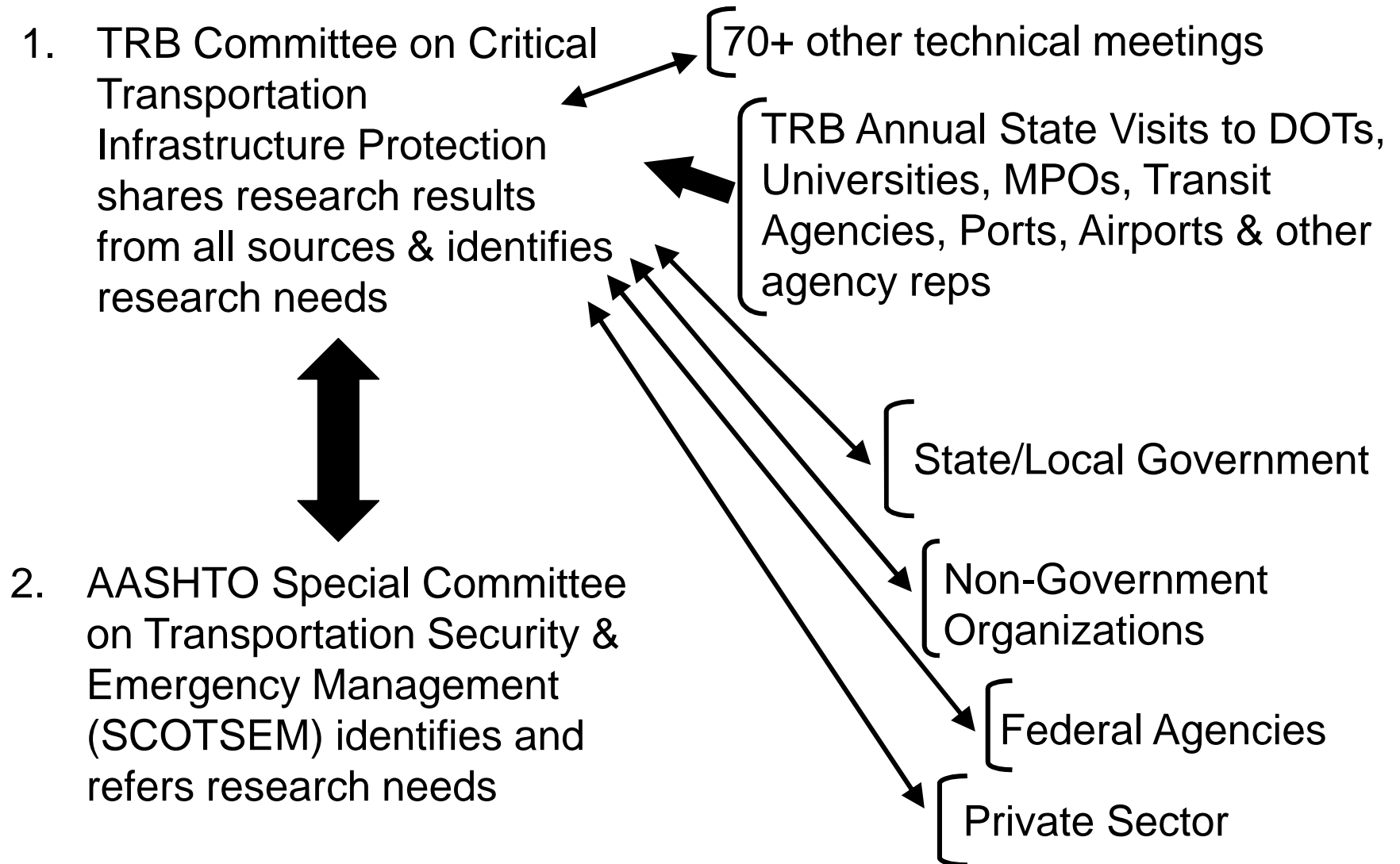
Recommendations for Bridge and Tunnel Security (2003)



“Blue Ribbon Panel on Bridge and Tunnel Security” report presented institutional, fiscal, and technical recommendations

<http://www.fhwa.dot.gov/bridge/security/brpcover.htm>
http://trb.org/news/blurb_detail.asp?id=1872

Identification of R&D Gaps & Needs



TCRP Report 86 Series

Guides on Transit Security

- | | |
|--|--|
| 1 Communication of Threats | 9 Emergency Drills and Exercises |
| 2 K9 Units | 10 Hazard and Security Plan Workshop |
| 3 Robotic Devices | 11 Security Measures for Ferry Systems |
| 4 Intrusion Detection | 12 Tunnel Security Countermeasures |
| 5 Customer Communications and Training | 13 Passenger Security Inspections |
| 6 Portable Explosive Detection Devices | |
| 7 Security Awareness for Employees | |
| 8 Continuity of Operations Planning | |

NCHRP Report 525 Series

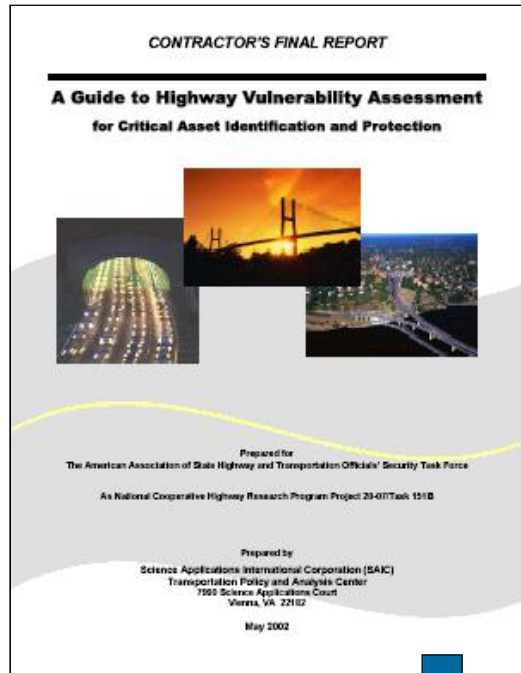
Guides on Surface Transportation Security

- | | |
|--|---|
| 1 Responding to Threats | 9 Emergency Drills and Exercises |
| 2 Information Sharing and Analysis | 10 Public Health Disasters |
| 3 Incorporating Security into Planning | 11 Disruption Impact Estimation |
| 4 Terrorism-Related Risk Management | 12 Tunnel Security Countermeasures |
| 5 Managing Sensitive Information | 13 Traffic Control for Agricultural Emergencies |
| 6 Emergency Operations | 14 Physical Security Primer |
| 7 Security Awareness for Employees | 15 Costing Asset Protection |
| 8 Continuity of Operations Planning | 16 Emergency Response Planning |



Risk-Informed Decision Support

Continuous Development of Risk Management and Emergency Response Planning Guidance



Published 2009:



NCHRP Report 525, Vol. 14

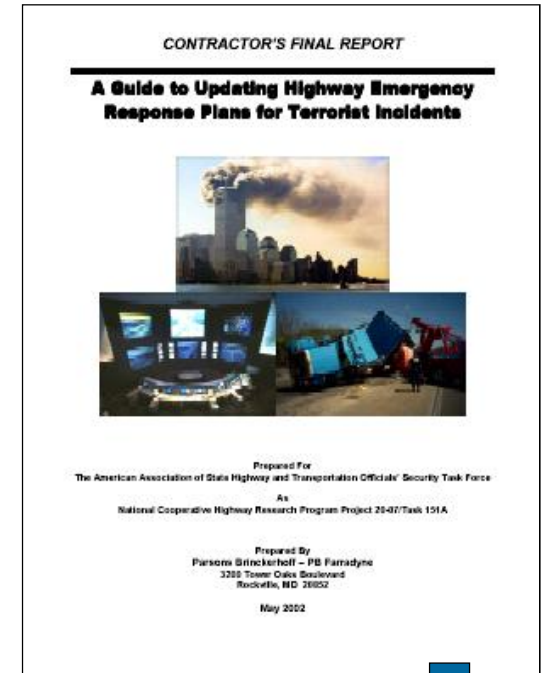
Security 101: A Physical Security
Primer for Transportation Agencies

2002: Guides to
Vulnerability Assessment
& Emergency Response
Planning

2002-2003: workshops

2004-2005: publications
that anticipated NIMS,
NRP/NRF, and NIPP.

2012: publications
adopted by AASHTO



Published 2010:



NCHRP Report 525, Vol. 16

A Guide to Emergency
Response Planning at State
Transportation Agencies

Security 101: A Physical Security Primer for Transportation Agencies (2009)

Chapter 1: Risk Management and Risk Assessment

Chapter 2: Plans and Strategies

Chapter 3: Physical Security Measures

Chapter 4: Security Personnel and Training

Chapter 5: Infrastructure Protection

Chapter 6: Homeland Security

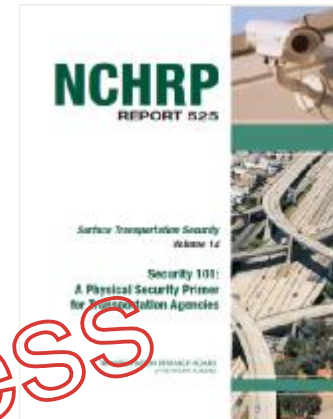


Figure 3-2. Layers of security.

*Effective Practices for the
Protection of Transportation Infrastructure
from Cyber Incidents (December 2015)*

Objective: develop (1) a primer and (2) a briefing for transportation system owners and operators explaining the nature of cyber events and their operational and safety impacts. These products contain a list of effective practices that can be used to protect transportation systems from cyber events and to mitigate damage should an attack or breach occur.

NCHRP Report 525, Volume 16
***A Guide to Emergency Response Planning
at State Transportation Agencies (2010)***

Guide

- Summary
- Overview for state transportation agencies (authorities, etc.)
- High-level requirements based on national policies and guidelines
- High-level self-assessment with pointers

Section 6: Resource Guide

- Organizational/staffing/position guidance
- Decision-making sequences
- Detailed self-assessment and resource lists



*Costing Asset Protection: An All Hazards Guide
for Transportation Agencies (CAPTA, 2009)*

Application Context

- Top-down, program level – to support resource allocation
- Consequence-driven – based on user-selected thresholds (“possibilistic”)
- Iterative – use to compare/refine assumptions

Model Attributes

- Objective – when possible use data rather than “best judgment”
- Transparent – avoid “weighting and rating”
- Consistent – uses simple, available data and criteria, standard data base, default values
- Replicable – identify basis of all judgments

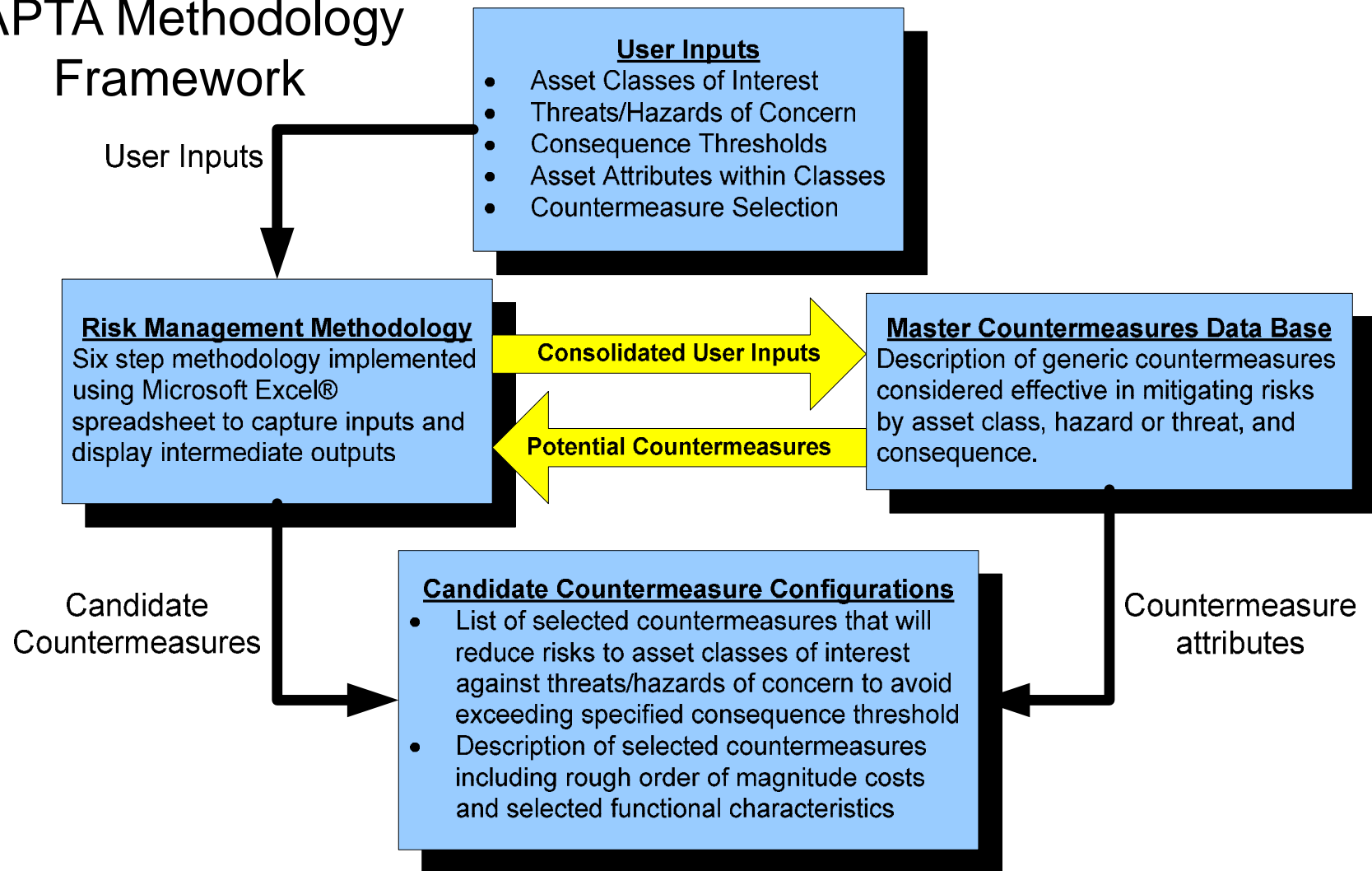
User Features

- Convenient – uses available resources (people and software) and imbedded data model
- Scalable – support a range of user contexts, mode, hazards,
- Expandable – to accommodate new threats/hazards, asset types, and countermeasures

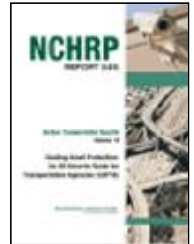
Update in Progress

Costing Asset Protection: An All Hazards Guide for Transportation Agencies (CAPTA, 2009)

CAPTA Methodology Framework



Costing Asset Protection: An All Hazards Guide for Transportation Agencies (CAPTA, 2009)



Basic CAPTA	Steps in Methodology	Expanded CAPTA
1	Identify Relevant Risks and Asset Classes	1
	Verify High Consequence Threats and Hazards	1a
2	Establish Consequence Thresholds	2
3	Describe Infrastructure Assets	3
4	Identify Critical Assets Across Modes	4
	Review Countermeasure Unit Costs	5a
	Identify and Describe Additional Countermeasures	5b
	Set Countermeasure Filters based on User Preference	5c
5	Select Candidate Countermeasures	5
6	Summary Report	6

Costing Asset Protection: An All Hazards Guide for Transportation Agencies (CAPTA, 2009)

① — ② — ③ — ④ — ⑤ — ⑥ Basic CAPTool
① — ①a — ② — ③ — ④ — ⑤a — ⑤b — ⑤c — ⑥ Expanded CAPTool

Select Candidate Countermeasures Instructions
 The following is a list of countermeasure opportunities for each critical asset -- orange indicates medium effectiveness and red indicates high effectiveness.

 To analyze an asset more closely, click on the name of the asset in row 15, and then click "Analyze Asset." A new sheet will pop up that details the effectiveness of the countermeasure against every relevant threat and hazard. The sheet will also tell you how many units of countermeasures you have selected so far for the asset, and the estimated cost.

 To add units of countermeasures, enter the desired number of units into any cell. Alternatively, the "Analyze Asset" sheet also has a field for adding units of countermeasures.
 When you are satisfied with your CM allocation, click "Continue."

Analyze Asset

Filter Countermeasures

Clear All Countermeasure Quantities

Next

Color Key

Medium Effectiveness
 High Effectiveness

Road Bridges			Road Tunnels			Transit/Rail Station														
Over Bridge	State Line Bridge	Veteran's Bridge	Downtown Tunnel	Uptown Tunnel	Midtown Tunnel	North Station	South Station	Bay Station	Downtown Station	West Station	Park Street Station	Government Center	State Street	City Center Station	Suburban Station	Airport Station	All other aboveground	All other belowground		
Quantity of Named Asset																				
Physical Security Countermeasures			Lighting																	
			Barrier Systems																	
			Fences																	
			CCTV																	
			Intrusion Detection Devices																	
Access Control Countermeasures			Physical Inspection of Asset																	
			ID Cards																	
			Biometrics																	
			Background Checks																	
			Metal Detectors																	
Asset Design/Engineering			Restricted Access																	
			Random Checks																	
			Visible Limited Access																	
			Visitor Control																	
			Locks																	
Operational Countermeasures			Explosive Detection																	
			Established Procedures																	
			Visible Security																	
			Seismic Mitigation																	
			Fire Detection & Suppression																	
			Encasement, Wrapping, Jacketing																	
			Patrols																	
			WX/Seismic Information																	
			Intelligence Networking																	
			HAZMAT Mitigation																	
			Security Awareness Training																	
			Emergency Response Training																	
			Emergency Evacuation Planning																	
			Planned Redundancy (e.g., detours)																	
			Public Information and Dissemination																	

Description of this step & instructions

Step indicators

Reset Buttons

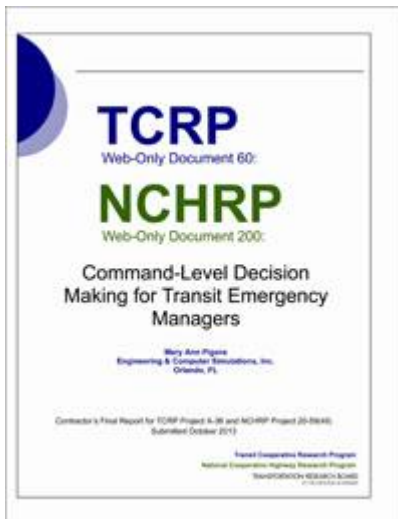
Color code key

User Options

TCRP Web-Only Document 60 / NCHRP Web-Only Document 200

Command-Level Decision Making For Transit Emergency Managers (2014)

Objective: develop a scenario-based training system compliant with federal standards (e.g., the National Incident Management System and the Homeland Security Exercise Evaluation Program) and relevant transit industry standards and regulations. It is anticipated that the training system will be delivered through an automated, functional exercise simulation system capable of providing on-demand emergency response training and exercises.



TCRP Project A-36 / NCHRP Project 20-59(49) / ACRP Project 4-04 *Command-Level Decision Making For Transportation (2017)*

Update in Progress

Action

Assess

Consequences

Initiate the Incident Briefing Form (ICS Form 201)

Relay information from damage report

Schedule a Planning Meeting

TERA
TRANSPORTATION EMERGENCY RESPONSE APPLICATION

Operations Coordinator, Facilitator (San Diego, California)
Clock is running

Mail Folders: inbox (51), Sent Items, Deleted Items

From: Priecilla Bailey (Logistics Cct Transport for H Fri Mar 09 08:07 AM
Alan Parsons (Dispatch, San Open Door San Fri Mar 09 08:03 AM
Arlyn Duglin (FEMA Coordina ETA Fri Mar 09 08:02 AM
Mark Buckner (SEOC Operatio Request for Car Thu Mar 08 08:53 AM
Sherborne Boggs (Department Bridges to Under Thu Mar 08 08:51 AM

Subject: Bridges to Undergo Safety Checks

From: Sherborne Boggs (Department of Transportation, Department of Transportation
To: Mary Ann Picora (Operations Coordinator, San Diego Transit SOCC, Ben V
Subject: Bridges to Undergo Safety Checks

I am sending out some DOT reports to the bridge districts to ensure bridge safety and

Have you notified the drivers that the bridge is closed?
Your answer:
Ok, thanks

Earthquake Registers 7.4 on the Richter Scale

Early this morning an earthquake registering 7.4 on the richter scale struck the area, destroying thousands of buildings, both residential and commercial. Roads were damaged as well as bridges. The 7.4 measurement was based on a U.S. Geological Survey. According to historical data, "major" earthquakes occur approximately 15 times a year, happening mostly in the western United States. The National Guard as well as FEMA have been notified of the situation and are on route to the scene to offer their assistance. Figures on the number of casualties and damage estimates are not yet available, but estimates are high.

Our office has been told unofficially that some Guardsmen were at a meeting in the Federal building when the bomb went off. We may have some casualties of our own. Do we need to take any action on this?

Check all of the boxes that apply.

☐ This is a CCIR.

☐ Get the names of the people at the meeting and arrange a press release announcing the fatalities.

☐ No, it's probably just a rumor. We should wait until things settle down.

☐ Yes, get with personnel to see if we can confirm and find out who was at the meeting.

reply Goodbye

File Manager

	Created By	Sensitivity
Form	TRB	For Official Use Only
Hotwash	TRB	For Official Use Only
ICS Form 202	TRB	For Official Use Only
ICS Form 203	TRB	For Official Use Only
ICS Form 204	TRB	For Official Use Only
ICS Form 205	TRB	For Official Use Only
ICS Form 205A	TRB	For Official Use Only
ICS Form 206	TRB	For Official Use Only
ICS Form 207	TRB	For Official Use Only

NCHRP Web-Only Document 215

Incident Command System (ICS) Training for Field Level Transportation Supervisors and Staff (December 2015)

NIMS/ICS: Perform Reliably & Effectively

- Goal of NIMS/ICS: Reliable and effective response to an event, emphasizing safety of DOT staff
- Achieved through
 - Safety
 - Check-in, check out, demobilization
 - Personnel accountability
 - Food, shelter, family contacts
 - Reimbursement
 - The job you save may be your own
 - MAP-21 changes, debris removal reimbursement



Check-In, Check-Out, and Demobilization at ICP



NCHRP Report 525, Vol. 2

Information Sharing and Analysis Centers: Overview and Supporting Software Features (2004)

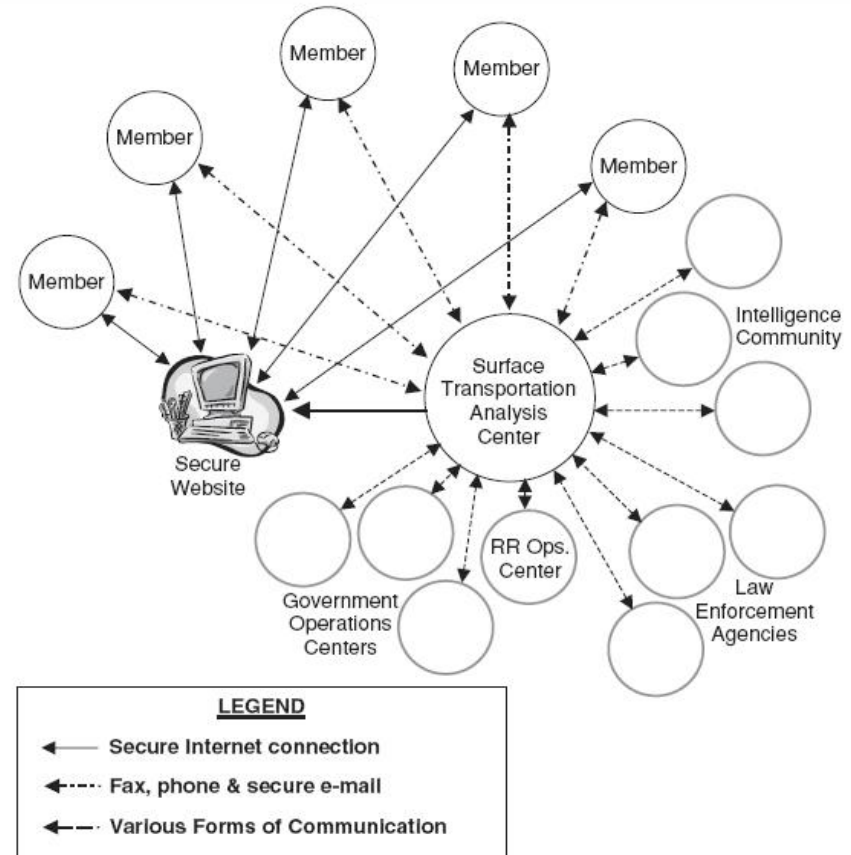
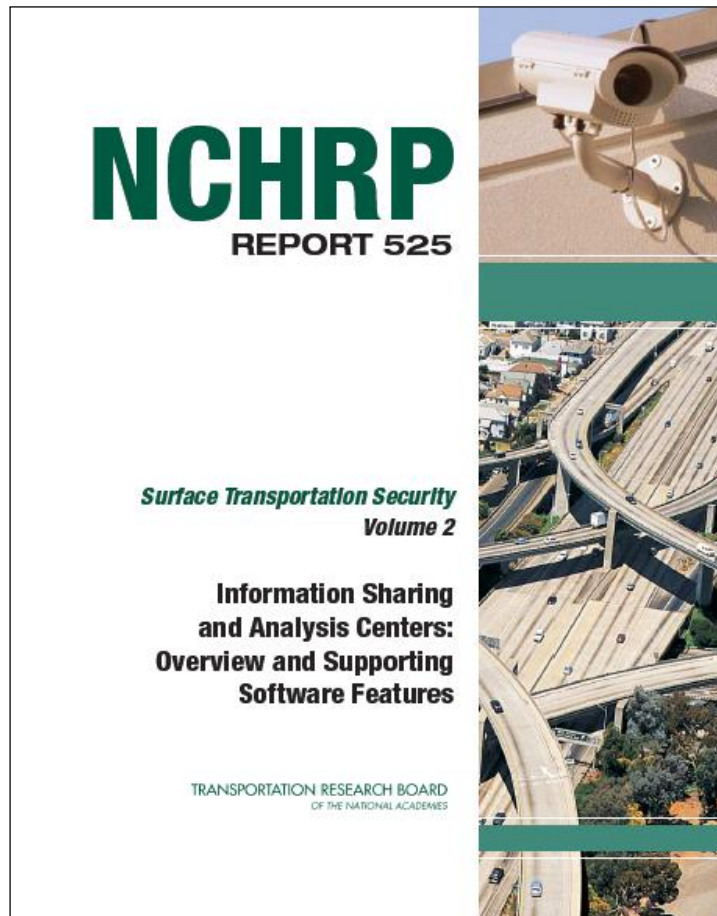
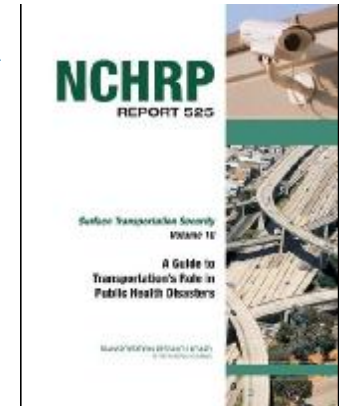


FIGURE 6: TYPICAL ST-ISAC INFORMATION PATHWAYS

NCHRP Report 525, Vol. 10 *A Guide to Transportation's Role in Public Health Disasters (2006)*

- Transportation response options to an extreme event with chemical, biological, or radiological agents
- Focuses on the effect and role of transportation
- Applicable to all civilian sites (not just transportation sites)



TERET (Tracking Emergency Response Effects on Transportation) – Spreadsheet Layout

Sheet 1:
Introduction
Provides summary
instructions

Sheet 3: Mass Care
Assess needs during shelter-in-
place, temporary shelters, or
quarantine shelter.

Sheet 2: Basic
Services
Assess criticalities
that may develop
from ER changes in
traffic patterns.

Microsoft Excel - 1-19 TERET 1.7.xls

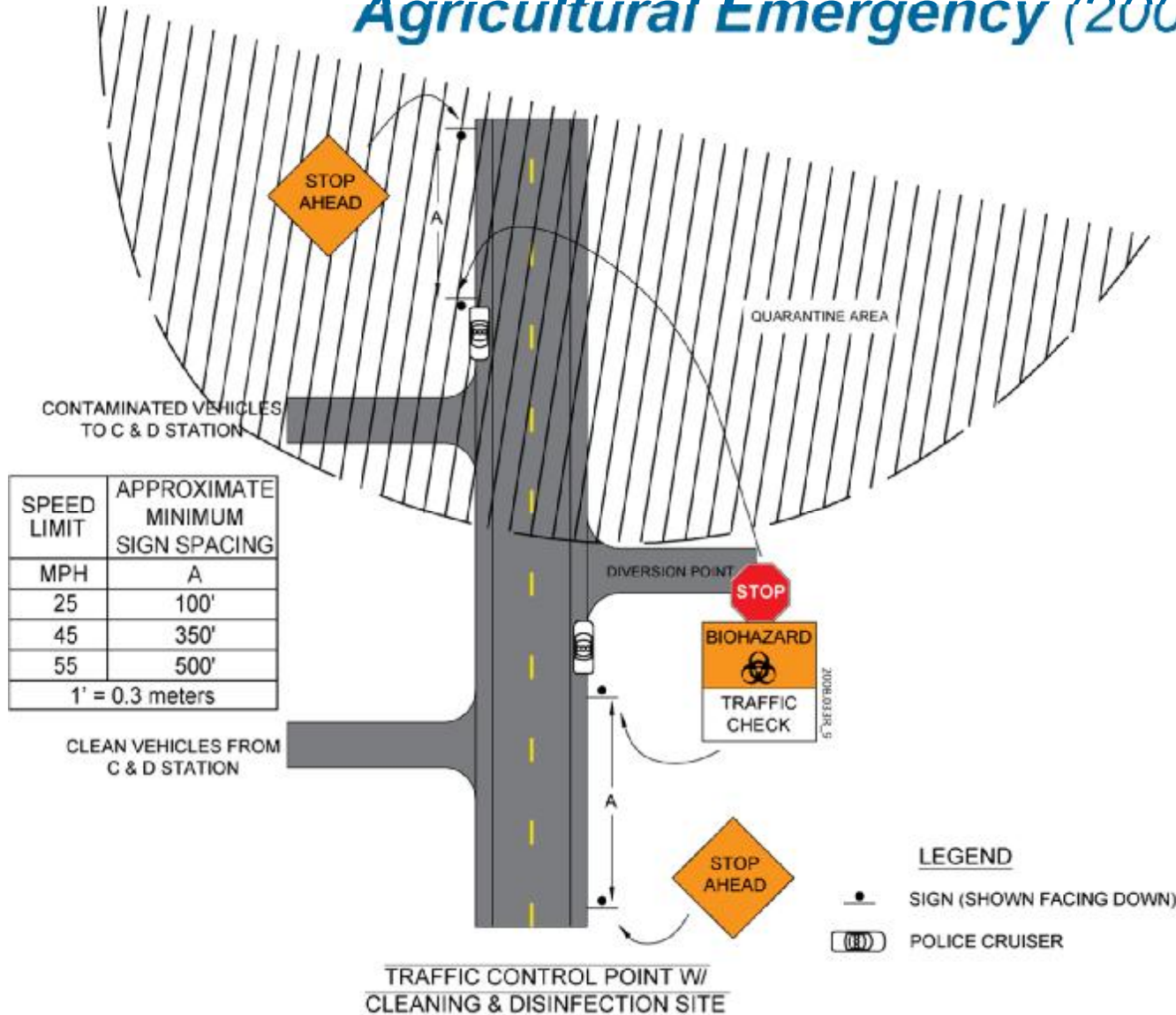
	File	Edit	View	Insert	Format	Tools	Extras	Window	Help					
	A B C D E F G H I J K L M N													
1	Tracking Transportation Basic Services for Normal Operations													
2	Objectives (from Incident 1)													
3	Objective A							Objective B						
4	Action List							Action List						
5	R1							R1						
6	R2							R2						
7	R3							R3						
8	R4							R4						
9	Pre-Event Information													
10	Essential Services		Modes				Hours to Criticality				Priority Severity			
11			Long	Full	Mass	Mobile	Firefighting	Long	Full	Mass			Mobile	Firefighting
12	CRITICAL SUPPLIES (For normal operations)													
13	Water													
14	Water Treatment Facilities													
15	Regional Water Supplier													
16	Food													
17	Local Food													
18	Regional Food (Distributor)													
19	Ice (warm climate) (warm tool)													
20	Medical (Non-essential-released)													
21	Local Medical Supplies													
22	Regional Medical Supplies													
23	Regional Medical Supplier (other)													
24	Vehicle and Generator Fuel													
25	Local Gasoline													
26	Regional Gasoline (Distributor)													
27	Electricity													
28	Regional Power Plant													
29	Heating Fuel													
30	Local Heating Fuel													
31	Regional Heating Fuel													
32	ESSENTIAL SERVICES / WORKERS													
33	Medical Personnel													

Microsoft Excel - TERET 1.7.xls

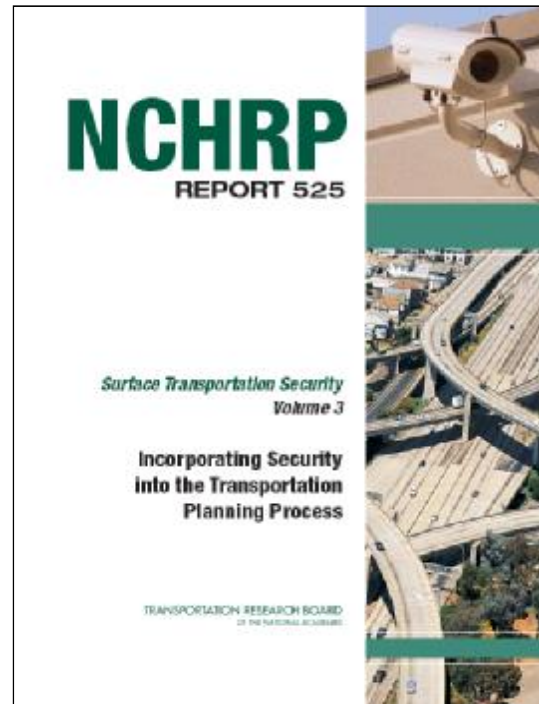
Mass Care Transportation Needs: Decon/Triage, Shelter-in-place, Temp									
Mass Care Objectives (from Incident)									
Decontamination Facilities:			Shelter-in-Place:			Temp			
Number of hours since mass care activation = 0			Hours of Need for Mass						
Mass Care Needs		Hours until Need		Physical Destruction (hurricane, explosion, etc)	Radio-logical	Chemical		Percent	Not
		Initial	Current			Percent	Percent		
Decon, Triage, Pre-hospital Treatment -- During evacuation until all evacuees are treated.		Total hours --> (for decontamination)		0	0	0	0	0	0
Mass Public Transport		Total hours --> (for shelter-in-place)		0	0	0	0	0	0
To decontamination, triage, pre-treatment		0	0	0	0	0	0	0	0
From triage/pre-treatment to hospitals		0	0	0	0	0	0	0	0
From decontamination to shelter		0	0	0	0	0	0	0	0
Standard Decontamination Supplies		Total hours --> (for shelter-in-place)		0	0	0	0	0	0
Soap, water		1	1	0	0	0	0	0	0
Portable showers, tents		1	1	0	0	0	0	0	0
Clothes		1	1	0	0	0	0	0	0
Hypochlorite / bleach / chlorine		1	1	0	0	0	0	0	0
Alkaline solution (carbonate or bicarbonate)		1	1	0	0	0	0	0	0
Reduced Power or Water Conditions		Total hours --> (for shelter-in-place)		0	0	0	0	0	0
Water (bottled)		0	0	0	0	0	0	0	0
Portable Toilets		2	2	0	0	0	0	0	0
Batteries		6	6	0	0	0	0	0	0
Ice (warm climate)		24	24	0	0	0	0	0	0
Fuel Heat (cold climate)		2	2	0	0	0	0	0	0
Shelter-in-Place -- delivery until evacuation or safe levels		Total hours --> (for shelter-in-place)		0	0	0	0	0	0
Temporary Shelter -- Shelter deliveries until other housing or safe levels		Total hours --> (for shelter)		0	0	0	0	0	0
Quarantine Shelter Until not contagious		Total hours --> (for quarantine)		0	0	0	0	0	0

NCHRP Report 525, Vol. 13

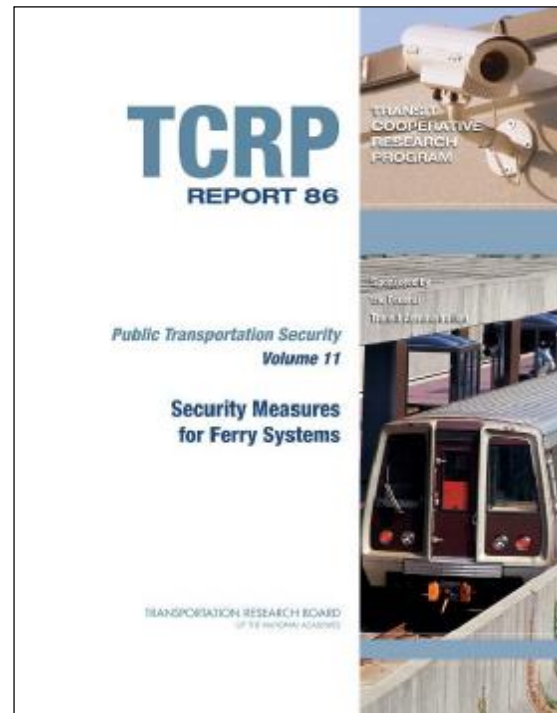
A Guide to Traffic Control of Rural Roads in an Agricultural Emergency (2008)



NCHRP Report 525, Vol. 3
***Incorporating Security Into the Transportation
Planning Process (2005)***



TCRP Report 86, Vol. 11
Security Measures for Ferry Systems (2006)



ACRP Report 5

Quarantine Facilities for Arriving Air Travelers: Identification of Planning Needs and Costs (2008)

Table 1. Total stand-by costs.

<p>1. Cost of Space in a Separate Facility if Used for Quarantine</p> <p>Needed: 20 square feet per person x 200 people = 4,000 square feet</p> <p>7 additional rooms for: recreation/leisure (3), office area, food assembly and serving, medical, and storage. Each room 500 square feet x 7 = 3,500 square feet. Total space: 7,500 square feet</p> <p>Approximately \$2.00 per square foot/month x 7,500 = \$15,000 per month</p>	<p>Value of the space: \$15,000 per month</p>
--	--



2. Privacy Partitions and Space Dividers

Partitions needed for sleeping areas—approximately 320 partitions (based on 10 individually divided spaces and 50 other divided spaces occupied by couples or small families). 7 other divided spaces for recreation/leisure (3), office area, food assembly and serving, medical, and storage—approximately 22 (2-3 dividers per space depending if it is on location next to walls or at end of aisles)

342 dividers x \$200 each = **\$68,400***

3. Storage

Lockers—6 tiered metal lockers (size 1 cu ft.) with 3 for each row (18 individual lockers) x 12 @ \$325 each = **\$3,900**

4. Cleaning supplies

Commercial mopping combo @ \$26.00 x 5 = \$130*

Mops @ \$11 each x 5 = \$55*

Trash cans: 1 44-gallon cans per 20 people plus 1 for each of 7 “other use” spaces and 3 extra = 20 cans x \$45 per can = **\$900***

Cleaning liquids, approximately 25 gallons x \$7.00 per gallon = **\$175**

Trash can liners @ \$1.50 per liner x 20 cans x 14 days = **\$420**

APPENDIX A. CDC DISEASE QUARANTINES

Disease / Reference	Symptoms in Early Stage (pre-convalescent stage)	Symptoms in Full Stage (convalescent stage)	Incubation Period (average and range for 90% of cases)	Mechanism of Contagion	Method for Diagnosis in Early Stage	Method for Diagnosis during Incubation
Diphtheria 1-4	Malaise, sore throat, loss of appetite, moderate fever, and hoarse cough.	Adherent, gray membrane forms over the anterior membrane of the mouth and/or pharynx.	2-5 days (range 1-10 days).	Direct person-to-person transmission by intimate respiratory and physical contact. Contagious isolates are important in transmission.	Detection of the diphtheria toxin produced by the bacteria that causes the disease (i.e., diphtheria toxin) is the definitive test for making a diagnosis of diphtheria. Also, testing the levels of two enzymes (pyruvate kinase and pyruvate dehydrogenase) may aid diagnosis.	None established by CDC.
Infectious TB 3-80	Prolonged recurrent fever, chronic cough, anorexia, fatigue, and weight loss.	Coughing blood from the lungs. Chronic obstructive pulmonary disease, abnormal spreading and enlargement of the respiratory passages caused by massive blockage, fluid in the lungs.	Average incubation period 21 weeks, 95% of cases will develop within 15-30 weeks.	Aerosol route. Extended period of close contact.	Abnormal chest radiograph. Respiratory specimens (sputum or culture positive). Tuberculin Skin Test (TST) or QuantiFERON-TB Test positive. Symptoms: blood-tinged sputum, cough (2 weeks), weight loss, and fatigue.	Quantiferon-TB Test.
Cholera 11-11	GI/DB of Cholera patients will show any symptoms before full onset of disease.	Cramps, painless, watery diarrhea. Vomiting also occurs in most patients.	Short incubation period, from less than one day to five days.	Ingesting contaminated water or food; person-to-person transmission is rare.	Diagnosis is confirmed by identification of the organism in a stool specimen.	None established by CDC.
Serratia 15-21	High fever, back pain, headache, vomiting, malaise, and prostration.	Maculopapular rash that progresses to papules, then vesicles, and then pustules and scabs.	Incubation period averages about 12 to 14 days but can range from 7 to 17 days.	Spread by inhalation of air droplets or aerosols. Direct contact with 6-7 feet and fairly prolonged (approximately 3 hours) face-to-face contact is required to spread infection from one person to another.	Characteristic rash and symptoms (fever, headache, back pain, etc.). Bacterial microscopy (Gram visualization, RT-PCR, Confirmation).	Close contact of case, virus found in throat during incubation.
Hemorrhagic Fever Viruses 22-34	Fever, aching muscles, dizziness, neck pain, stiffness, headache, headache, sore eyes and sensitivity to light. Nausea, vomiting, sore throat, diarrhea, and generalized abdominal pain. Liver enlargement.	Flu-like run, enlarged lymph nodes, and a rash caused by bleeding into the skin. Bleeding in the mouth and throat, the upper breast, and the joints. Hepatitis. Liver and kidney and pulmonary failure.	Incubation 2-21 days. Length of incubation may depend on the point of acquisition (Crimean Congo HFV: 3-6 days, 1 to 3 days with a maximum of 9 days). Incubation period is usually 3 to 6 days, with a documented maximum of 11 days.	Direct contact with blood or other infected tissues from livestock or sick bird. Human to human close contact.	After 4 days of illness, antibodies can be detected (IgG or IgM). Prior to this, virus must be isolated from blood or tissue specimens and grown in host cells. Viral DNA may also be detected in the blood.	Virus can be isolated from blood or tissue specimens in the first five days of illness, and grows in cell culture. Likelihood of finding virus in serum, urine, nasal mucus, blood, lymph, and sweat/saliva.
Plague 25-31	Fever, chills, headache, malaise, aching muscles, nausea, and prostration. Bubonic plague: painful, swollen lymph nodes. Pneumonic plague: cough, breathing difficulties.	Bubonic: draining the size of the flea bite. Pneumonic plague: bloody sputum.	Bubonic: 3-6 days. Pneumonic: 2-4 days with range of 1-6 days.	Flies/bites. Direct contact with infectious animals or other materials or inhalation of infectious respiratory droplets. Ingestion.	The swollen gland called a “bubo.” (T) Ag. immunoelectrophoresis (IEHA). Culture typed by specific bacteriology.	None established by CDC. Bacteria likely found by throat swab or in lymph.

NCHRP Report 740 (2013)

A Transportation Guide for All-Hazards Emergency Evacuation

Objective
to develop an all-hazards
emergency evacuation
guide for transportation
and emergency
management agencies
that integrates the broad
community of resources
that are necessary to
plan, train, exercise, and
execute evacuations.



Security-, Emergency Management-, and Infrastructure Protection-related Projects In Development (May 2017)

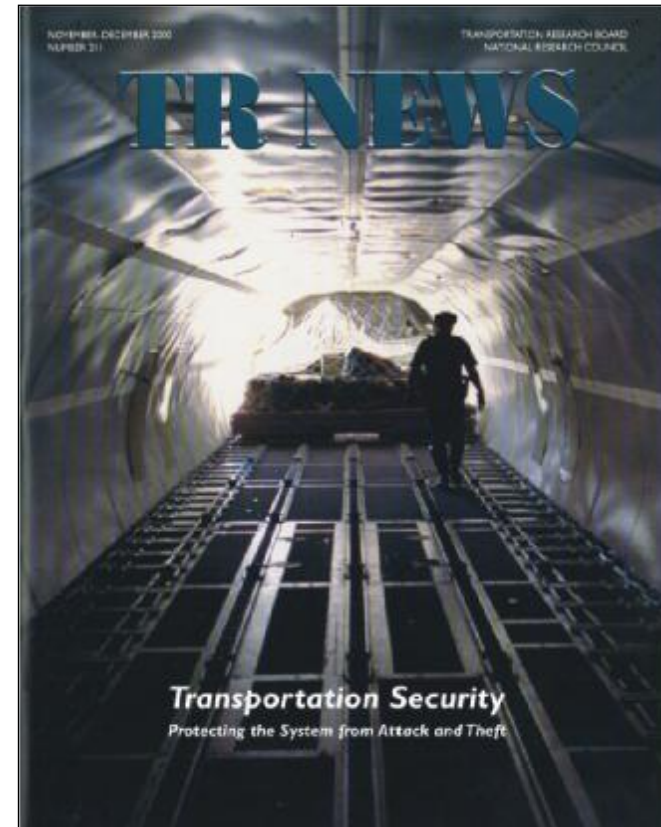
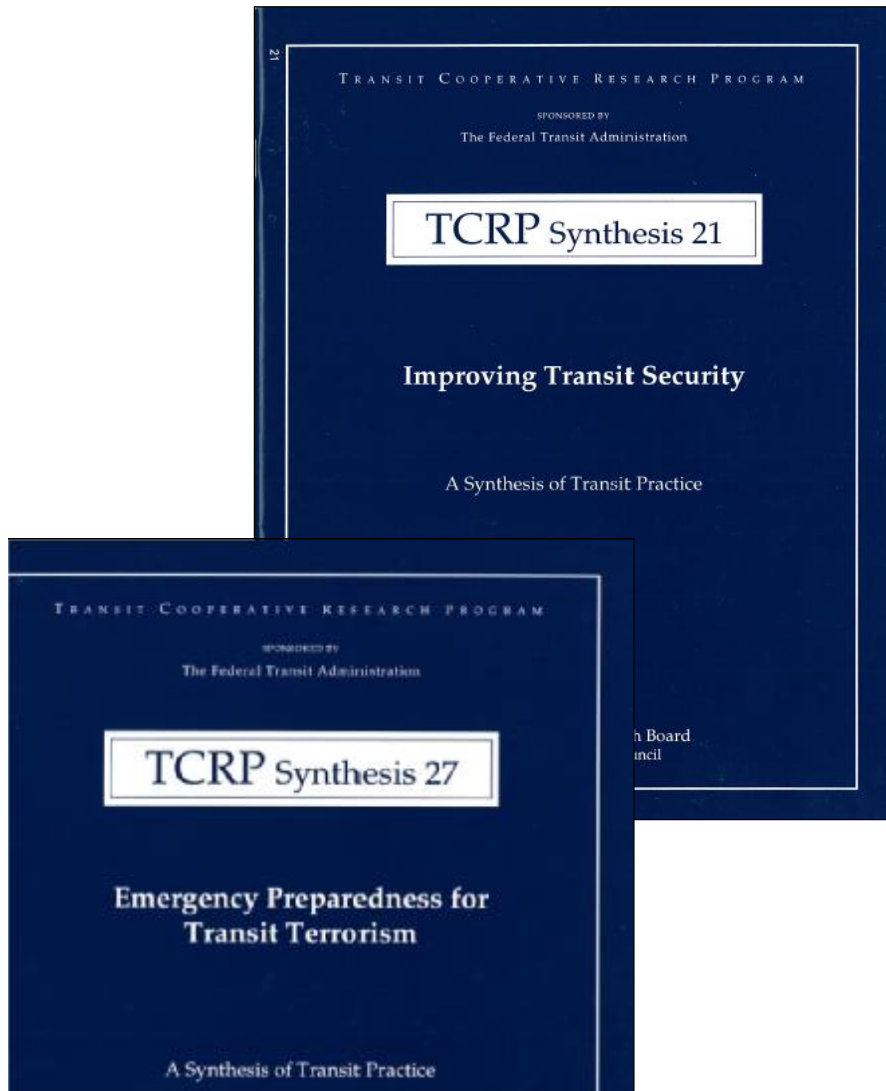
1. Climate Resilience and Benefit Cost Analysis--A Handbook for Airports
2. Emergency Communication Models for Persons with Disabilities and Non-English Speakers
3. Airport Public Health Preparedness and Response: Legal Rights, Powers, and Duties
4. Train-the-Trainer Regional Workshops for *Incident Command System for Field Level Transportation Supervisors and Personnel*
5. Update of *A Pre-Event Recovery Planning Guide for Transportation*
6. Voice and Data Interoperability for Transportation
7. Impacts of Connected/Automated Vehicles on State and Local Transportation Agencies
8. Deploying Transportation Security Practices in State DOTs
9. Emergency Management in State Transportation Agencies
10. Deploying Transportation Resilience Practices in State DOTs

The Past Is Prologue

1. Prior to September 11, 2001

TRB Publications in 1997 & 2000 - Security and Terrorism

- **Improving Transit Security (1997)**
- **Emergency Preparedness for Transit Terrorism (1997)**



November-December 2000, TR News 211
Transportation Security: Protecting the System from Attack and Theft

2. Stage I

Immediate Aftermath of September 11, 2001:

Information Sharing

2002 APTA/FTA Transit Security Workshops

APTA/FTA Transit Security Workshops

January 2002 – May 2002

1. New York City
2. San Francisco, California
3. Atlanta, Georgia
4. Chicago, Illinois

CONTRACTOR'S REPORT ON THE 2002 APTA/FTA SECURITY WORKSHOPS

NEW YORK CITY
SAN FRANCISCO
ATLANTA
CHICAGO

Requested by:

American Public Transportation Association
Executive Committee Security Task Force

Prepared by:

Nicholas J. Bahr
Booz | Allen | Hamilton
8283 Greensboro Drive
McLean, Virginia 22102-3838

DECEMBER 11, 2002

The information contained in this report was prepared as part of TCPRP Project J-10, Task J-10 (1),
Transit Cooperative Research Program, Transportation Research Board

APTA International Transit Security Workshop September 2002 –
Leads to Transit Security Exchange Plans

TCRP Report 86, Vol. 1

Communication of Threats: A Guide (2002)

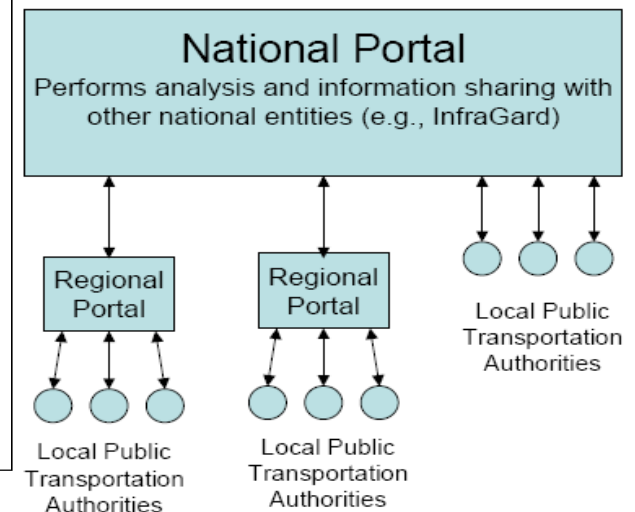
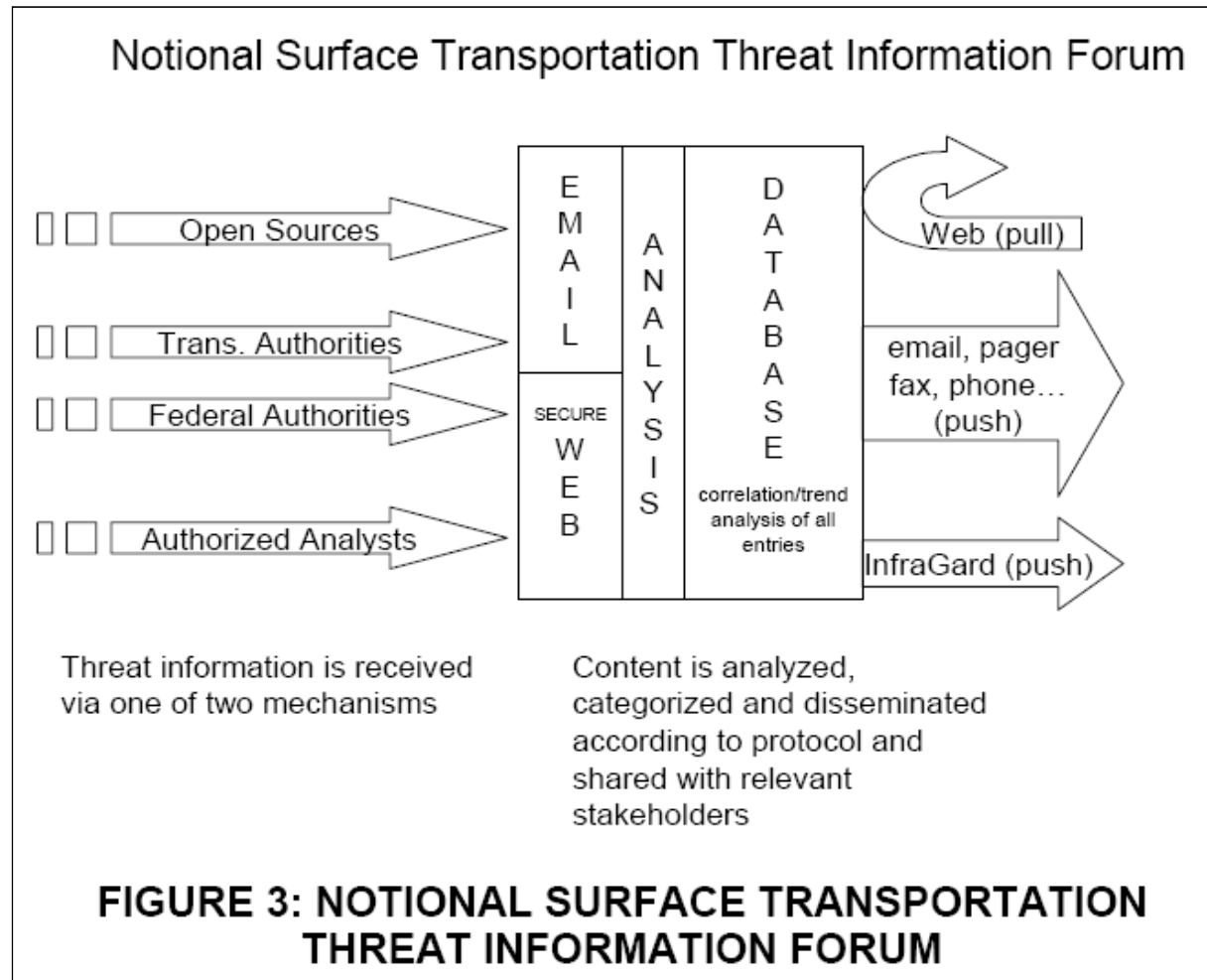


FIGURE 4: DISTRIBUTED IMPLEMENTATION MODEL

NCHRP Report 525, Vol. 2

Information Sharing and Analysis Centers: Overview and Supporting Software Features (2004)

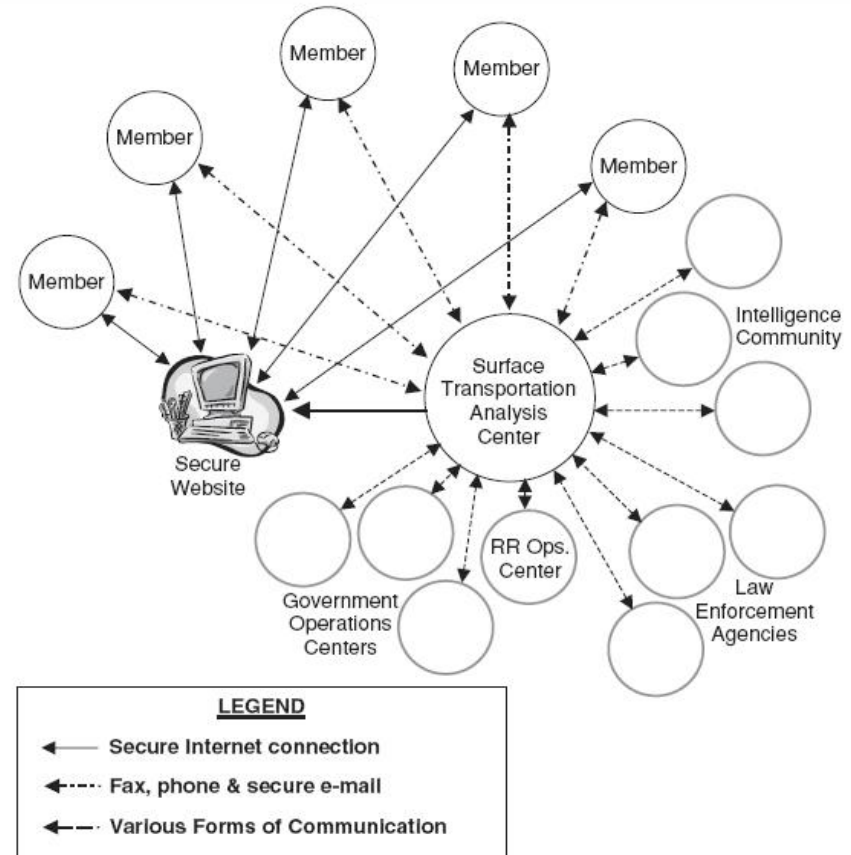
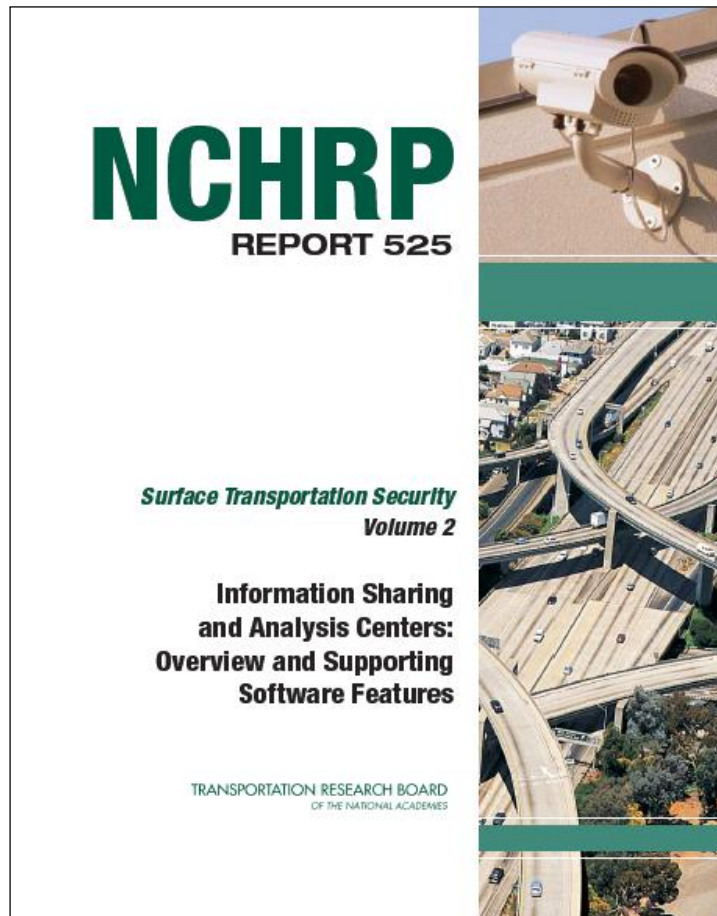
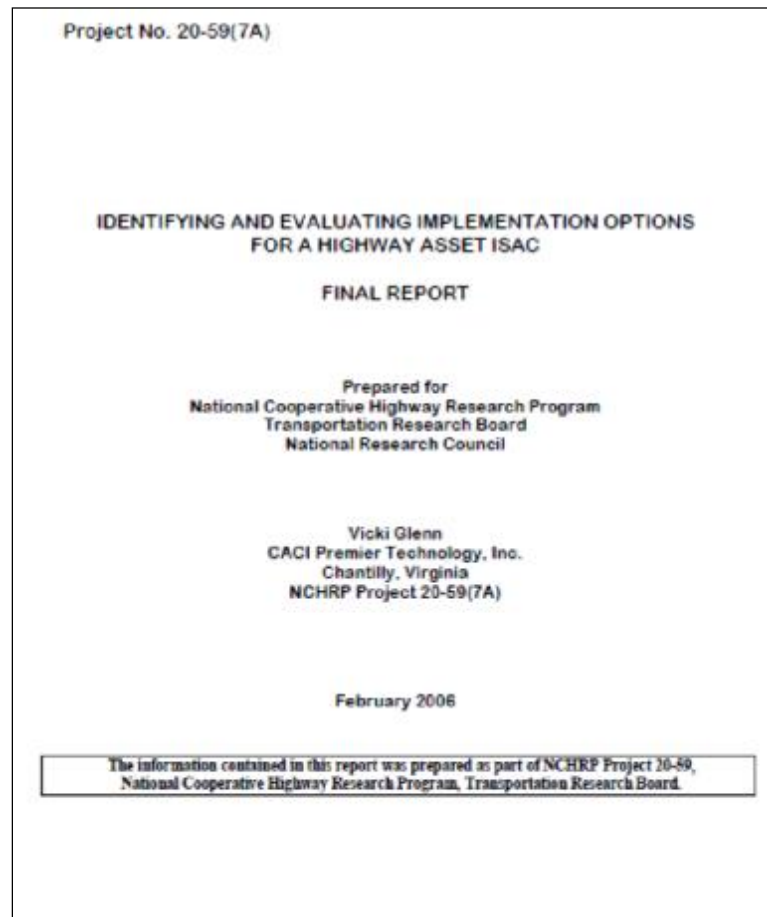


FIGURE 6: TYPICAL ST-ISAC INFORMATION PATHWAYS

Security White Paper (2006)

Identifying and Evaluating Implementation Options for a Highway Asset ISAC



3. Stage I

Technology Assessments

Security White Paper (May 2002)

Public Transportation System Technology Clearinghouse

Task-Order #J-10(2)B

**SECURITY WHITE PAPER ON PUBLIC TRANSPORTATION
SYSTEM TECHNOLOGY CLEARINGHOUSE**

Performed under: Contract NAS#112 --
Task-Order Support for Surface Transportation
Security Research

Submitted to:

Mr. S. A. Parker, Project Manager
Transit Cooperative Research Program
Transportation Research Board
National Research Council
2001 Wisconsin Avenue, NW
Washington, DC 20007

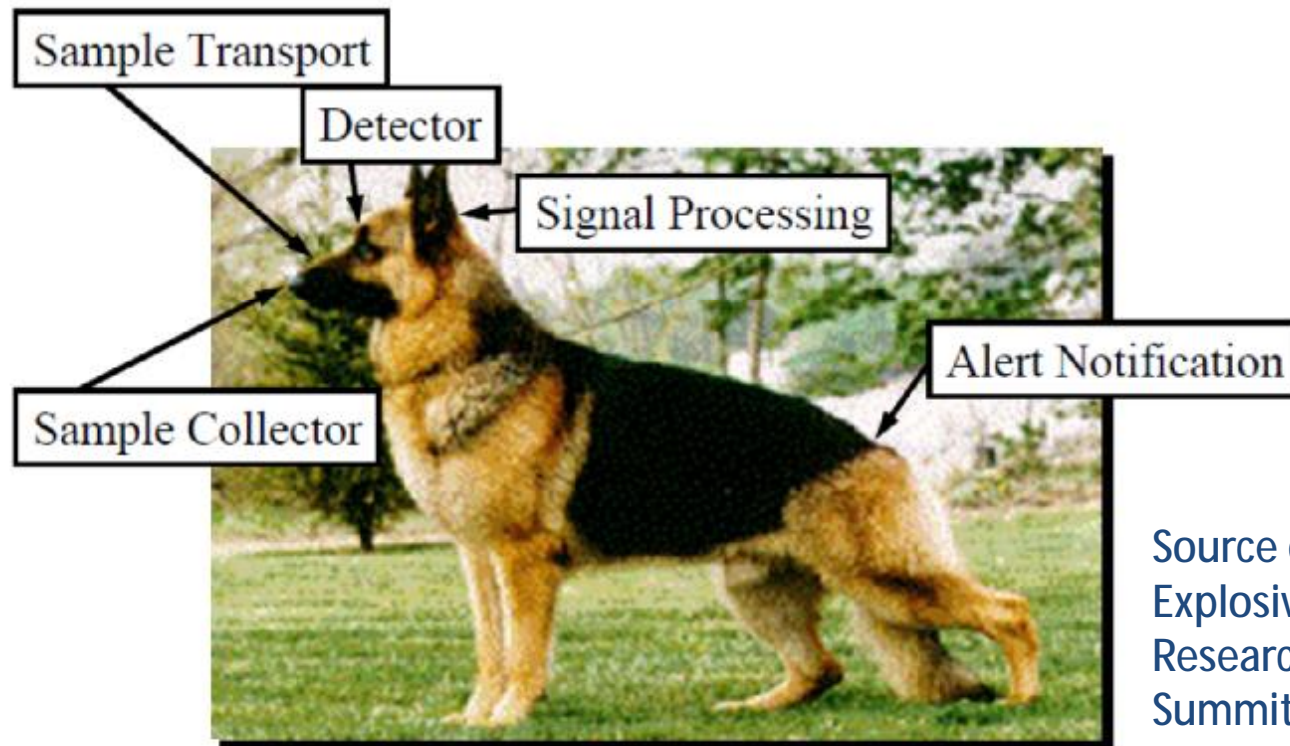
Submitted by:

Roger Jenkins (P.I.)
Science Applications International Corporation
1710 SAIC Drive
McLean, VA 22102
(703) 676 - 8128

Date: May 10, 2002

TCRP Report 86, Vol. 2
*K9 Units in Public Transportation:
A Guide for Decision Makers (2002)*

Anatomy of a Detection System



Source of graphic: DHS. Gongwer -
Explosives Detection Canine
Research - University Network
Summit on Research and Education,
March 16, 2007, Washington DC

TCRP Report 86, Vol. 2

K9 Units in Public Transportation: A Guide for Decision Makers (2002)

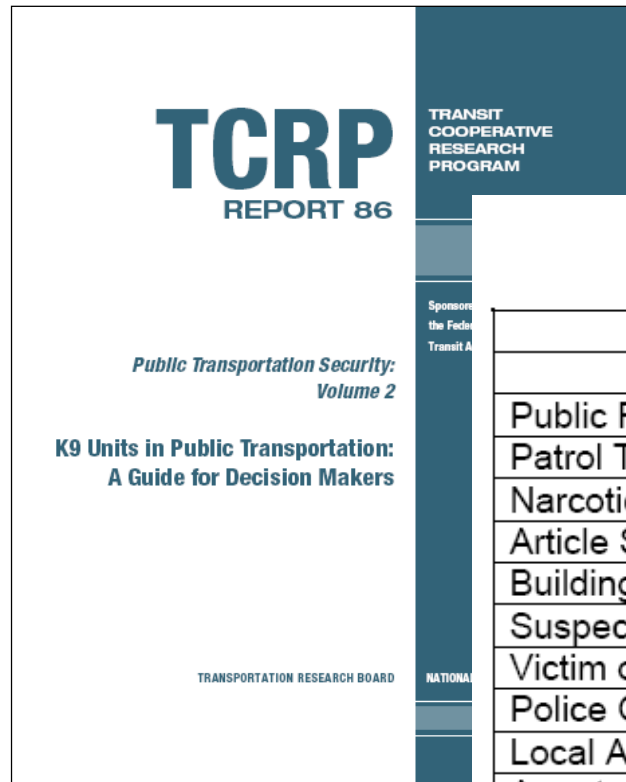
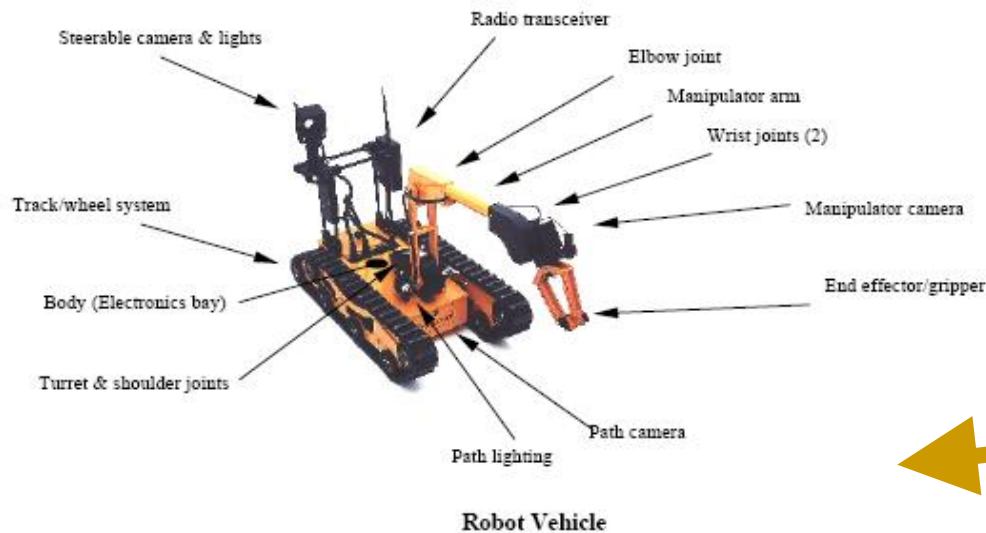


TABLE 22: ACTIVITY OF DUAL PURPOSE K9 TEAM

Activity	Number per Year
Public Relations and Other Demonstrations	10-20
Patrol Tours or Routes (two-hour shifts)	500-700
Narcotics Searches	25-50
Article Search	25
Building Search	100
Suspect Tracking	50
Victim or Lost Person Tracking	1
Police Officer Assist Calls	50
Local Agency Assist Calls	25
Arrests Made or Supported	12-50
Trials and Competitions	2

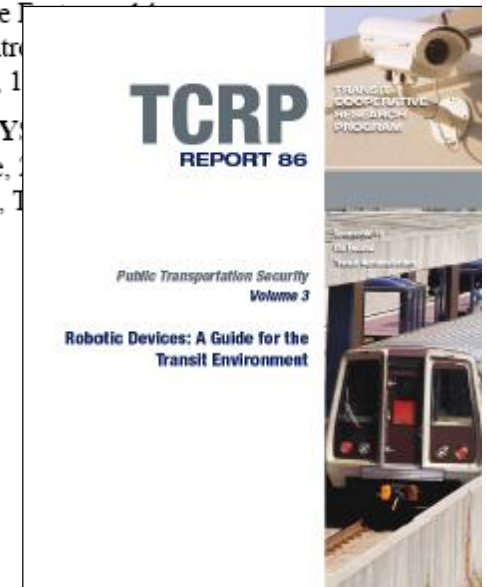
TCRP Report 86, Vol. 3

Robotic Devices for the Transit Environment (2003)



By permission of EOD Performance

1	INTRODUCTION
2	OVERVIEW
2	ENVIRONMENTS
	Structures, 2
	Vehicles, 4
	Vehicle Access/Egress, 4
	Vehicle Pathways, Overheads, and Transitions, 6
	Vehicle Special Obstacles, 7
	Roadways and Terrain, 9
	Weather Conditions, 10
	Optical Navigation Environments, 10
	Radio Environments, 10
	Hazardous Environments, 10
	Other Requirements, 11
	Requirements Specification, 12
13	AVAILABLE ROBOTIC SYSTEMS
	Introduction to Robotic Systems, 13
	Robot Vehicle
	Operator Control
	Available Systems, 1
20	SELECTION ANALYSIS
	Selection Rationale, 2
	Operator Demands, 1
22	GLOSSARY
23	BIBLIOGRAPHY

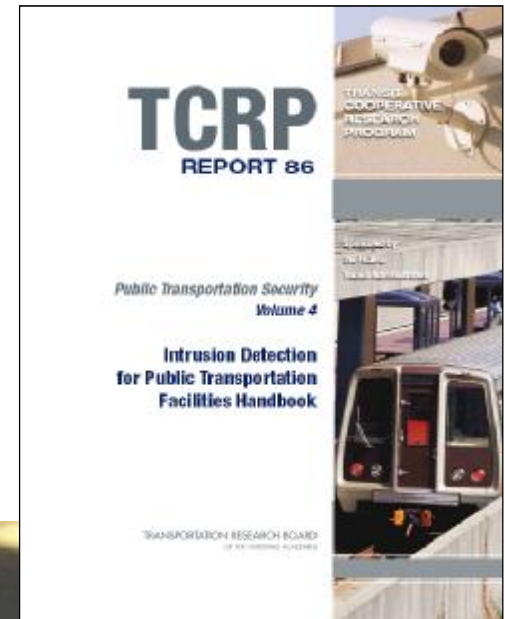
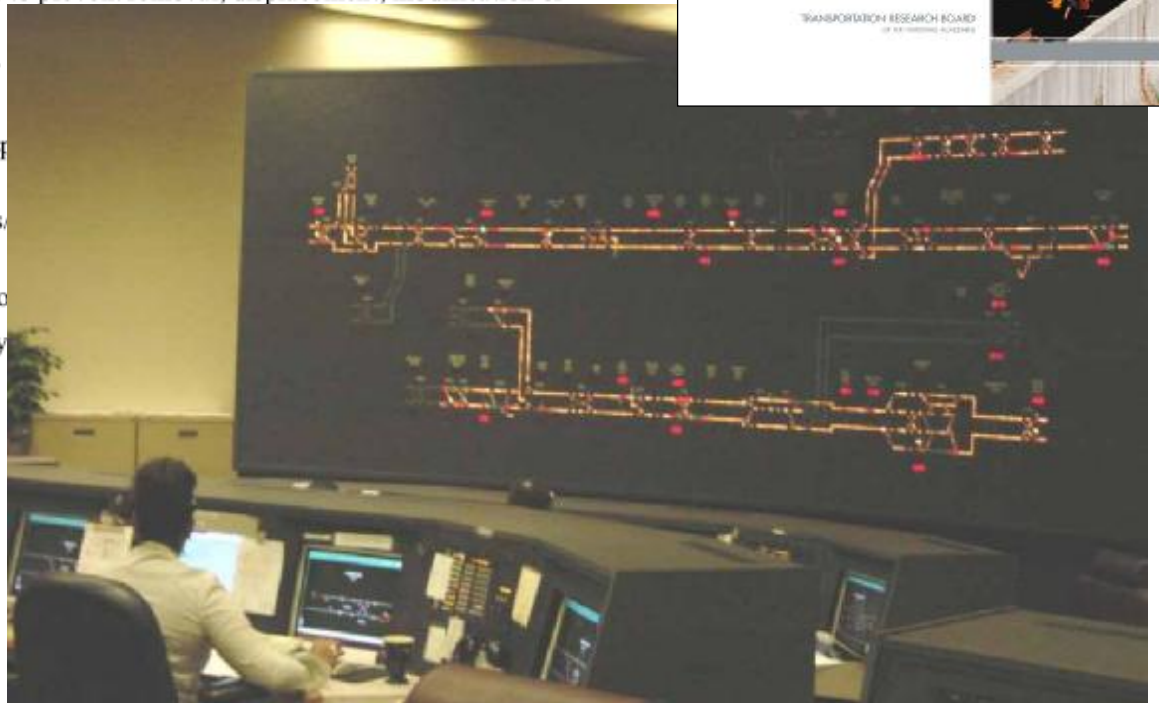


TCRP Report 86, Vol. 4

Intrusion Detection for Public Transportation Facilities Handbook (2003)

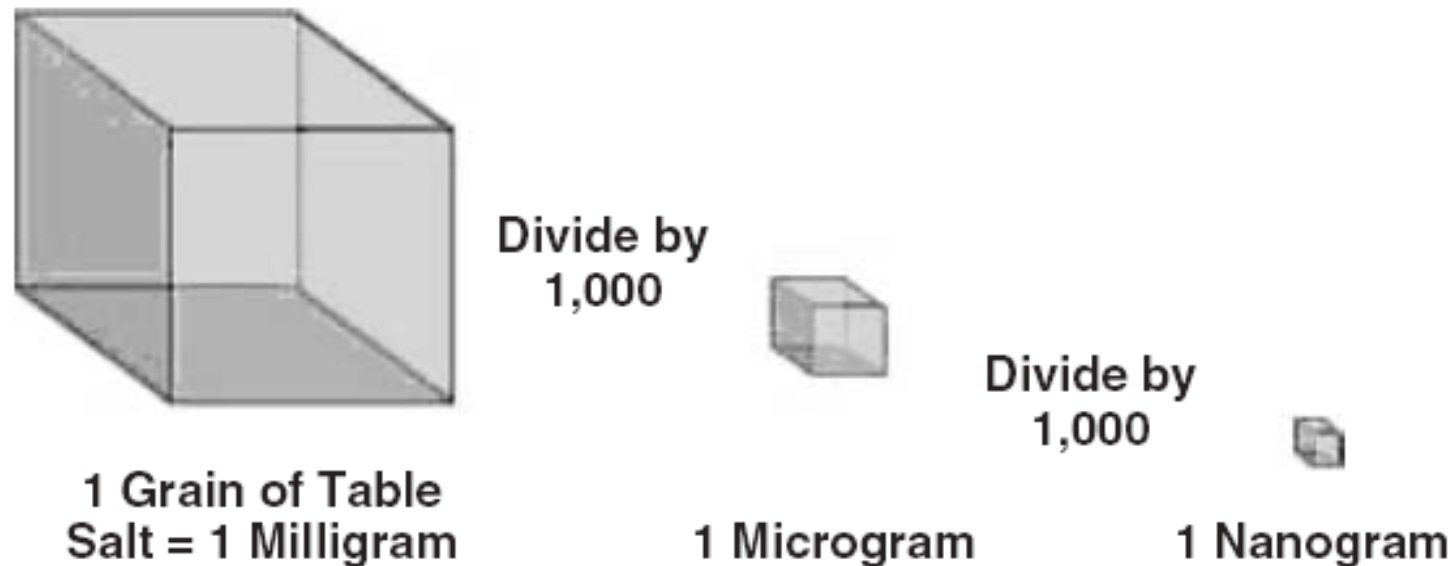
Checklist:

- ☐ Does the lighting system meet the transit agency's established security requirement?
- ☐ Does the lighting system comply with the local building and safety codes?
- ☐ Have lighting effects on neighboring buildings or private homes been considered?
- ☐ Are sufficient portable lighting devices available?
- ☐ Is there a need for specialized spotlighting or infrared (IR) lighting?
- ☐ If required, is there adequate backup electrical power to support the lighting system?
- ☐ Is the lighting system clear of any obstructions within 6-feet (minimum) to 20-feet (ideal)?
- ☐ Is the lighting system properly secured to prevent removal, displacement, modification or theft?
- ☐ If required, are there adequate signs or language(s)?
- ☐ Are procedures in place for routine inspection of hardware?
- ☐ Have the system operators/maintainers provided input to the selection of this system?
- ☐ Are there adequate spare parts to support the system?
- ☐ Is Point-of-Contact information readily available to the system?



TCRP Report 86, Vol. 6

Applicability of Portable Explosive Detection Devices in Transit Environments (2004)



Sensitivity of the tested device: 10 nanograms (not to scale)

4. Stage I

Decontamination

Security White Paper (August 2002)

Public Transportation System Nuclear, Biological, and Chemical Decontamination Procedures

Task-Order #J-10(2)A

SECURITY WHITE PAPER ON PUBLIC TRANSPORTATION SYSTEM NUCLEAR,
BIOLOGICAL, AND CHEMICAL DECONTAMINATION PROCEDURES

Final

Performed under: Contract NAS#112 --
Task-Order Support for Surface Transportation
Security Research

Submitted to:

Mr. S. A. Parker, Project Manager
Transit Cooperative Research Program
Transportation Research Board
National Research Council
2001 Wisconsin Avenue, NW
Washington, DC 20007

Submitted by:

Roger Jenkins (P.I.)
Science Applications International Corporation
1710 SAIC Drive
McLean, VA 22102
(703) 676 - 8128

Date: August 23, 2002

Innovations Deserving Exploratory Analysis (IDEA)

Nine Transit IDEA projects address security.



January 6, 2006, presentation on Transit IDEA Project 45, Chemical and Biological Decontamination System for Rail Transit Facilities (completed January 2007).

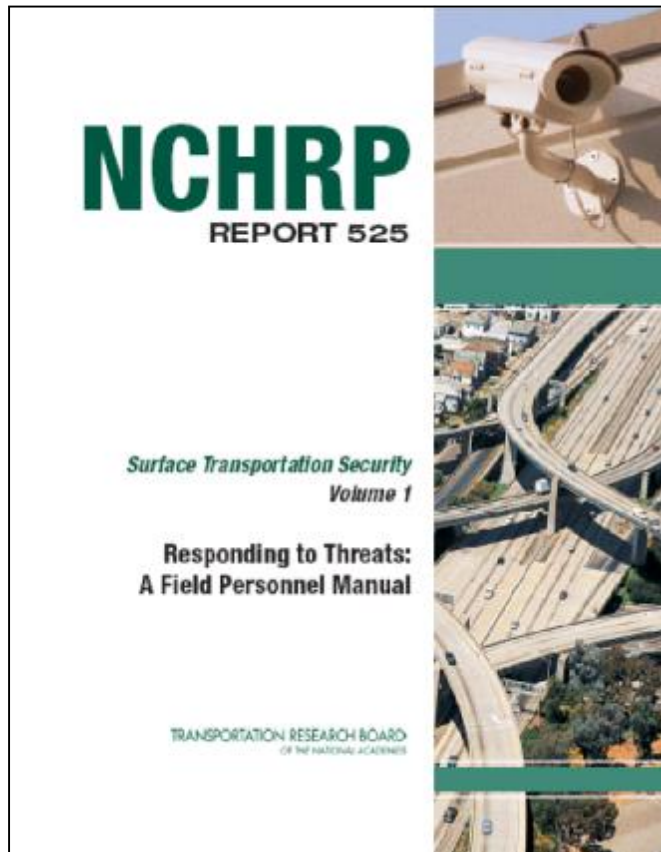
5. Stage I

Training

NCHRP Report 525, Vol. 1

Responding to Threats: A Field Personnel Manual

(2004)



- 1** Introduction, 1
- 2** How Terrorists/Criminals Select a Target or a Victim, 2
- 3** Potential Targets, 3
- 4** What the Terrorist/Criminal Needs to Know, 4
- 5** Where to Look, 5
- 6** What to Look For, 7
- 7** How and What to Report, 10
- 8** When to Intervene, 12
- 9** Potential Actions to Further Improve Security, 13
- 10** Sample Report, 15
- 11** Contact List, 16
- 12** A Few Key Reminders, 17

Provides a draft template that contains basic security awareness training in a workbook format that can be redesigned as a pamphlet, glove-box brochure, or other user-specific document.

NCHRP Report 525, Vol. 7

System Security Awareness for Transportation Employees (2005)

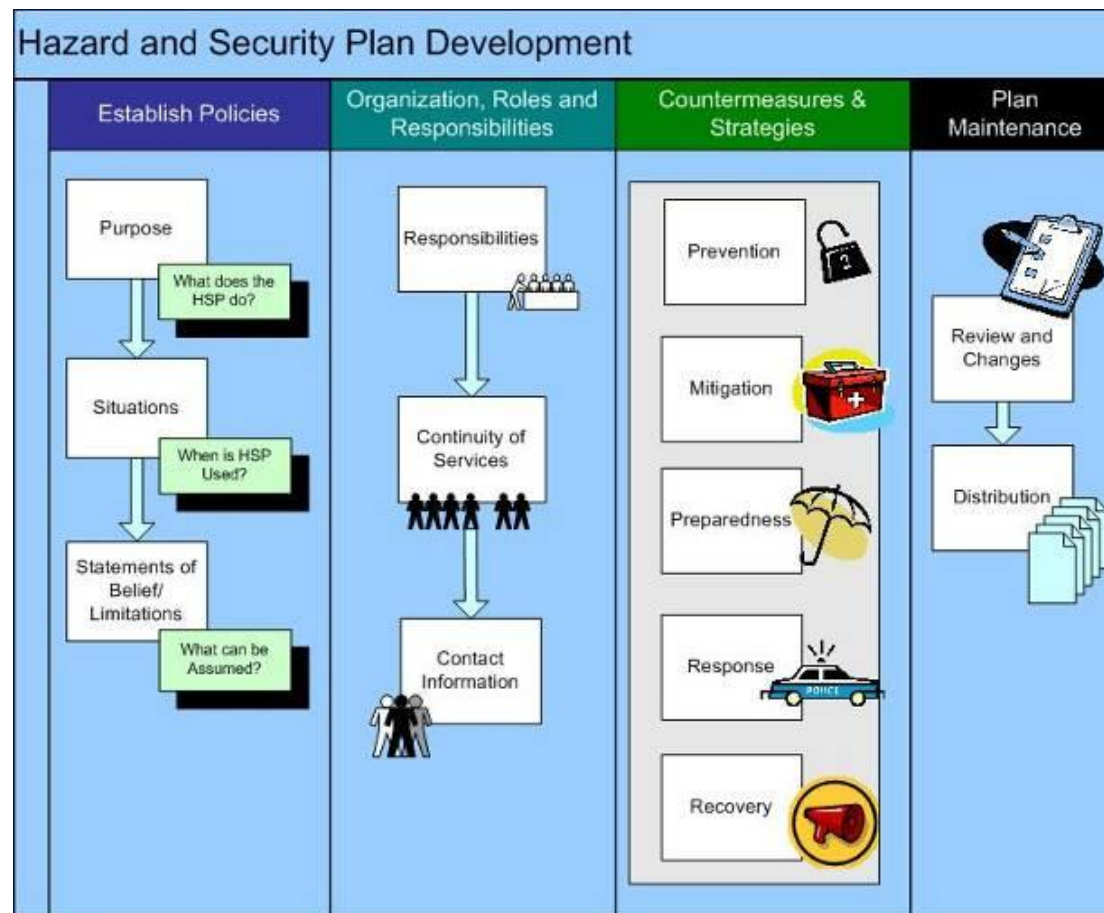


An interactive CD-ROM training course; also provided as train-the-trainer and by direct delivery through the National Transit Institute

TCRP Report 86, Vol. 10

Hazard and Security Plan Workshop: Instructor Guide (2006)

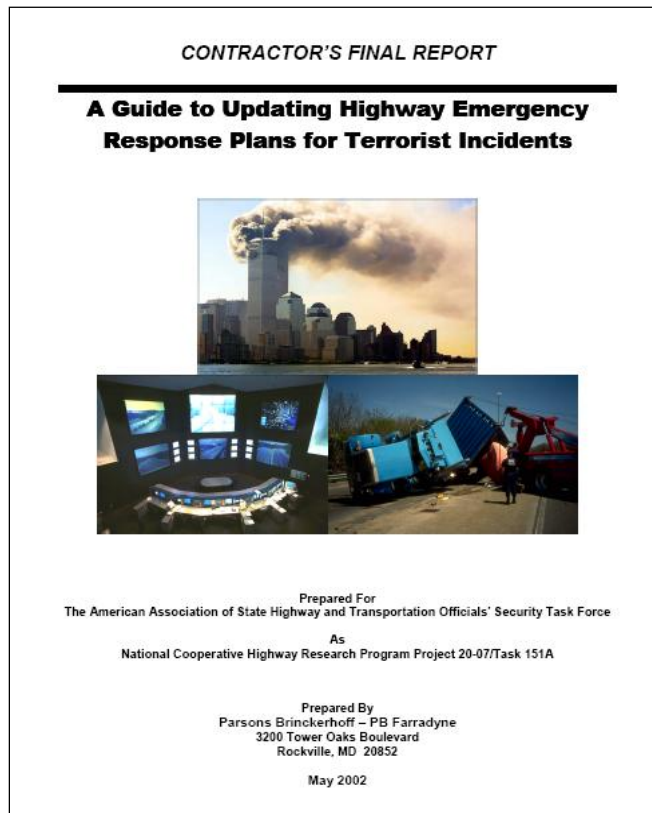
Hazard and Security Planning Tools for Rural, Small Urban, and Community-Based Public Transportation Operations



6. Stage I

Immediate Guidance on Risk Management and Emergency Response

A Guide to Updating Highway Emergency Response Plans for Terrorist Incidents available May 2002



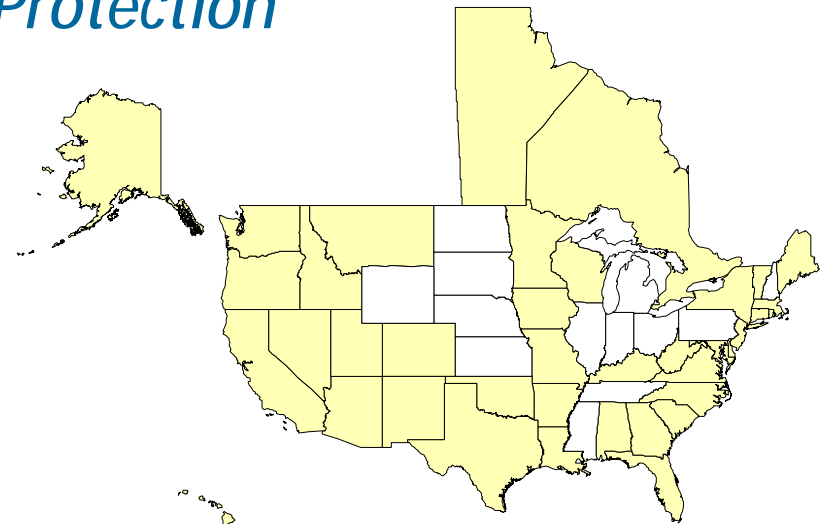
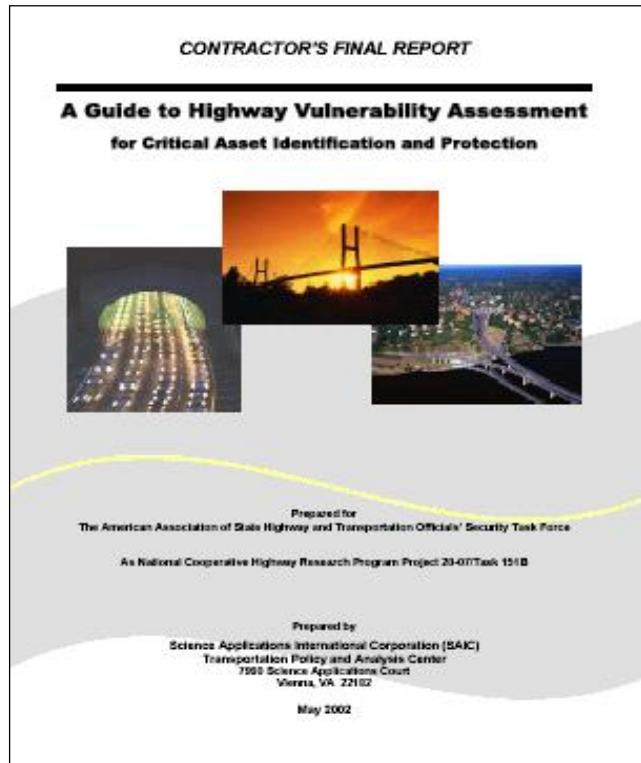
Emergency Transportation
Operations Preparedness
& Response Workshops
For Statewide Applications

June – November 2003

1. New Mexico
2. Minnesota
3. Washington
4. Idaho

<http://security.transportation.org/sites/security/docs/guide-ResponsePlans.pdf>

A Guide to Highway Vulnerability Assessment for Critical Asset Identification and Protection



Bridge/Tunnel/Highway Infrastructure Vulnerability Workshop Attendees February-March 2003

1. Sacramento, California
2. Albany, New York
3. Austin, Texas

http://security.transportation.org/sites/security/docs/guide-VA_FinalReport.pdf
http://security.transportation.org/sites/security/docs/guide-VA_Appendices.pdf

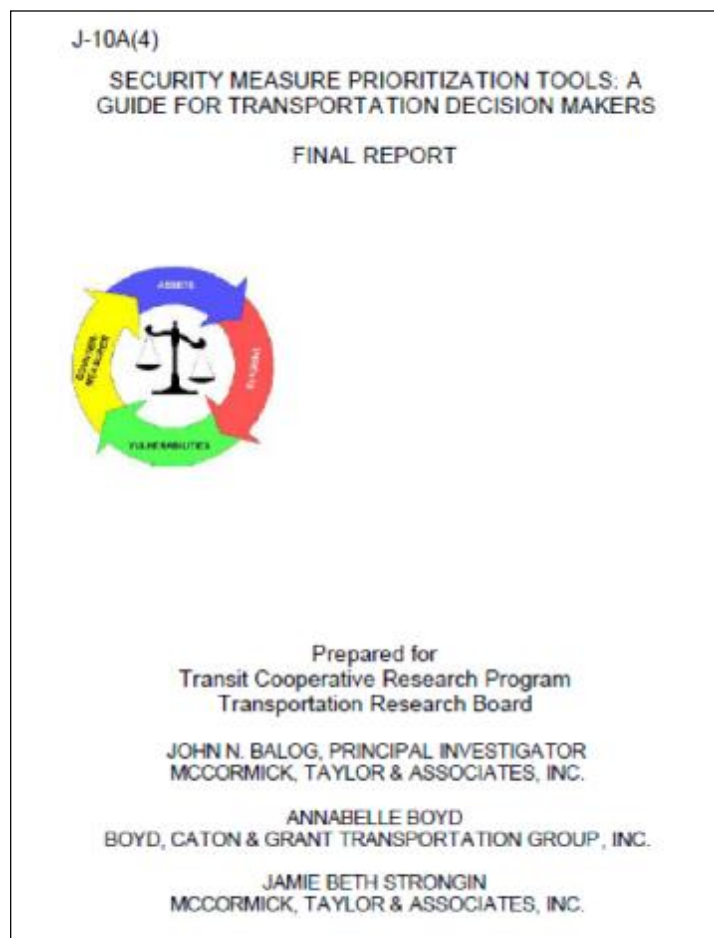
NCHRP Report 525, Vol. 4
A Self-Study Course on Terrorism-Related Risk Management of Highway Infrastructure (2005)

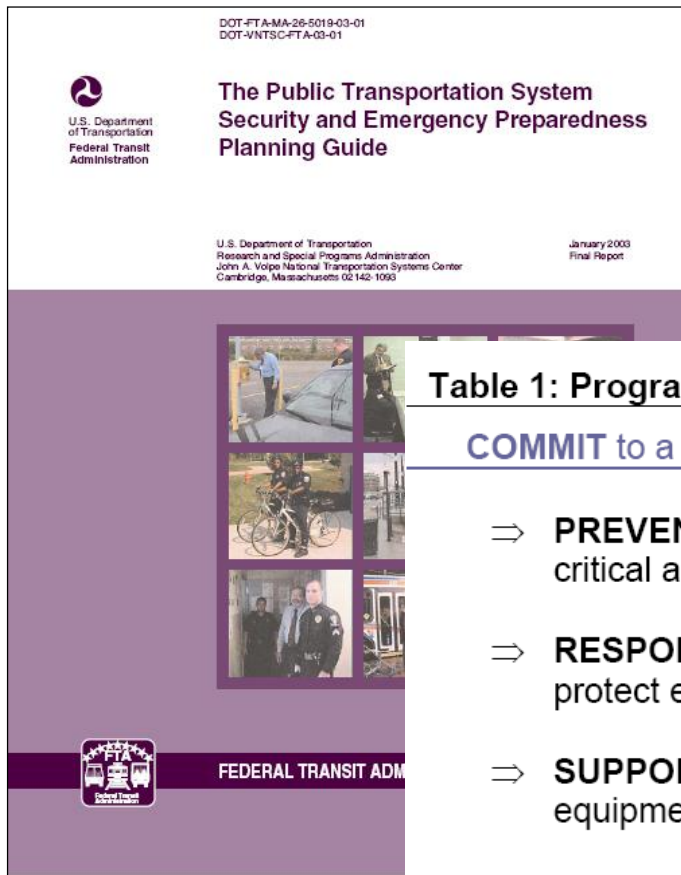
Vulnerability Issues		Countermeasures	C/E
Perception	•Demonstrated defense	• <i>Deter</i> Discourage attacks by visibility of countermeasures	<div>Level of protection</div> <div>Level of cost</div> <div>Cost-effectiveness</div>
Ease of Access	•Adjacent land-use •Road approach •Vessel approach	• <i>Deny</i> Increase standoff distance from bridge substructure and tunnel entrances	
Clear zone	•Adjacent vegetation •Adjacent buildings	• <i>Dynamic</i> Threat-adjustable operational measures (inspections)	
Exposure	•Lighting level •Visibility	• <i>Detect</i> Monitor access to bridge substructure and tunnel portals to minimize time on targets	
Time on target	•Detection •Response		
Structure	•Scale •Specific features	• <i>Defend</i> Harden key structural elements	

Security White Paper (May 2003)

Security Measure Prioritization Tools:

A Guide for Transportation Decision Makers





The Public Transportation System Security and Emergency Preparedness Planning Guide (2003)

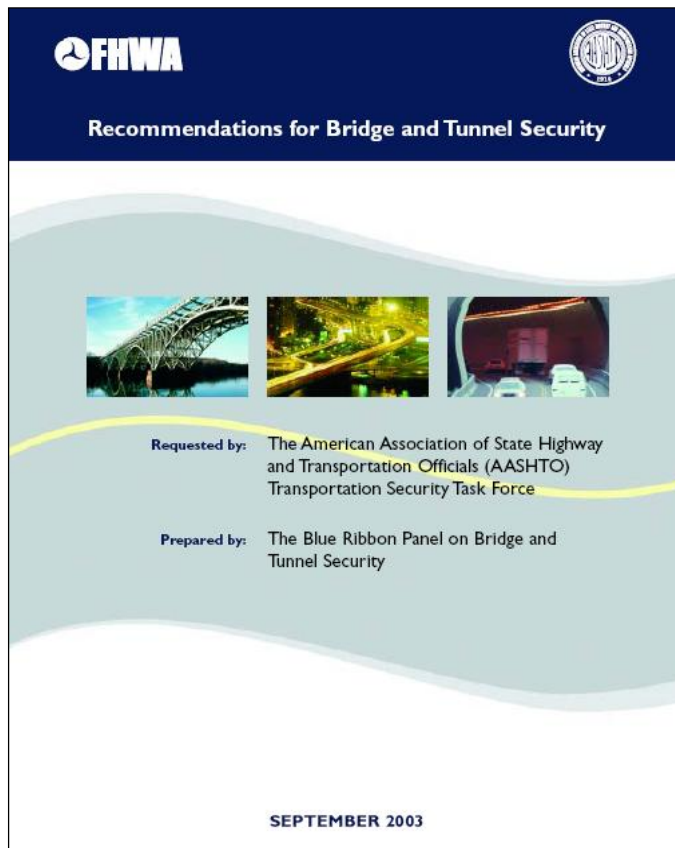
Table 1: Program of Commitments

COMMIT to a program that enables the public transportation system to:

- ⇒ **PREVENT** incidents within its control and responsibility, effectively protect critical assets;
- ⇒ **RESPOND** decisively to events that cannot be prevented, mitigate loss, and protect employees, passengers, and emergency responders;
- ⇒ **SUPPORT** response to events that impact local communities, integrating equipment and capabilities seamlessly into the total effort; and
- ⇒ **RECOVER** from major events, taking full advantage of available resources and programs.

<http://www.transit-safety.volpe.dot.gov/Publications/security/PlanningGuide.pdf>

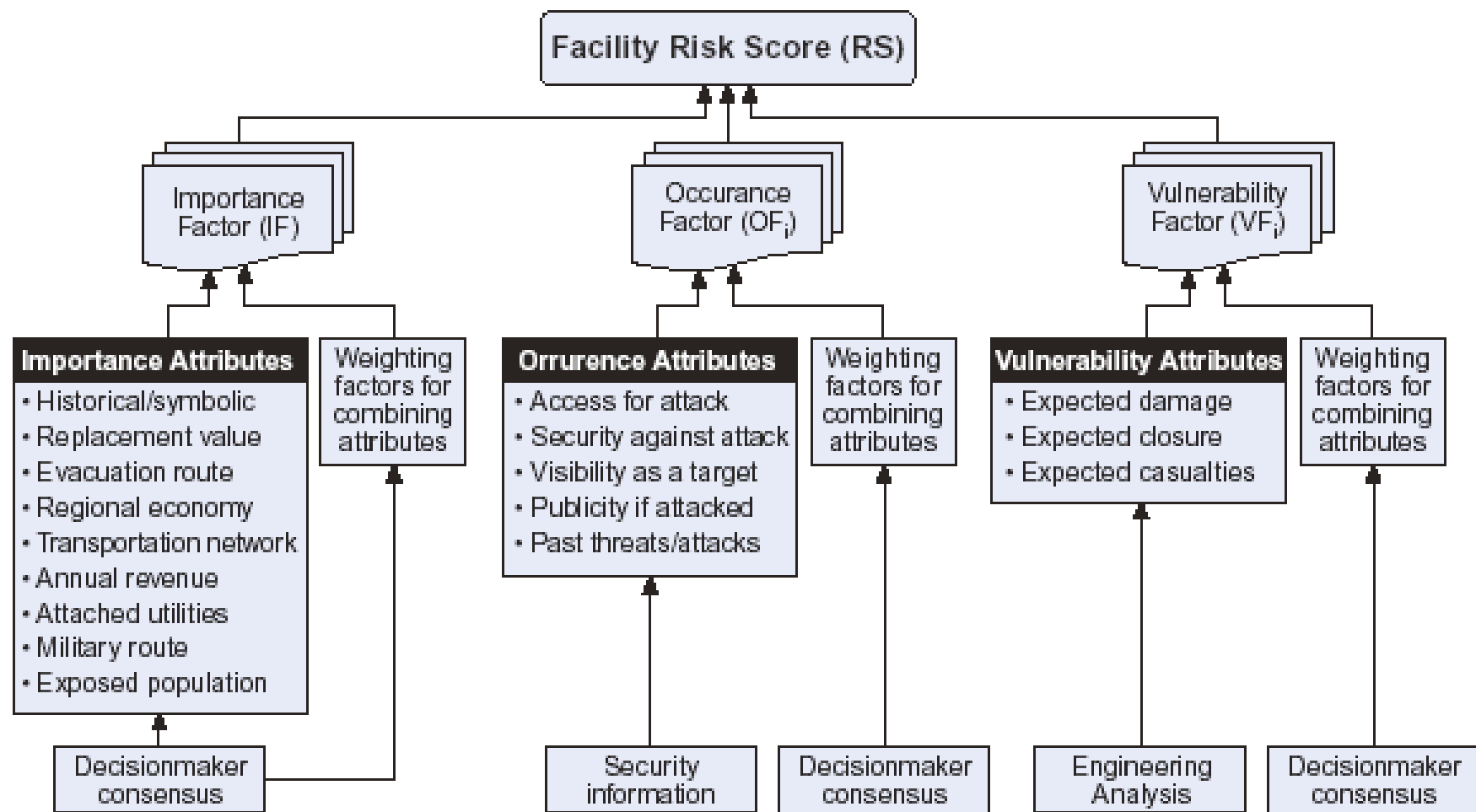
Recommendations for Bridge and Tunnel Security (2003)



“Blue Ribbon Panel on Bridge and Tunnel Security” report presented institutional, fiscal, and technical recommendations

<http://www.fhwa.dot.gov/bridge/security/brpcover.htm>
http://trb.org/news/blurb_detail.asp?id=1872

Components in Risk Assessment for a Facility



7. Stage II

Development of Organizational Capacity to Support Security and Emergency Management Activities

NCHRP Report 525, Vol. 3

Incorporating Security Into the Transportation Planning Process (2005)

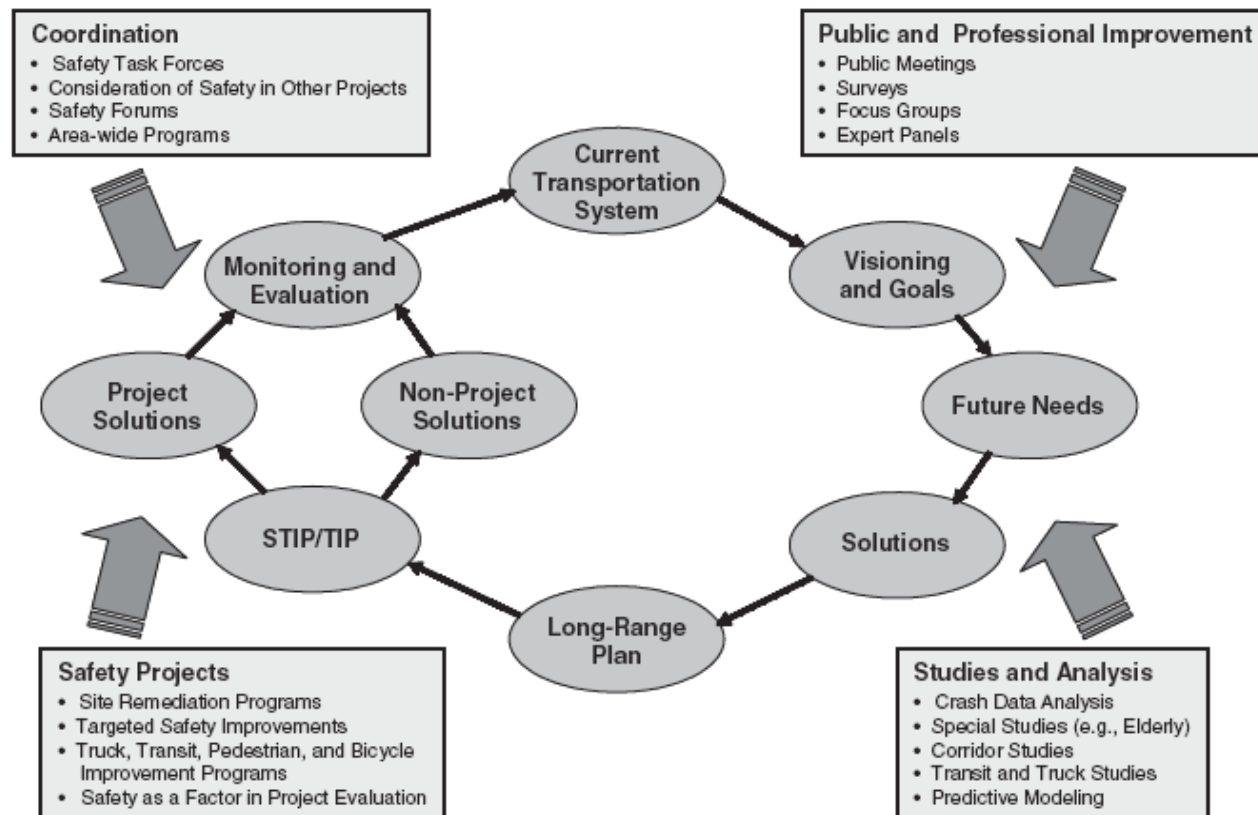
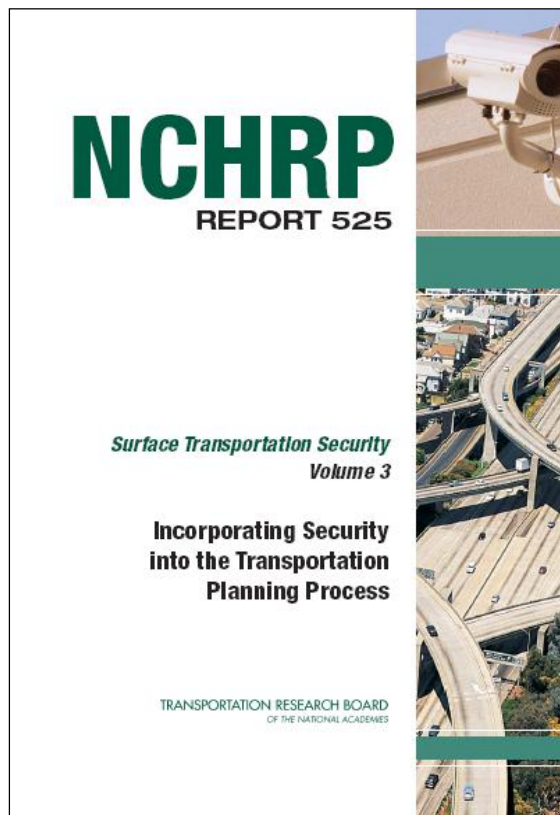


Figure 3. Overview of the transportation planning process in the context of safety (adapted from FHWA, *Citizen's Guide to Transportation Decisionmaking*, FHWA EP-01-013, 2001).

Peer Exchange Series: State & Metropolitan Transportation Planning Issues

Disaster Response in Transportation Planning (2007)

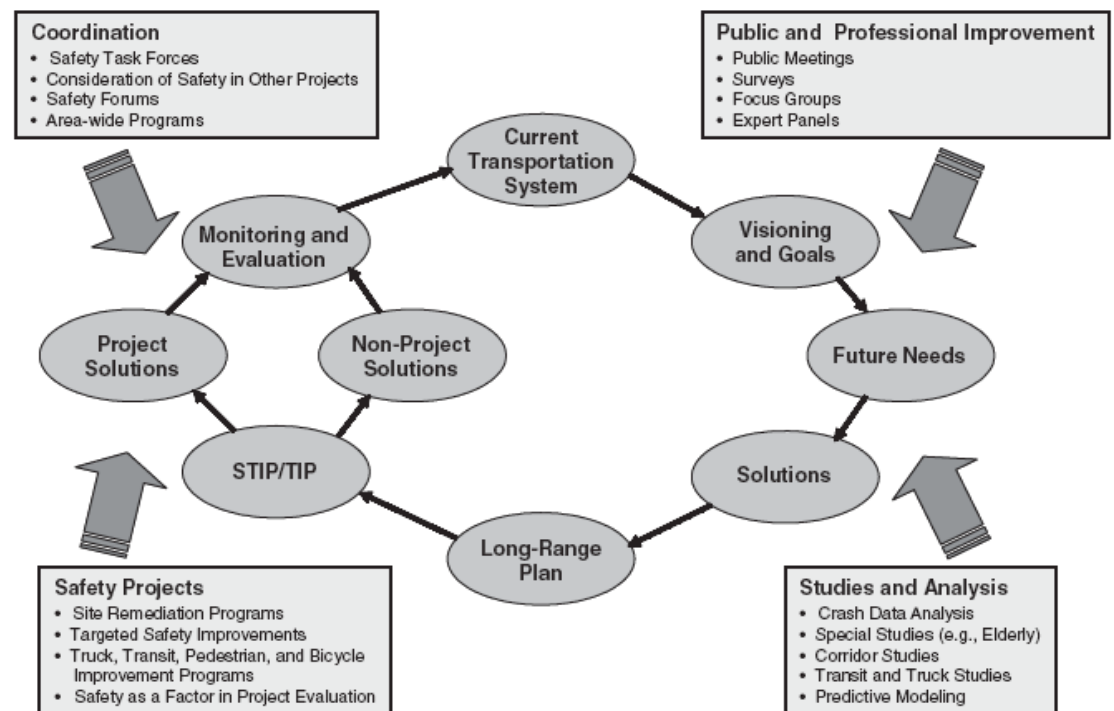
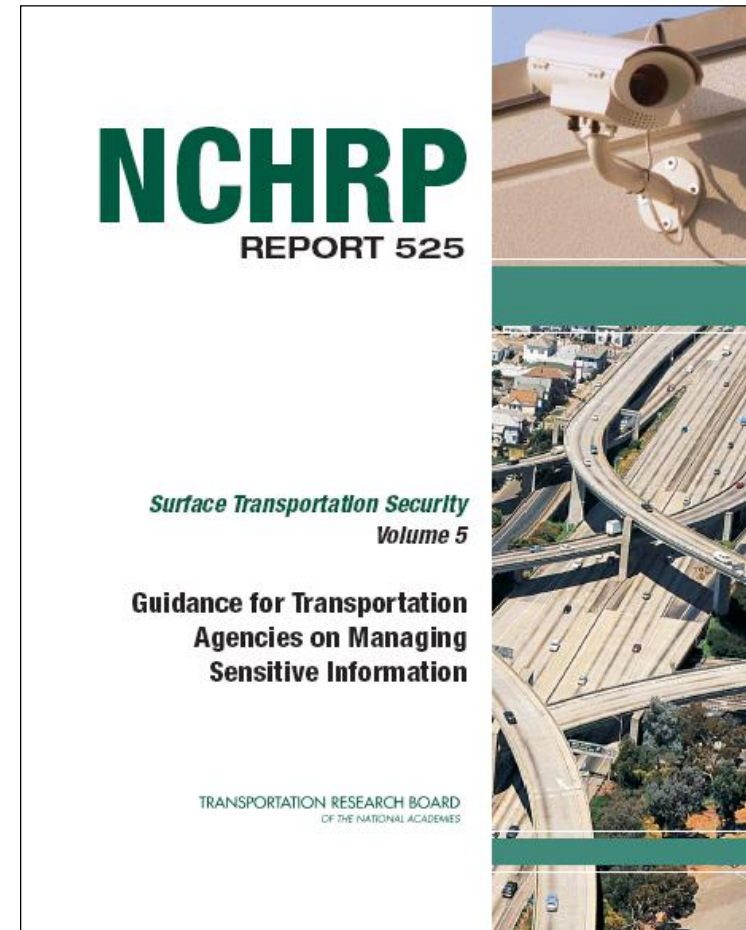


Figure 3. Overview of the transportation planning process in the context of safety (adapted from FHWA, *Citizen's Guide to Transportation Decisionmaking*, FHWA EP-01-013, 2001).

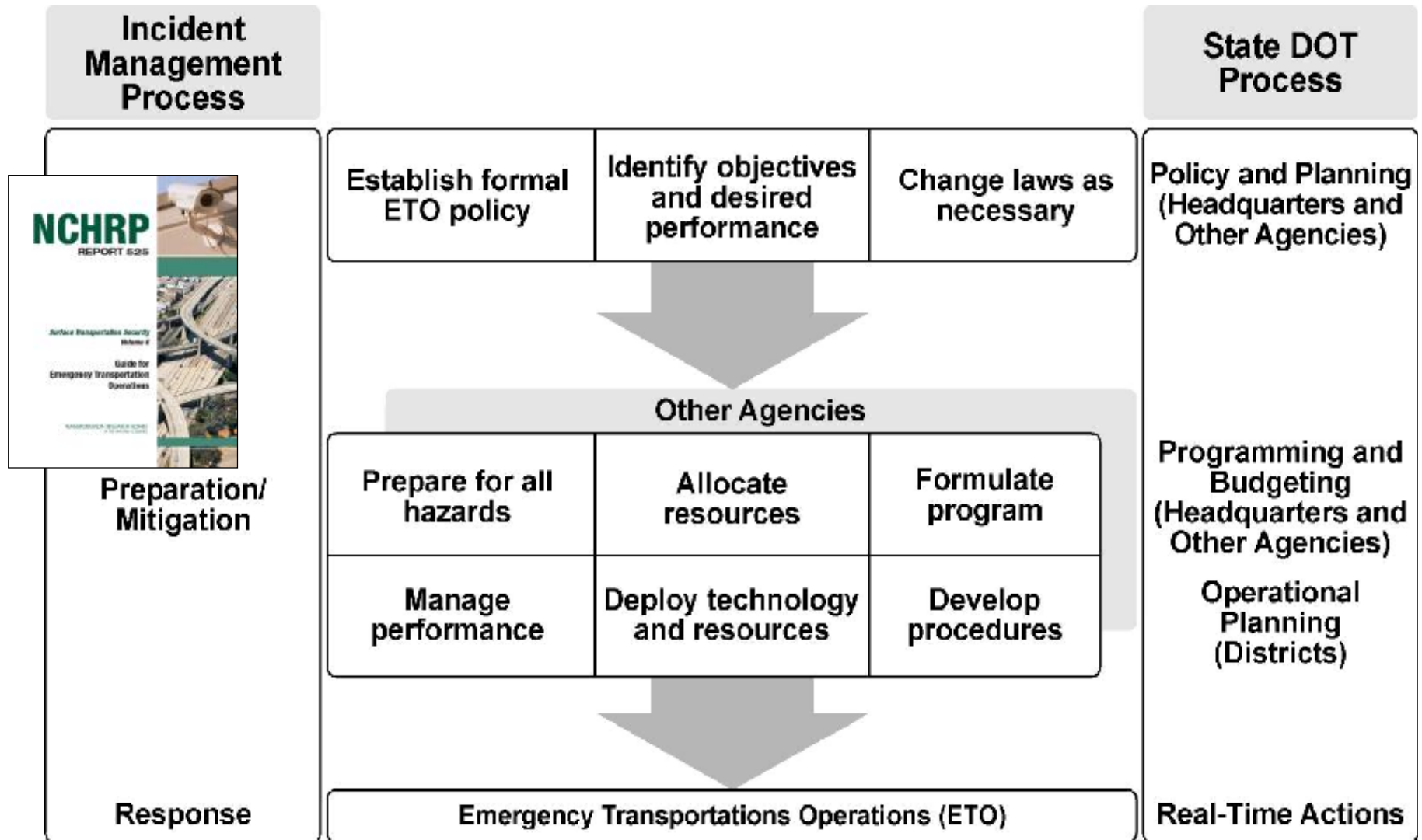
NCHRP Report 525, Vol. 5
***Guidance for Transportation Agencies
on Managing Sensitive Information (2005)***

- 1** Establishing a Sensitive Information Management Policy, 1
- 2** Identifying Sensitive Information, 3
- 3** Controlling Access to Sensitive Information, 5
- 4** Keys for Success, 10
- Appendix A** Florida DOT's Exempt Documents and Security System Plan Request Form, A-1
- Appendix B** Texas DOT's Confidential Safety Information Memorandum, B-1
- Appendix C** Examples of State Legislation to Exempt Selected Sensitive Transportation-Related Information from State "FOIA" Laws, C-1



NCHRP Report 525, Vol. 6

Guide for Emergency Transportation Operations (2005)

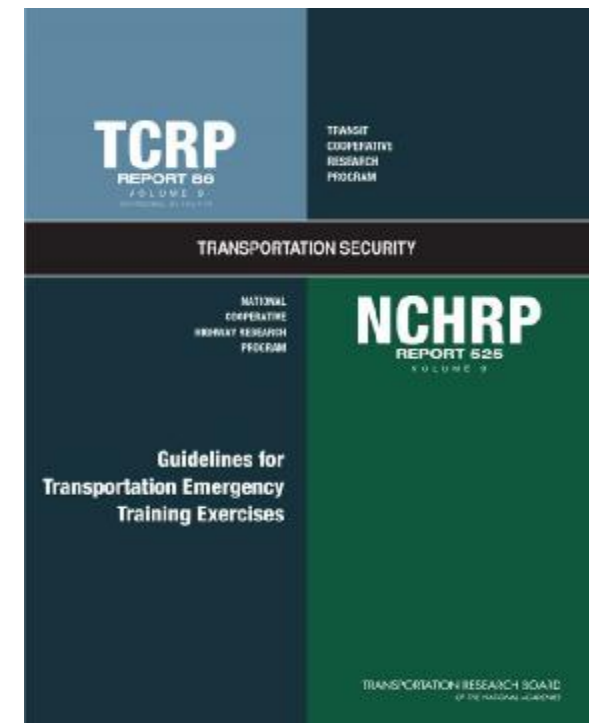


TCRP Report 86, Vol. 9 / NCHRP Report 525, Vol. 9 (2006)

Guidelines for Transportation Emergency Training Exercises

TABLE 1 EMERGENCY EVENTS AFFECTING TRANSPORTATION AGENCIES

Naturally Occurring	Human-Caused	
	Intentional	Unintentional
<ul style="list-style-type: none"> ▶ Droughts ▶ Dust/Wind Storms ▶ Earthquakes ▶ Electrical Storms ▶ Floods ▶ High Winds ▶ Hurricanes ▶ Ice Storms ▶ Landslides ▶ Naturally Occurring Epidemics ▶ Snowstorms and Blizzards ▶ Tornadoes ▶ Tropical Storms ▶ Tsunamis ▶ Typhoons ▶ Wildfires 	<ul style="list-style-type: none"> ▶ Bomb Threats and Other Threats of Violence ▶ Disruption of Supply Sources ▶ Fire/Arson ▶ Fraud/Embezzlement ▶ Labor Disputes/Strikes ▶ Misuse of Resources ▶ Riot/Civil Disorder ▶ Sabotage: External and Internal Actors ▶ Security Breaches ▶ Terrorist Assaults Using Chemical, Biological, Radiological, or Nuclear Agents ▶ Terrorist Assaults Using Explosives, Firearms, or Conventional Weapons ▶ Theft ▶ Vandalism ▶ War ▶ Workplace Violence 	<ul style="list-style-type: none"> ▶ Accidental Contamination or Hazardous Materials Spills ▶ Accidental Damage to or Destruction of Physical Plant and Assets ▶ Accidents That Affect the Transportation System ▶ Gas Outages ▶ Human Errors ▶ HVAC System Failures or Malfunctions ▶ Inappropriate Training on Emergency Procedures ▶ Power Outages ▶ Software/Hardware Failures or Malfunctions ▶ Unavailability of Key Personnel ▶ Uninterruptible Power Supply (UPS) Failure or Malfunction ▶ Voice and Data Telecommunications Failures or Malfunctions ▶ Water Outages



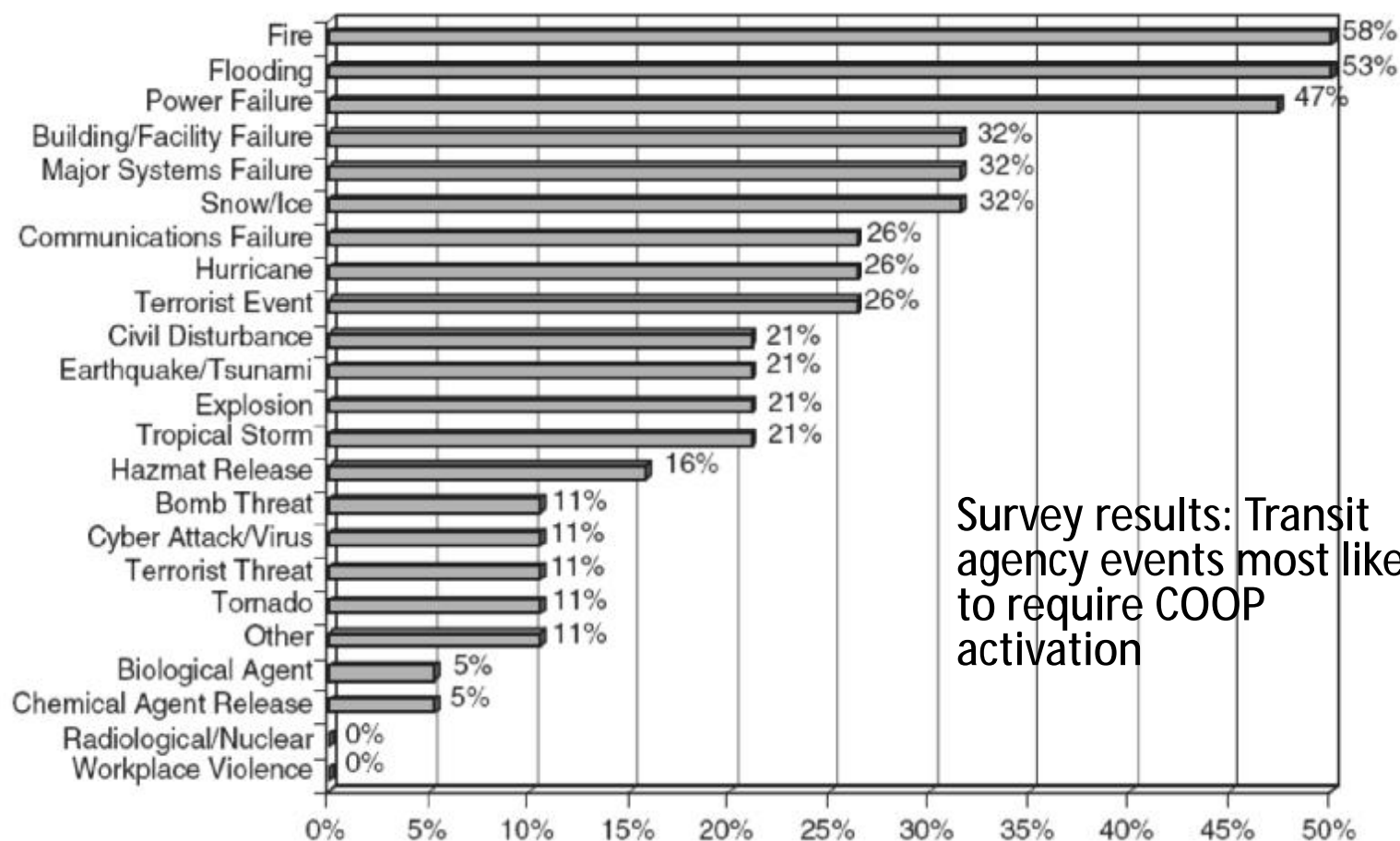
Guidelines for Transportation Emergency Training Exercises

- Guidelines, resource CD-ROM and templates for developing a Progressive Exercise Program, compliant with DHS and ODP requirements
- Exercise program must address NIMS requirements and Transit Emergency Response Plan and procedures.
- Moves users through the steps necessary to develop and implement a three-year program.
- Practical emphasis on affordable exercises, cost sharing, and grant opportunities.

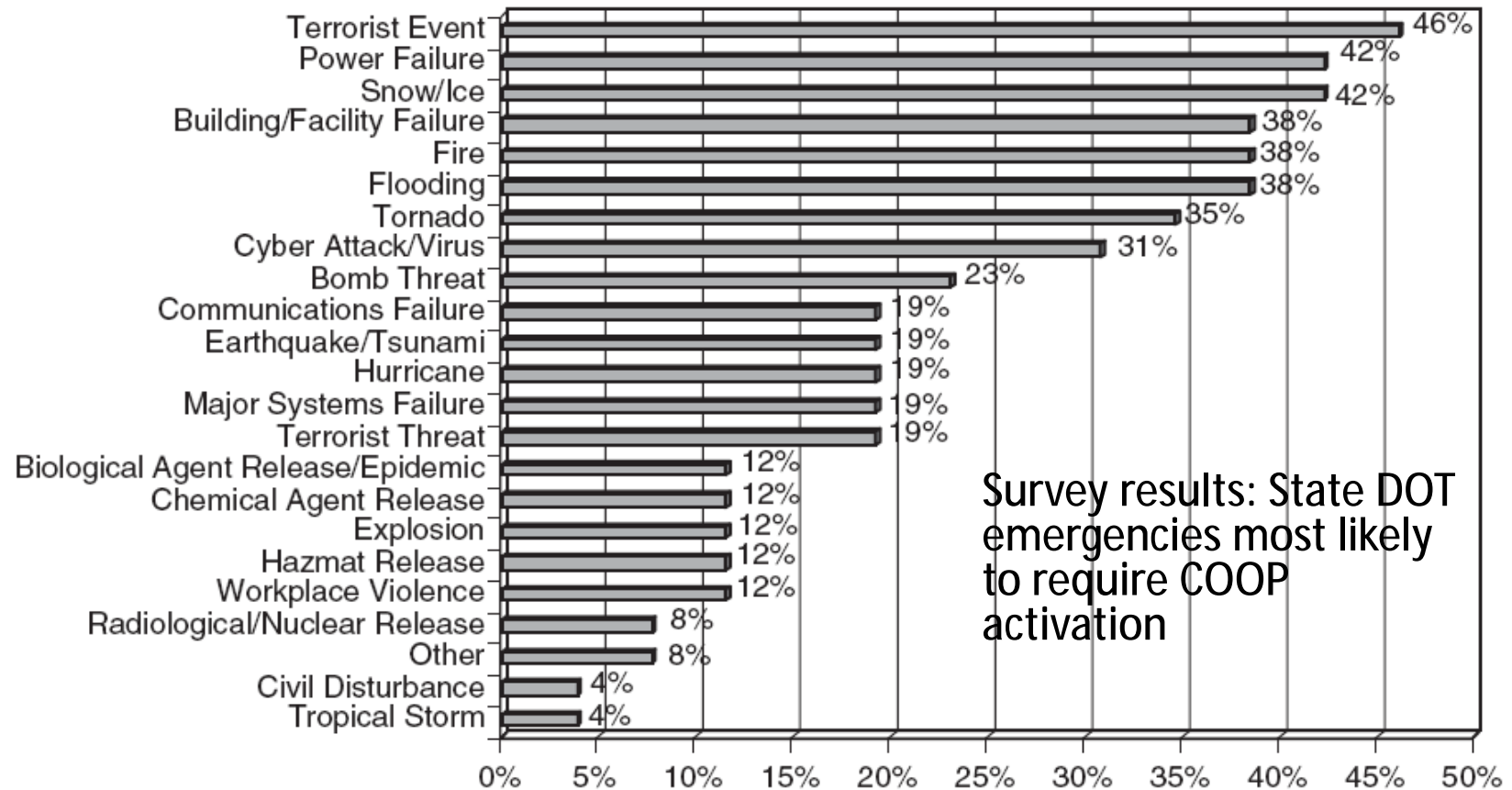
Building Block Approach



NCHRP Report 525, Vol. 8 / TCRP Report 86, Vol. 8
*Continuity of Operations (COOP) Planning Guidelines
for Transportation Agencies (2005)*



NCHRP Report 525, Vol. 8 / TCRP Report 86, Vol. 8
*Continuity of Operations (COOP) Planning Guidelines
for Transportation Agencies (2005)*



NCHRP Legal Research Digest 49

Emergency Contracting: Flexibilities in Contracting Procedures during an Emergency (2007)

- I. Introduction—When Is
- Emergency Contracting
- Applicable?
- II. The Concept of Flexibility
- for Contracting in Emergency
- Situations and How It
- Can Be Misused
- III. Basic Conditions for
- Waiving Contract
- Requirements in
- Emergency Situations
- IV. Range of Contracting
- Options
- V. Specific Authority to
- Waive Certain Contracting
- Requirements



- VI. Federal Statutes
- Applicable to State
- Emergency Procurements
- (Title 23)
- VII. Limitations Imposed
- by FEMA for Reimbursement to
- the States in an Emergency
- VIII. Impact of Limitations
- Imposed by FEMA for
- Reimbursement
- to the States for
- Emergency Procurements
- IX. General Guidance That
- Has Been Issued on Federal
- Emergency Contracting
- X. Summary and Conclusion

8. Stage II

Specialized Guidance

Security-Related Customer Communications and Training for Public Transportation Providers (2004)

1. Being Prepared: Security Training and Communication (video)
2. Overview (PowerPoint presentation)
3. Guide to Security-Related Customer Communications and Training for Public Transportation Providers (final report for Volume 5 of TCRP Report 86, in pdf)
4. Templates of Communication Devices Presented in the Final Report for Volume 5 of TCRP Report 86 (MS-Word)

CD-ROM contains all 4 items

Response

All-hazards approach

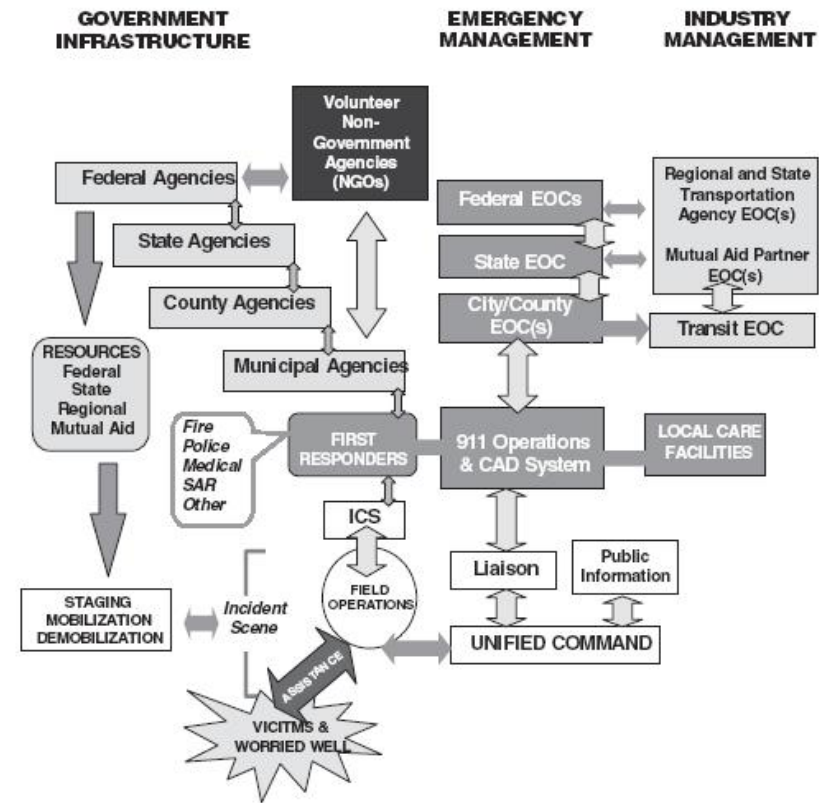
- **Natural disasters (e.g., hurricanes, tornadoes, floods, storms)**
- **Human accidents (e.g., hazardous materials spills, fires)**
- **Terrorism**

Communication protocols must be applicable to all emergency events



Public Transportation Emergency Mobilization and Emergency Operations Guide (2005)

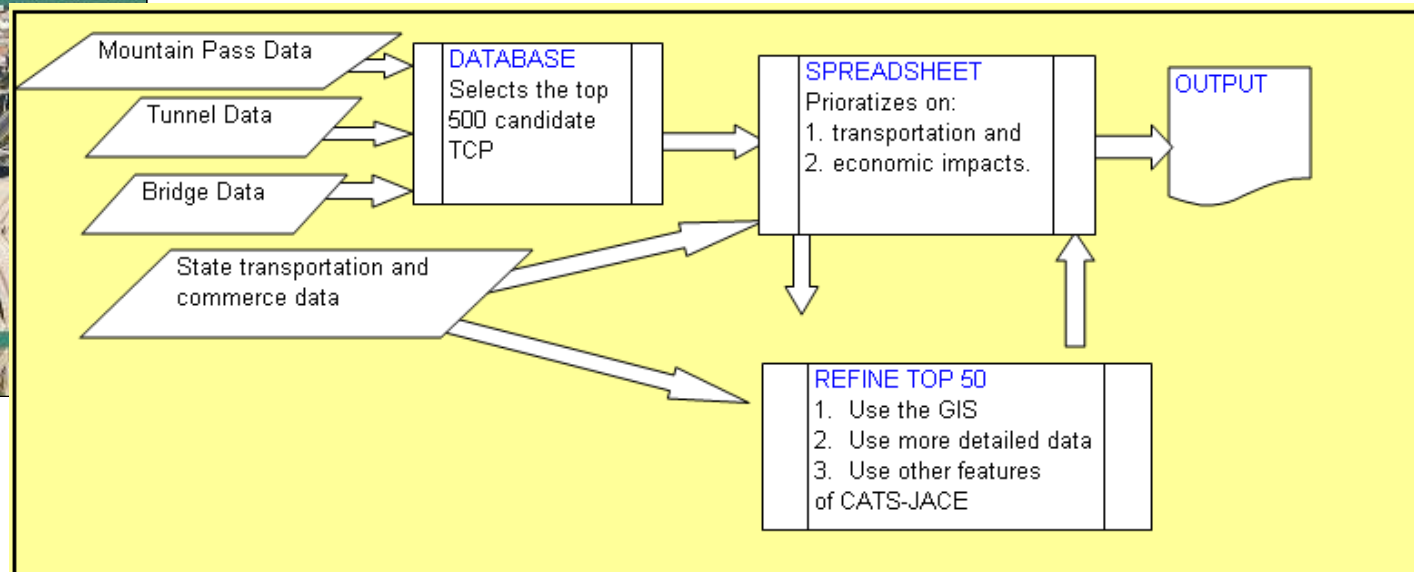
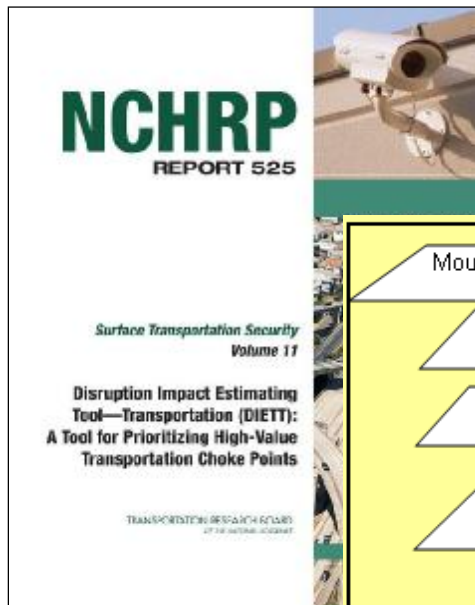
- Overview of NIMS/NRP requirements.
- Updated discussion regarding new threats to transportation agencies:
 - Chronology of worldwide incidents.
 - Capabilities and intentions of specified terrorist groups.
- Guidance for updating Transit Emergency Response Plans.
- Recommendations for establishing a Transit Incident Management Organization.
- Specialized research and recommendations for mobilizing transit personnel resources to address a range of emergencies, including no-notice evacuations and terrorist events.
 - Over all incident management phases: awareness, prevention, preparedness, response and recovery.
 - Checklist for response to events indicating WMD agent release



NCHRP Report 525, Vol. 11

Disruption Impact Estimating Tool—Transportation (DIETT): A Tool for Prioritizing High-Value Transportation Choke Points (2006)

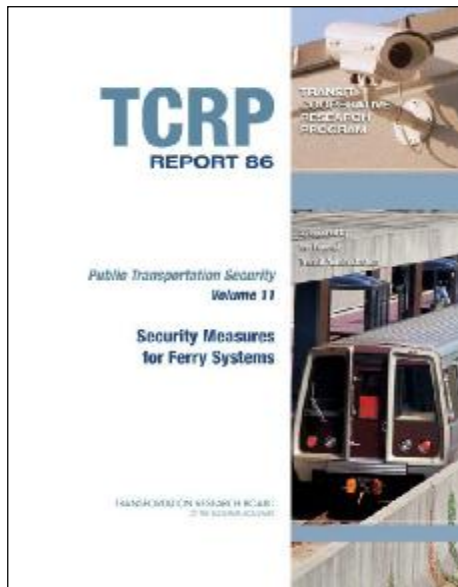
- Highways, rail, and waterway choke points
- Key variable: Impact on commercial shipments
- Prioritize on net national economic impacts
- Excludes replacement costs & collateral damage



TCRP Report 86, Vol. 11

Security Measures for Ferry Systems (2006)

Table 1. Categorization of GSMs.



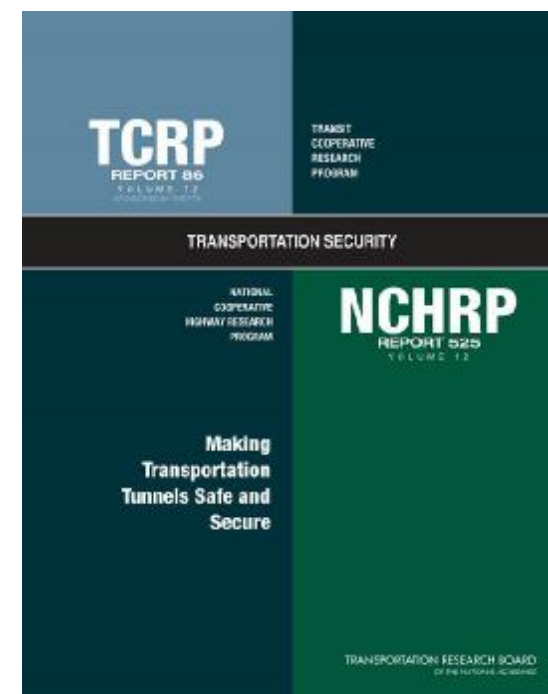
(General Security Measures)	
GSM Categories and Sub-Categories	# of GSMs
Fencing/Barriers	
Retractable vehicle barriers/gates	5
Fixed vehicle deterrent with pedestrian access	4
Fixed, both vehicle and pedestrian deterrent	5
Access Control	
Credentials	13
Locks	3
System Control	3
Intruder Sensors	
Perimeter (doors & windows, walls & fences, and buried)	13
Volume sensors – motion detectors	9
Monitoring	
Lighting	3
CCTV/video	7
Procedural/Low Cost	5
Waterside Security	
Surface	4
Underwater	5
Screening	
Passengers and Cargo	7
Trace Detection	14
Human Observation	
All Areas	3
Waterside	2

TCRP Report 86, Vol. 12 / NCHRP Report 525, Vol. 12

Making Transportation Tunnels Safe and Secure (2006)

Table 72. How countermeasures deter, detect, and respond to hazards and threats.

Deterrence	Detection	Response
<ul style="list-style-type: none"> Operational Tactics <ul style="list-style-type: none"> Roving patrols Bomb-sniffing dogs Background checks of employees and contractors Background checks of facility vendors Access control Credentialing and identification card system Guards at entry points Intelligence Hazardous material restriction Inspections Technology <ul style="list-style-type: none"> CCTV Intrusion detectors System integration Engineering <ul style="list-style-type: none"> Blast design Elimination of hidden corners, alcoves, and shelves Open, unimpeded lines of sight Lighting Locked facility doors 	<ul style="list-style-type: none"> Operational Tactics <ul style="list-style-type: none"> Intelligence Security awareness training of operating and maintenance personnel Roving patrols Guards at entry points Bombing-sniffing dogs Identification card system Inspections Technology <ul style="list-style-type: none"> Intrusion detectors Identification card readers Chemical/biological/radiological detectors Seismic/stress detectors Mobile monitoring Explosive detectors System integration Engineering <ul style="list-style-type: none"> Fire detection 	<ul style="list-style-type: none"> Operational Tactics <ul style="list-style-type: none"> Command and control (multi-tenant) Evacuation protocol Information sharing Tunnel ventilation Portable fire extinguishers Technology <ul style="list-style-type: none"> CCTV system Communication Chemical/biological/radiological monitoring Explosive detectors Interface with traffic monitoring System integration Engineering <ul style="list-style-type: none"> Fire protection Lighting Ventilation



NCHRP Project 20-7 Task 230

Safety & Security in Roadway Tunnels (2008)

SAFETY & SECURITY IN ROADWAY TUNNELS

FINAL REPORT

Requested by:
American Association of State Highway
and Transportation Officials (AASHTO)
Standing Committee on Highways

Prepared by:
Kathleen Almand
Fire Protection Research Foundation
Quincy, Massachusetts

March 2008

The information contained in this report was prepared as part of NCHRP Project 20-7, Task 230,
National Cooperative Highway Research Program, Transportation Research Board.




NCHRP Synthesis 415

Design Fires in Road Tunnels (2011)

NCHRP

SYNTHESIS 415

Design Fires in Road Tunnels



A Synthesis of Highway Practice

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

NATIONAL
COOPERATIVE
HIGHWAY
RESEARCH
PROGRAM

TABLE 38
MAIN DESIGN FIRE VARIABLES

Time Dependent Design Fire Variables	Values Range		Design fire variables are a function of:
Fire Size—Maximum FHRR	(1.5 MW–300 MW)	}	Type of vehicle (cars, buses, HGVs, tankers; alternative fuel)
Fire Growth Rate (slow, medium, fast, ultra fast)	0.002–0.178 kW/s ² as high as 0.331 kW/s ² measured at one test		Type of cargo including bulk transport of fuel
Fire Decay Rate	0.042–0.06 (min ⁻¹)		Fire detection system and delay in activation of FLS systems
Perimeter of Fire	Car—truck perimeter		Ventilation profile
Maximum Gas Temperature at Ceiling	110°C–1350°C (212°F–2462°F) (higher with FCV)		Fire suppression system
Fire Duration	10 min–2 days		Tunnel geometry
Smoke and Toxic Species Production Rate	20–300 m ³ /sec		- tunnel width, height, cross section, length
Radiation	From 0.25 to 0.4 of total heat flux up to 5,125 W/m ² (1,625 Btu/hr/ft ²)		- volume (available oxygen)
Flame Length			- shape of tunnel, grade - location of exits
			Tunnel drainage system

NCHRP Report 645

Blast-Resistant Highway Bridges: Design and Detailing Guidelines (2010)



NCHRP 12-72

Final Report

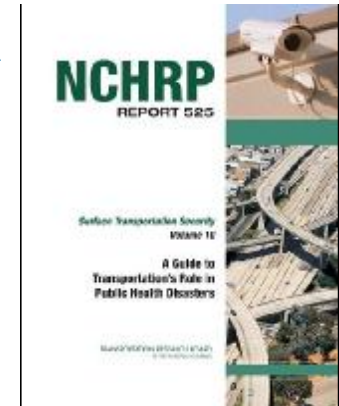
Countermeasure	Function/Effectiveness				Costs per year		
	Deterrence	Detect	Defend	Reduce Impact	Capital	Operating	Maintenance
Countermeasure 1	M	L	L		\$	\$	\$
Countermeasure 2	M	H			\$	\$	\$
Countermeasure 3				H	\$	\$	\$
Countermeasure 4	L		H		\$	\$	\$
L = Low Effectiveness M = Medium Effectiveness H = High Effectiveness		Source: Modified from SAIC "A Guide to Highway Vulnerability Assessment for Critical Asset Identification and Protection."					

Figure 17. Countermeasure summary sheet (Winget and Williamson, 2003)



NCHRP Report 525, Vol. 10 *A Guide to Transportation's Role in Public Health Disasters (2006)*

- Transportation response options to an extreme event with chemical, biological, or radiological agents
- Focuses on the effect and role of transportation
- Applicable to all civilian sites (not just transportation sites)



TERET (Tracking Emergency Response Effects on Transportation) – Spreadsheet Layout

Sheet 1:
Introduction
Provides summary
instructions

Sheet 3: Mass Care
Assess needs during shelter-in-
place, temporary shelters, or
quarantine shelter.

Sheet 2: Basic
Services
Assess criticalities
that may develop
from ER changes in
traffic patterns.

Microsoft Excel - 1-19 TERET 1.7.xls

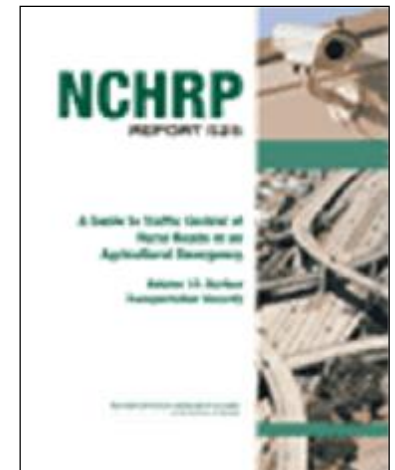
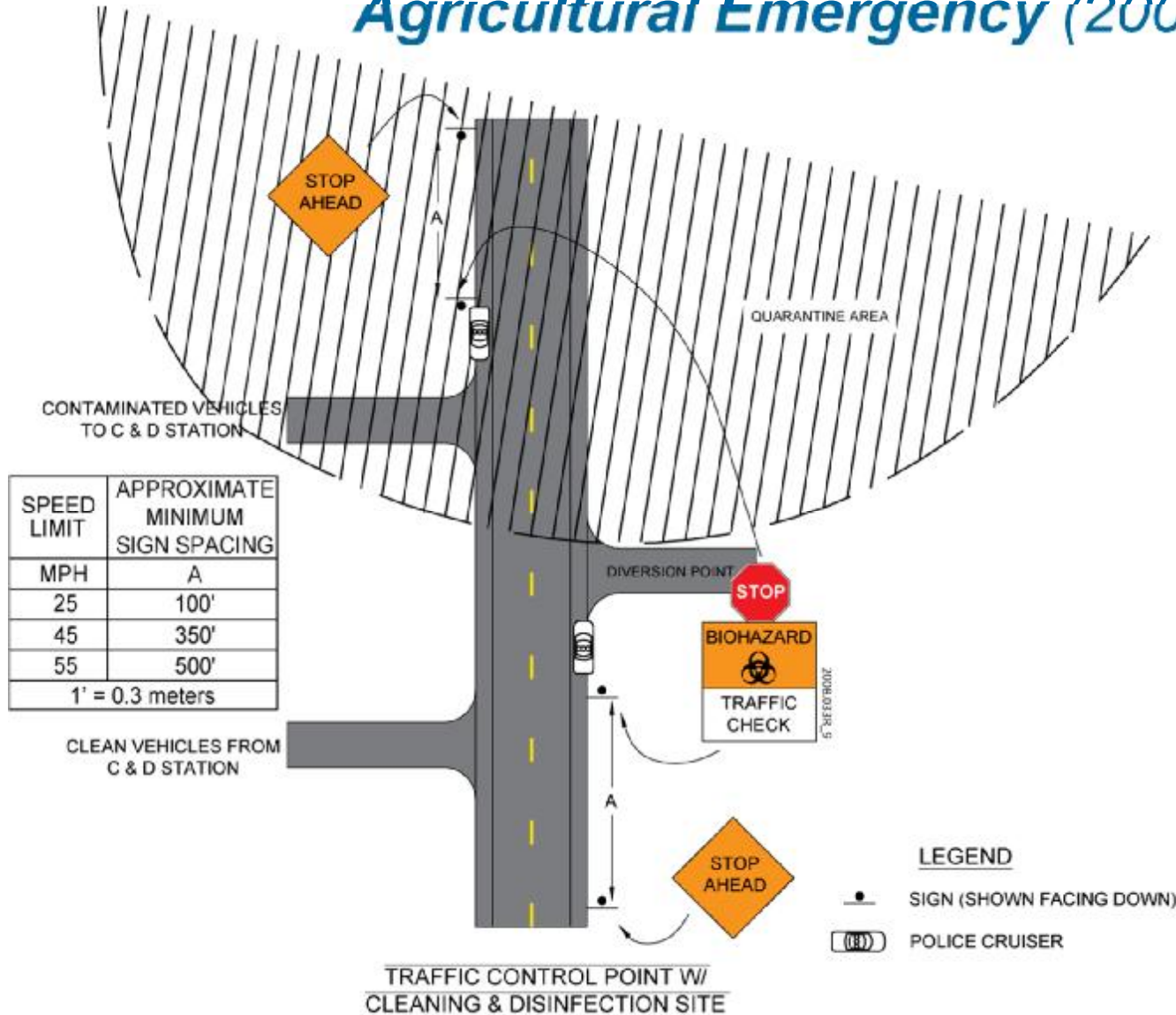
Tracking Transportation Basic Services for Normal Operations									
Objective A					Objective B				
Action List					Action List				
Pre-Event Information									
Essential Services	Modes				Hours to Criticality				
	Long	Full	Mass	Mobile	Long	Full	Mass	Mobile	Priority
CRITICAL SUPPLIES (For normal operations)									
Water									
Water Treatment Facilities									
Regional Water Supplier									
Food									
Local Food									
Regional Food (Distributor)									
Ice (warm climate) (warm food)									
Medical (Non-essential-related)									
Local Medical supplies									
Regional Medical Supplier									
Regional Medical Supplier (other)									
Vehicle and Generator Fuel									
Local Gasoline									
Regional Gasoline (Distributor)									
Electricity									
Regional Power Plant									
Regional Fuel									
Local Heating Fuel									
Regional Heating Fuel									
ESSENTIAL SERVICES WORKERS									
Medical Personnel									

Microsoft Excel - TERET 1.7.xls

Mass Care Transportation Needs: Decon/Triage, Shelter-in-place, Temp						
Mass Care Objectives (from Incident)						
Decontamination Facilities:		Shelter-in-Place:		Temp		
Number of hours since mass care activation = 0		Hours of Need for Mass				
Mass Care Needs	Hours until Need		Physical Destruction (hurricane, explosion, etc)	Radio-logical	Chemical	
	Initial	Current			Persistent	Not
Decon, Triage, Pre-hospital Treatment -- During evacuation until all evacuees are treated.			Total hours →	0	0	0
(for decontamination)						
Mass Public Transport						
To decontamination, triage, pre-treatment			0	0	0	0
From triage/pre-treatment to hospitals			0	0	0	0
From decontamination to shelter			0	0	0	0
Standard Decontamination Supplies						
Soap, water			1	1	0	0
Portable showers, tents			1	1	0	0
Clothes			1	1	0	0
Hypochlorite / bleach / chlorine			1	1	0	0
Alkaline solution (carbonate or bicarbonate)			1	1	0	0
Reduced Power or Water Conditions						
Water (bottled)			0	0	0	0
Portable Toilets			2	2	0	0
Batteries			6	6	0	0
Ice (warm climate)			24	24	0	0
Fuel/Heat (cold climate)			2	2	0	0
Shelter-in-Place -- delivery until evacuation or safe levels			Total hours →	0	0	0
(for shelter-in-place)						
Temporary Shelter -- Shelter deliveries until other housing or safe levels			Total hours →	0	0	0
(for shelter)						
Quarantine Shelter Until not contagious			Total hours →			
(for quarantine)						

NCHRP Report 525, Vol. 13

A Guide to Traffic Control of Rural Roads in an Agricultural Emergency (2008)



TCRP Legal Research Digest 22

The Case for Searches on Public Transportation (2005)

1. Traditional Fourth Amendment Considerations
2. Specific Warrantless Search Categories
3. State Constitutional Issues
4. Structuring Search Policies

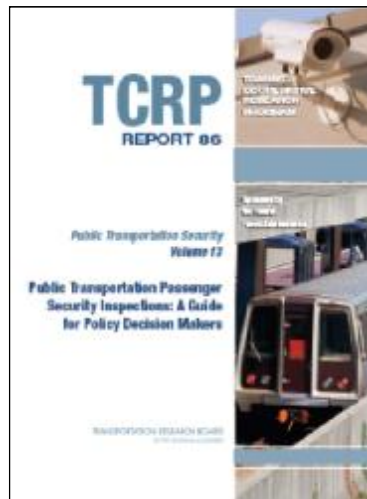


Photos source: Ernest R. Frazier Sr., Esq, Countermeasures Assessment & Security Experts, LLC
GAO Panel on Explosives Detection Technologies That Could Help Protect Passenger Rail, 11-12 August 2009



TCRP Report 86, Vol. 13

Public Transportation Passenger Security Inspections: A Guide for Policy Decision Makers (2007)



Includes measures for:

1. Mitigation of intrusion
2. Mitigation of privacy concerns
3. Mitigation of claims with respect to unreasonable detention, etc.
4. Mitigation of health risks

Table 7. Mitigation measures.

	Mitigation of intrusion	Mitigation of privacy concerns	Mitigation of claims with respect to unreasonable detention, etc.	Mitigation of health risks
Behavioral assessments	Use, to extent feasible, of objective indicators; reasonable limitations on officer's discretion; extreme caution in using racial/ethnic characteristics.	Same as for intrusion.	Same as for intrusion.	N/A
Radiation detection pagers	Not a primary risk.	Not a primary risk.	Require positive results be treated as cause for suspicion; not evidence of guilt, and process accordingly in conducting secondary screening.	Not a primary risk.
Trace detector integrated into ticket machine	Provide notice that ticket machine contains a scanner to allow passenger option of avoiding even minimally intrusive inspection.	Not a primary risk.	Require positive results be treated as cause for suspicion; not evidence of guilt, and process accordingly in conducting secondary screening.	Scrutinously maintain radiation components.
Non-integrated (desktop) scanner	Minimally intrusive for Fourth Amendment purposes.	Not a primary risk.	Require positive results be treated as cause for suspicion; not evidence of guilt, and process accordingly in conducting secondary screening.	Scrutinously maintain radiation components.
Explosives detection canine	Not a primary risk.	Not a primary risk.	Require positive results be treated as cause for suspicion; not evidence of guilt, and process accordingly in conducting secondary screening.	N/A
Visual/physical bag search	Protocols and inspection policies and procedures must be documented and followed. Inspections are based on compelling government need. No additional measures.	Directing officers not to read any material in passenger bags will minimize privacy claims as well as intrusiveness.	Not a primary risk.	N/A
Handheld trace detector		Not a primary risk.	Require positive results be treated as cause for suspicion; not evidence of guilt, and process accordingly in conducting secondary screening.	Scrutinously maintain radiation components.
Handheld magnetometers	Use as secondary PSI method should mitigate intrusiveness of physical approach to passenger, as there would be some grounds for suspicion.	Not a primary risk.	Not a primary risk.	Not a primary risk.
Backscatter X-ray	Conceal sensitive body areas or reduce image details. Also ensure that images are not displayed to anyone but the inspectors. Destroying images once they are reviewed for security purposes should also mitigate risk.	Conceal sensitive body areas or reduce image details. Also ensure that images are not displayed to anyone but the inspectors. Destroying images once they are reviewed for security purposes should also mitigate risk.	Require positive results be treated as cause for suspicion; not evidence of guilt, and process accordingly in conducting secondary screening.	Scrutinously maintain radiation components.
Millimeter wave imaging scanner	Not a primary risk.	Not a primary risk.	Require positive results be treated as cause for suspicion; not evidence of guilt, and process accordingly in conducting secondary screening.	Scrutinously maintain radiation components.
Puffer portal	Not a primary risk.	Not a primary risk.	Require positive results be treated as cause for suspicion; not evidence of guilt, and process accordingly in conducting secondary screening.	Scrutinously maintain radiation components.
Baggage X-ray	Not a primary risk.	Not a primary risk.	Not a primary risk.	Scrutinously maintain radiation components.
Z backscatter van	Avoid scanning vans with passengers.	Avoid scanning vans with passengers.	Require positive results be treated as cause for suspicion; not evidence of guilt, and process accordingly in conducting secondary screening.	Scrutinously maintain radiation components; avoid scanning vans with passengers.

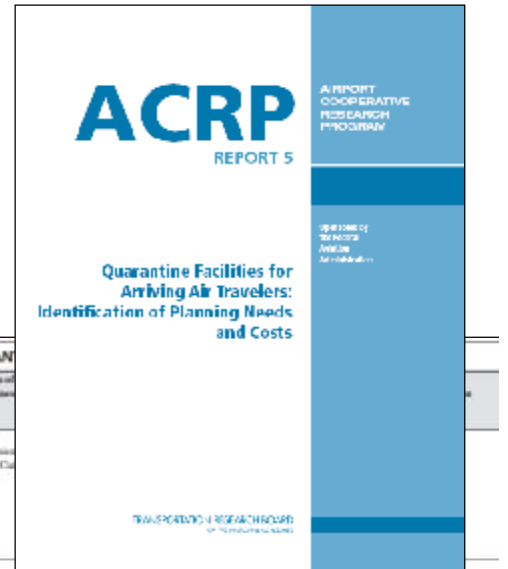
ACRP Report 5

Quarantine Facilities for Arriving Air Travelers: Identification of Planning Needs and Costs (2008)

Table 1. Total stand-by costs.

1. Cost of Space in a Separate Facility if Used for Quarantine	
<p>Needed: 20 square feet per person x 200 people = 4,000 square feet</p> <p>7 additional rooms for: recreation/leisure (3), office area, food assembly and serving, medical, and storage. Each room 500 square feet x 7 = 3,500 square feet. Total space: 7,500 square feet</p> <p>Approximately \$2.00 per square foot/month x \$7,500 = \$15,000</p>	<p>Value of the space: \$15,000 per month</p>
2. Privacy Partitions and Space Dividers	
<p>Partitions needed for sleeping areas—approximately 320 partitioned individually divided spaces and 50 other divided spaces occupied small families). 7 other divided spaces for recreation/leisure (3), food assembly and serving, medical, and storage—approximately 22 (2) spaces depending if it is on location next to walls or at end of aisle</p> <p>342 dividers x \$200 each = \$68,400*</p>	
3. Storage	
<p>Lockers—6 tiered metal lockers (size 1 cu ft.) with 3 for each room (lockers) x 12 @ \$325 each = \$3,900</p>	
4. Cleaning supplies	
<p>Commercial mopping combo @ \$26.00 x 5 = \$130*</p> <p>Mops @ \$11 each x 5 = \$55*</p> <p>Trash cans: 1 44-gallon cans per 20 people plus 1 for each of 7 spaces and 3 extra = 20 cans x \$45 per can = \$900*</p> <p>Cleaning liquids, approximately 25 gallons x \$7.00 per gallon = \$175*</p> <p>Trash can liners @ \$1.50 per liner x 20 cans x 14 days = \$420</p>	

APPENDIX A. CDC DISEASE QUARANTINE						
Disease / Reference	Symptoms in Early Stage (prodrome stage)	Symptoms in Full Blown Illness (definitive stage)	Incubation Period (average and range for 95% of cases)	Mechanism of Contagion	Diagnosis	Quarantine
Ethiopia 1.4	Malaise, sore throat, loss of appetite, moderate fever, and hacking cough.	Adherent, gray membrane forms over the mucous membrane of the mouth and/or pharynx.	2-5 days (range 1-10 days)	Direct person-to-person transmission (respiratory and physical contact). Can be spread in transmission.		
Infectious TB 1.10	Prolonged recurrent fever, chronic cough, anorexia, fatigue, and weight loss.	Coughing blood from the lungs, Chronic Obstructive Pulmonary Disease, abnormal chest x-ray and/or imaging of the respiratory passages caused by chronic blockages, fluid in the lungs.	Average incubation period 21 weeks, 95% of cases will develop within 15-20 weeks.	Airborne route. Extended period of illness (months).	Abnormal chest radiograph. Respiratory specimens (sputum or culture positive). Tuberculin Skin Test (TST) or Quantiferon-TB Test positive. Symptoms based: combination of chronic cough (≥2 weeks), weight loss, and fatigue.	Quarantined, TB test.
Cholera 11.14	>20% of Cholera patients will show any symptoms before full onset of disease.	Cramps, painless, watery diarrhea. Vomiting also occurs in most patients.	Short incubation period, from less than one day to five days.	Ingesting contaminated water or food, person-to-person transmission is rare.	Diagnosis is confirmed by identification of the organism in a stool specimen.	None established by CDC.
Smallpox 11.21	High fever, back pain, headache, vomiting, malaise, and prostration.	Maculopapular rash that progresses to papules, then vesicles, and then pustules and scab lesions.	Incubation period averages about 12 to 14 days but can range from 7 to 17 days.	Spread by inhalation of air droplets or aerosols. Direct (within 6-7 feet) and fairly prolonged (approximately 3 hours) face-to-face contact is required to spread smallpox from one person to another.	Characteristic rash and symptoms (fever, abdominal pain, etc.). Electron microscope (EM) visualization, RT-PCR, Confirmation.	Close contact of cases, virus found in throat during incubation.
Hemorrhagic Fever Virus 11.24	Fever, aching muscles, dizziness, neck pain, stiffness, headache, sore eyes and sensitivity to light. Nausea, vomiting, sore throat, diarrhea, and generalized abdominal pain. Liver enlargement.	Fast heart rate, enlarged lymph nodes, and a rash caused by bleeding into the skin. Bleeding in the mouth and throat, the upper bowel, and the gums. Hepatitis. Liver and kidney and pulmonary failure.	Incubation 2-21 days. Length of incubation may depend on the mode of acquisition (Crimean-Congo RV), tick bite, 1 to 3 days, with a maximum of 9 days; infected blood or tissue is usually 3 to 6 days, with a documented maximum of 13 days.	Direct contact with blood or other infected tissues from livestock or tick bite. Human to human close contact.	After 5 days of illness, antibodies can be detected (IgG or IgM). Prior to that, virus must be isolated from blood or tissue specimens and grown in fetal cells. Viral DNA may also be detected in the blood.	Virus can be isolated from blood or tissue specimens in the first five days of illness, and grown in cell culture. Likely to find virus in throat swabs, nasal swabs, blood, lymph, and aspirates.
Plague 11.31	Fever, chills, headache, malaise, aching muscles, nausea, and prostration. Bubonic plague: painful, swollen lymph nodes. Pneumonic plague: cough, breathing difficulties.	Edema draining the size of the flea bite. Pneumonic plague: bloody sputum.	Bubonic 2-4 days. Pneumonic 2-4 days with range of 1-4 days.	flea bite. Direct contact with infectious animals or other materials or inhalation of infectious respiratory droplets. Ingestion.	The swollen gland called a "bubo." F1 Ag immunosorbent ELISA. Culture by using specific bacteriophage.	None established by CDC. Bacteria likely first by throat swab or in lymph.



ACRP Report 12

An Airport Guide for Emergency Planning for CBRNE Events (2009)



Special Considerations for CBRNE

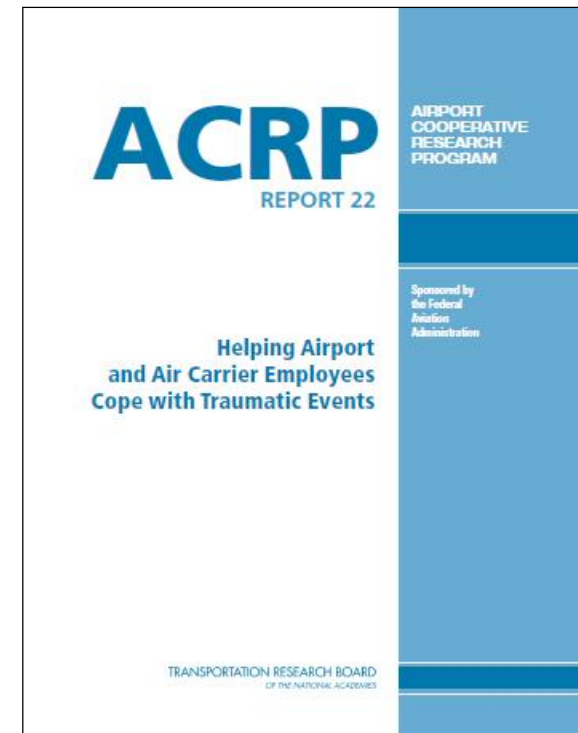
(Chemical, Biological, Radiological, Nuclear, or Explosives)

- Command and control
- Responder communications
- Emergency public information
- Firefighting and special operations
- Law enforcement and special operations
- Emergency Medical Services (EMS)
- Quarantine
- Fatality management
- Logistics
- Continuity of Operations
- Family and customer assistance

ACRP Report 22

Helping Airport and Air Carrier Employees Cope with Traumatic Events (2009)

Five Essential Intervention Principles



Source: Hobfoll, et. al. (2007).

9. Stage II

All Hazards, All Modes

Six Goals

Five Pillars

Transportation Sector Rationale for An All Hazards Approach to Natural Hazards and Security

Safety first: build on the successful experience of the systems approach, and extend the mission of existing safety personnel

Build on DOT expertise in response: urban areas work with law enforcement, fire, rescue, and towing and recovery on traffic incident management; statewide presence with emergency contracting, equipment (e.g., communications systems), personnel, and common response to weather emergencies; trained to observe and report

Build on transit expertise in security: in urban areas parallel size and location of high-value infrastructure; invested; bring expertise on policing and security; trained to observe and report

Make interdependence an asset: transportation depends on, and is depended on, by other critical infrastructures; roads and transit are publicly owned and managed, and house public involvement experts

Six Goals for Transportation Security

1. **Social:** Involve the public—make pre-operational surveillance riskier
2. **Budget & Policy:** Make risk-informed decisions the norm
3. **Technical:** focus on countermeasures & design (instead of vulnerabilities & threats) with dual benefits
4. **Operational:** quick, layered response with effective surge capability
5. **Psychological:**
 - a. for the public, peace of mind/acceptance of risk:
security \approx satisfaction
 - b. for the attack planner, transportation is a difficult target,
prepare more or attack something easier
6. **Intelligence:** Support police/military/intelligence by having trained transportation employees report suspicious activities and by making the bad guys stretch out their planning time

Six Goals for Transportation Security

Desired Outcome

Mainstreaming an integrated, high level, all-hazard, National Incident Management System (NIMS)-responsive, multimodal risk management process into major transportation agency programs and activities

Six Goals for Transportation Security

Desired Outcome

Five Pillars

- 1. A systems approach to emergency management functions focusing on a holistic approach to risk reduction:** A Guide to Planning Resources on Transportation and Hazards
- 2. Understanding security fundamentals:** Security 101: A Physical Security Primer for Transportation Agencies (Security 101)
- 3. Organizing to be a reliable partner in emergency management:** Guide for Emergency Transportation Operations (ETO)
- 4. Risk-informed decision support to buy down risk:** Costing Asset Protection: An All Hazards Guide for Transportation Agencies (CAPTA)
- 5. Integrated emergency response planning:** A Guide to Emergency Response Planning at State Transportation Agencies (2010 Guide)

The Hazards and Disaster Management System

Pre-Impact Interventions

Mitigation Practices
Emergency Preparedness Practices
Recovery Preparedness Practices

Post-Impact Responses

Emergency Activities
(planned and improvised)
Recovery Activities
(planned and improvised)

Hazard Vulnerability

Hazard Exposure
Physical Vulnerability
Social Vulnerability

EVENTS

Disaster Impacts

Physical
Social

Disaster Event Characteristics

Frequency	Magnitude of Impact
Predictability	Scope of Impact (spatial and social)
Controllability	Duration of Impact
Length of Forewarning	

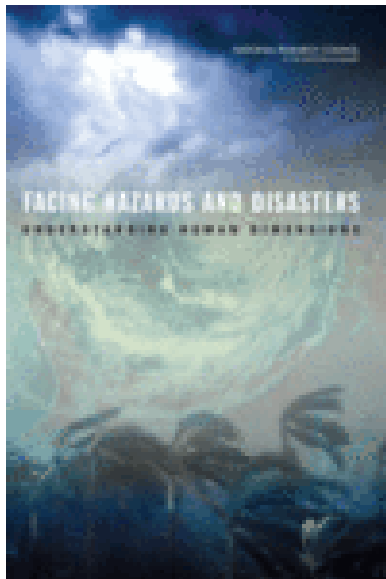
CHRONOLOGICAL TIME

Pre-Impact

Trans-Impact

Post-Impact

SOCIAL TIME

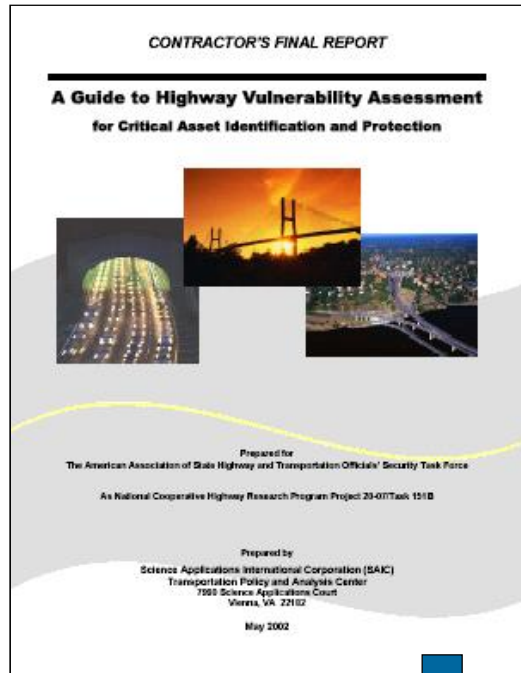


Source: Facing Hazards and Disasters (NAS, 2006), adapted from Kreps (1985), Cutter (1996), Lindell and Prater (2003)

10. Stage III

Risk-Informed Decision Support

Continuous Development of Risk Management and Emergency Response Planning Guidance



Published 2009:



NCHRP Report 525, Vol. 14

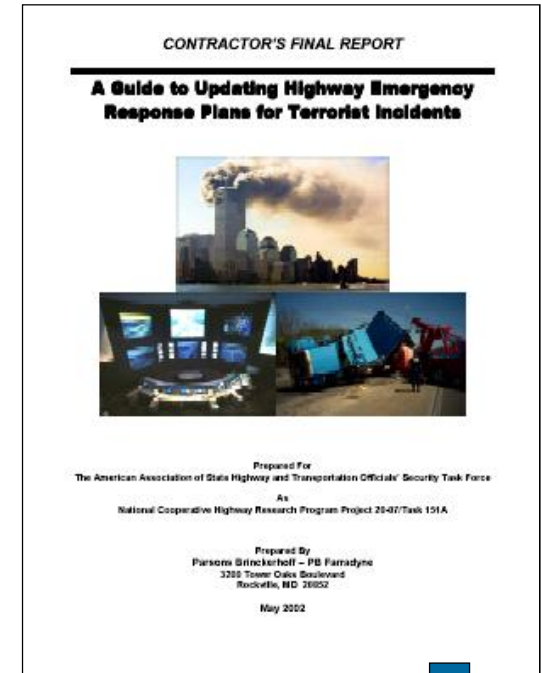
Security 101: A Physical Security
Primer for Transportation Agencies

2002: Guides to
Vulnerability Assessment
& Emergency Response
Planning

2002-2003: workshops

2004-2005: publications
that anticipated NIMS,
NRP/NRF, and NIPP.

2012: publications
adopted by AASHTO



Published 2010:



NCHRP Report 525, Vol. 16

A Guide to Emergency
Response Planning at State
Transportation Agencies

*Costing Asset Protection: An All Hazards Guide
for Transportation Agencies (CAPTA, 2009)*

Application Context

- Top-down, program level – to support resource allocation
- Consequence-driven – based on user-selected thresholds (“possibilistic”)
- Iterative – use to compare/refine assumptions

Model Attributes

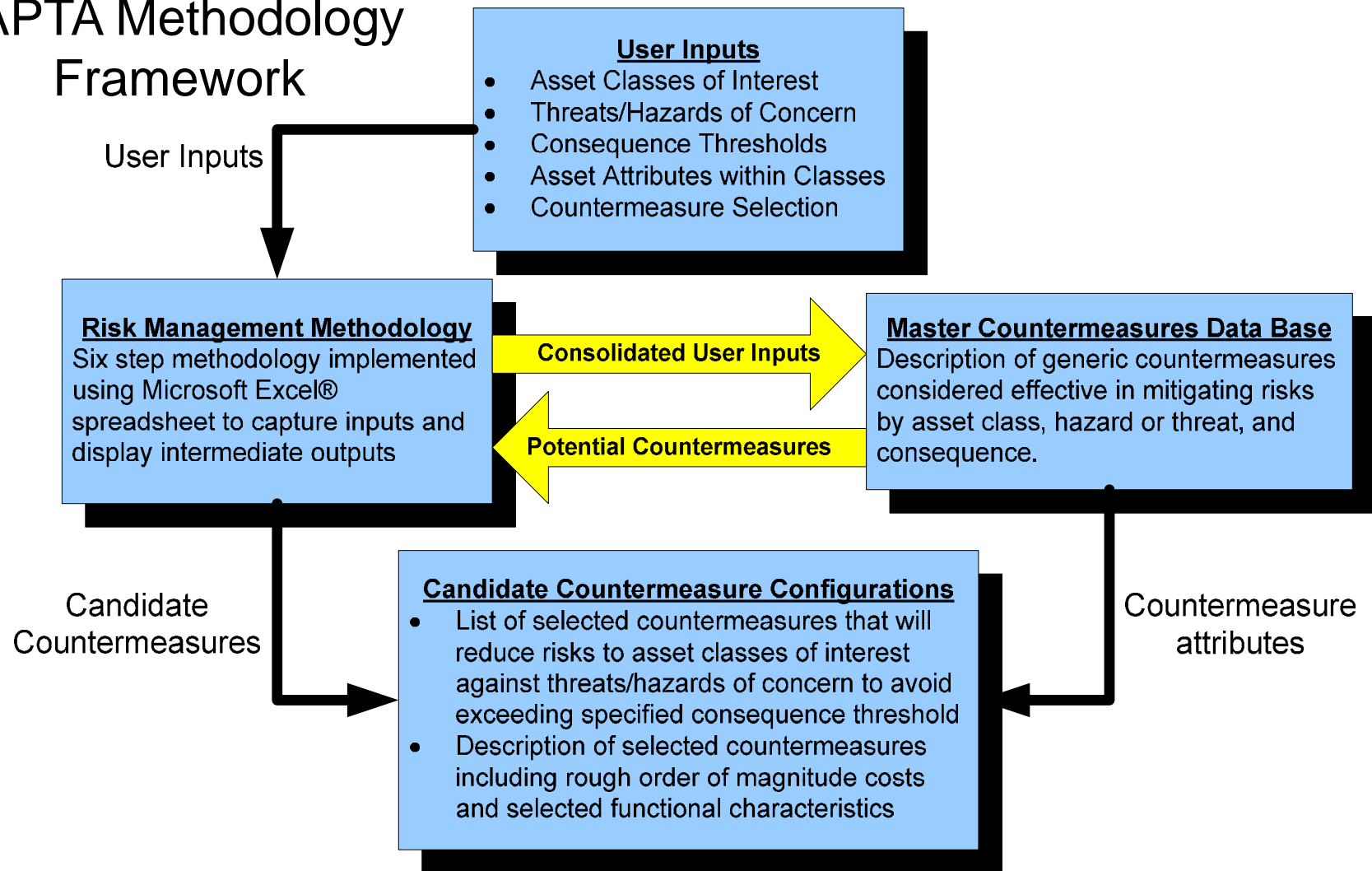
- Objective – when possible use data rather than “best judgment”
- Transparent – avoid “weighting and rating”
- Consistent – uses simple, available data and criteria, standard data base, default values
- Replicable – identify basis of all judgments

User Features

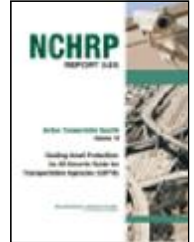
- Convenient – uses available resources (people and software) and imbedded data model
- Scalable – support a range of user contexts, mode, hazards,
- Expandable – to accommodate new threats/hazards, asset types, and countermeasures

Costing Asset Protection: An All Hazards Guide for Transportation Agencies (CAPTA, 2009)

CAPTA Methodology Framework



Costing Asset Protection: An All Hazards Guide for Transportation Agencies (CAPTA, 2009)



Basic CAPTA	Steps in Methodology	Expanded CAPTA
1	Identify Relevant Risks and Asset Classes	1
	Verify High Consequence Threats and Hazards	1a
2	Establish Consequence Thresholds	2
3	Describe Infrastructure Assets	3
4	Identify Critical Assets Across Modes	4
	Review Countermeasure Unit Costs	5a
	Identify and Describe Additional Countermeasures	5b
	Set Countermeasure Filters based on User Preference	5c
5	Select Candidate Countermeasures	5
6	Summary Report	6

Costing Asset Protection: An All Hazards Guide for Transportation Agencies (CAPTA, 2009)

① — ② — ③ — ④ — ⑤ — ⑥ Basic CAPTool
① — ①a — ② — ③ — ④ — ⑤a — ⑤b — ⑤c — ⑥ Expanded CAPTool

Select Candidate Countermeasures Instructions

The following is a list of countermeasure opportunities for each critical asset -- orange indicates medium effectiveness and red indicates high effectiveness.

To analyze an asset more closely, click on the name of the asset in row 15, and then click "Analyze Asset." A new sheet will pop up that details the effectiveness of the countermeasure against every relevant threat and hazard. The sheet will also tell you how many units of countermeasures you have selected so far for the asset, and the estimated cost.

To add units of countermeasures, enter the desired number of units into any cell. Alternatively, the "Analyze Asset" sheet also has a field for adding units of countermeasures.

When you are satisfied with your CM allocation, click "Continue."

Analyze Asset

Filter Countermeasures

Clear All Countermeasure Quantities

Next

Color Key

Medium Effectiveness

High Effectiveness

Road Bridges															Road Tunnels					Transit/Rail Station									
Over Bridge	State Line Bridge	Veteran's Bridge	Downtown Tunnel	Uptown Tunnel	Midtown Tunnel	North Station	South Station	Bay Station	Downtown Station	West Station	Park Street Station	Government Center	State Street	City Center Station	Suburban Station	Airport Station	All other aboveground	All other belowground											
Quantity of Named Asset																													
Physical Security Countermeasures																													
Lighting																													
Barrier Systems																													
Fences																													
CCTV																													
Intrusion Detection Devices																													
Physical Inspection of Asset																													
Access Control Countermeasures																													
ID Cards																													
Biometrics																													
Background Checks																													
Metal Detectors																													
Restricted Access																													
Random Searches																													
Visible Security																													
Limited Access																													
Visitor Management																													
Locks																													
Explosive Detection																													
Established Perimeter																													
Visible Security																													
Asset Design/Engineering																													
Seismic																													
Fire Detection & Suppression																													
Encasement, Wrapping, Jacketing																													
Operational Countermeasures																													
Patrols																													
WX/Seismic Information																													
Intelligence Networking																													
HAZMAT Mitigation																													
Security Awareness Training																													
Emergency Response Training																													
Emergency Evacuation Planning																													
Planned Redundancy (e.g., detours)																													
Public Information and Dissemination																													

Description of this step & instructions

Step indicators

Reset Buttons

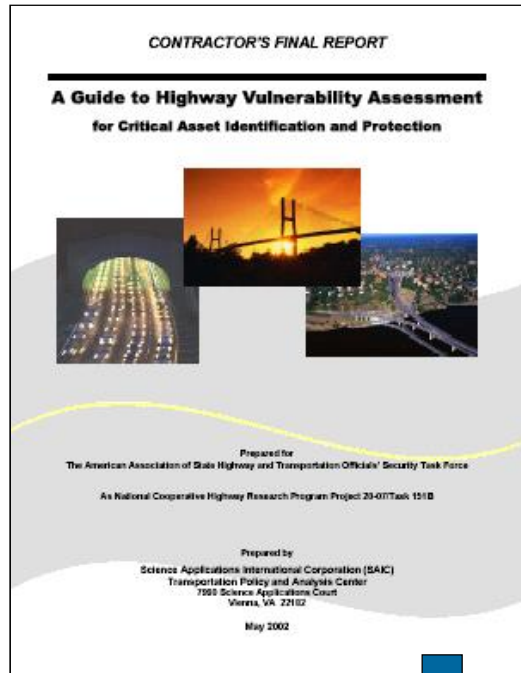
User Options

Color code key

11. Stage III

Comprehensive Emergency Response Planning

Continuous Development of Risk Management and Emergency Response Planning Guidance



Published 2009:



NCHRP Report 525, Vol. 14

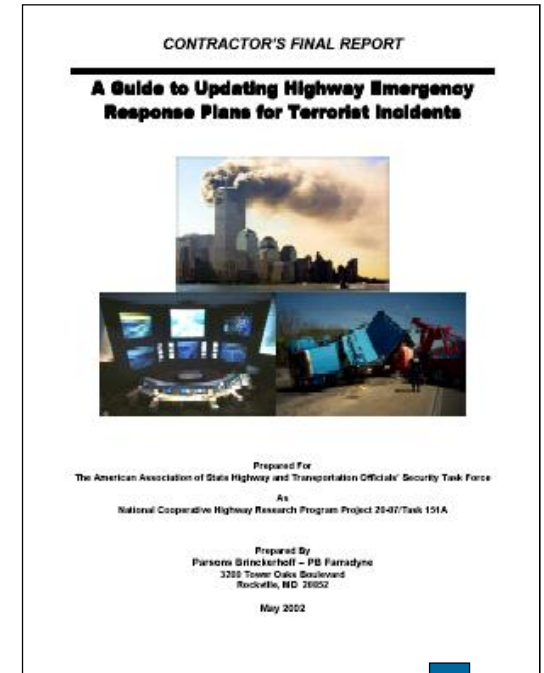
Security 101: A Physical Security
Primer for Transportation Agencies

2002: Guides to
Vulnerability Assessment
& Emergency Response
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adopted by AASHTO



Published 2010:



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A Guide to Emergency
Response Planning at State
Transportation Agencies

NCHRP Report 525, Volume 16

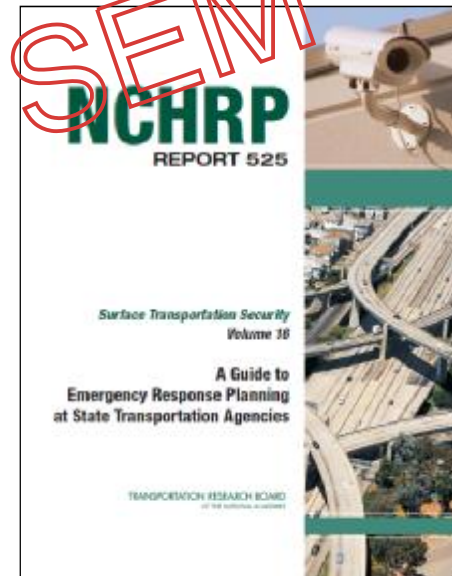
A Guide to Emergency Response Planning at State Transportation Agencies (2010)

Guide

- Summary
- Overview for state transportation agencies (authorities, etc.)
- High-level requirements based on national policies and guidelines
- High-level self-assessment with pointers

Section 6: Resource Guide

- Organizational/staffing/position guidance
- Decision-making sequences
- Detailed self-assessment and resource lists



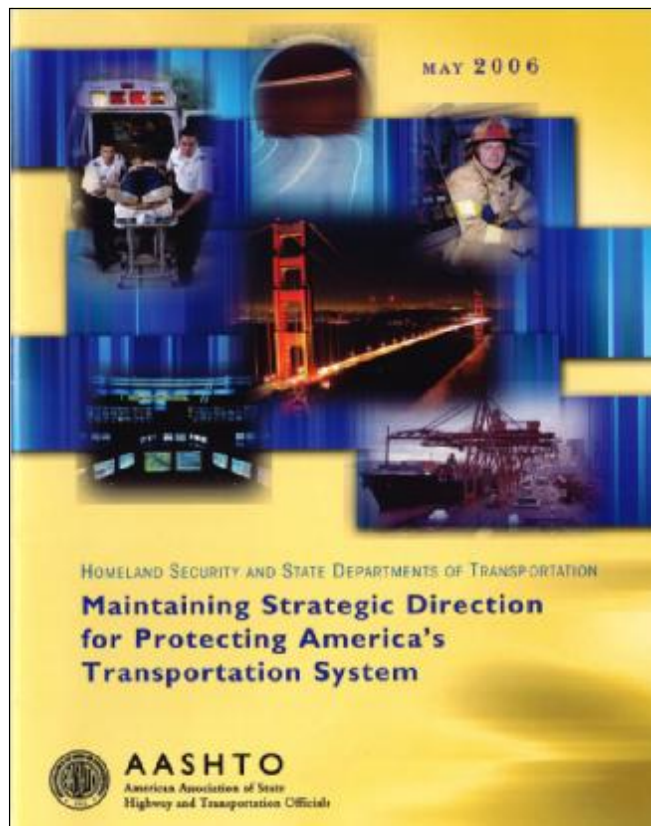
NCHRP Report 525, Volume 16

A Guide to Emergency Response Planning at State Transportation Agencies (2010)

- Appendices (A-M)
 - Applicable parts of 2002 Report (A)
 - Details of material summarized in Sections 1-5 (B-G)
 - Links to model emergency operations plans (H)
 - Links to model policy/procedural memoranda/MOUs (I)
 - Links to model exercises/training plans (J)
 - Annotated bibliography (K)*
 - White Paper: Identification and Delineation of Incident Management and Large-Scale Emergency Response Functions (L)*
 - PowerPoint presentation (M)*
- **available at www.TRB.org/SecurityPubs*

12. Stage III

A Focus on Fundamentals



Homeland Security and State Departments of Transportation: Maintaining Strategic Direction for Protecting America's Transportation System

1. State DOTs—Guardians of Transportation Infrastructure and Mobility
2. Protection of Critical Transportation Assets
3. Emergency Management Support to First Responders
4. Critical Gaps and Needs

State DOTs - Guardians of Nation's Transportation Network

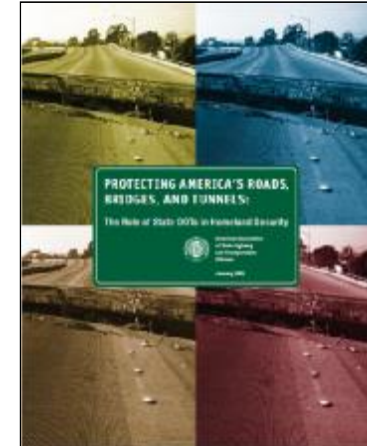
- DOTs own & operate 1.8 million lane miles & 273,200 bridges
- 5 billion daily vehicle miles (DVMT) traveled on DOTs' roads and bridges, or 65% of total DVMT
- \$92 billion/yr needed just to preserve system without extra security



Source: Protecting America's Roads, Bridges, & Tunnels: The Role of State DOTs in Homeland Security, AASHTO, 2006.

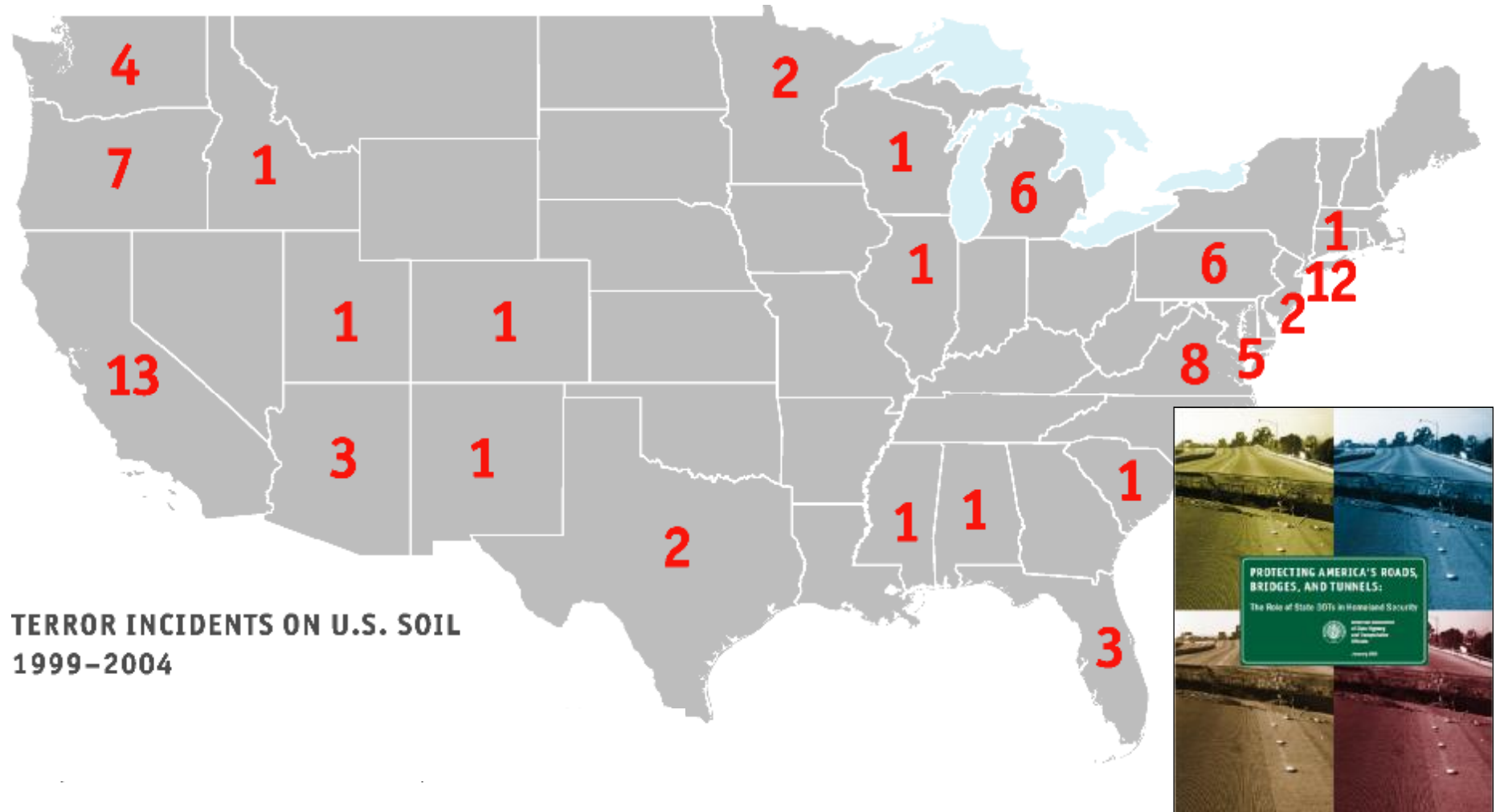
State DOTs' Major Responsibilities

- Highways
- Transit
- Freight and passenger rail
- Ports and ferries
- General and commercial aviation facilities
- Bike/pedestrian
- Motor carrier/motor vehicle services
- State patrol



Source: Protecting America's Roads, Bridges, & Tunnels: The Role of State DOTs in Homeland Security, AASHTO, 2006.

U.S. Terror Incidents 1999-2004



Source: Memorial Institute for the Prevention of Terrorism, Terrorism Knowledge Database. Cited in Protecting America's Roads, Bridges, & Tunnels: The Role of State DOTs in Homeland Security, AASHTO, 2006.

All Hazards Planning Fundamentals

- Prevention: Capabilities necessary to avoid, prevent, or stop a threatened or actual act of terrorism.
- Protection: Capabilities necessary to secure against acts of terrorism and manmade or natural disasters.
- Mitigation: Capabilities necessary to reduce loss of life and property by lessening the impact of disasters.
- Response: Capabilities necessary to save lives, protect property and the environment, and meet basic human needs after an incident has occurred.
- Recovery: Capabilities necessary to assist communities affected by an incident to recover effectively.

Source: AASHTO. Fundamentals of Effective All Hazards Security and Resilience for State DOTs, 2015.

Transportation Agency Resilience: Fundamental Capabilities

Prevention	Protection	Mitigation	Response	Recovery
Planning				
Public Information and Warning				
Operational Coordination				
Intelligence & Information Sharing Screening, Search, & Detection	Access Control Physical Protective Measures Risk Management Supply Chain Integrity & Security	Long-Term Vulnerability Reduction Risk & Disaster Resilience Assessment Threat & Hazard Identification	Critical Transportation Operational Communications Situational Assessment	Infrastructure Systems
Cybersecurity				
Training and Exercises				

Source: AASHTO. Fundamentals of Effective All Hazards Security and Resilience for State DOTs, 2015.

NCHRP Research Results Digest 333 / TCRP Research Results Digest 90

Natural Hazards Informer Number 4

A Guide to Planning Resources on Transportation and Hazards (2009)

Chapter 1: Introduction to the Disaster Cycle

Chapter 2: Overview

Chapter 3: The Economy and Hazards

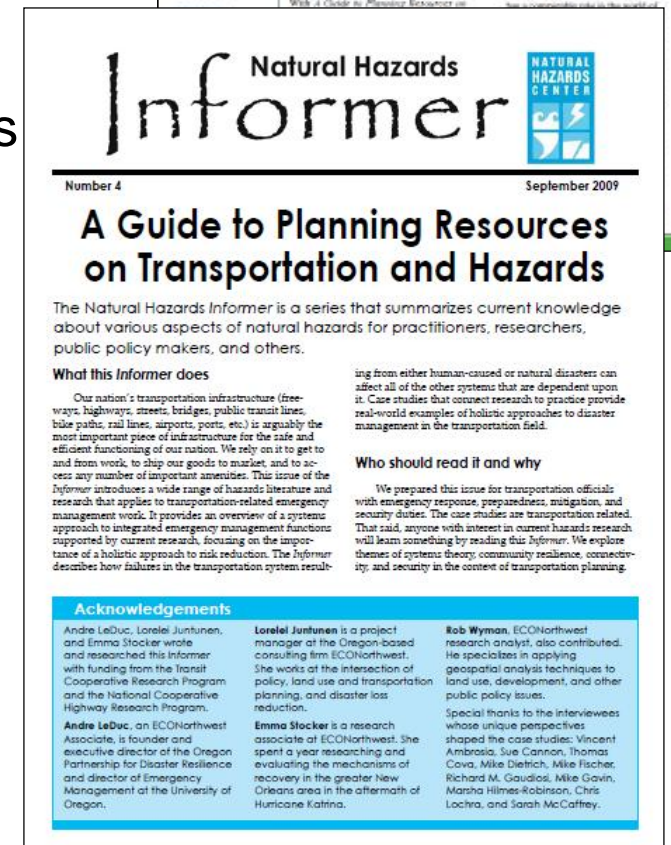
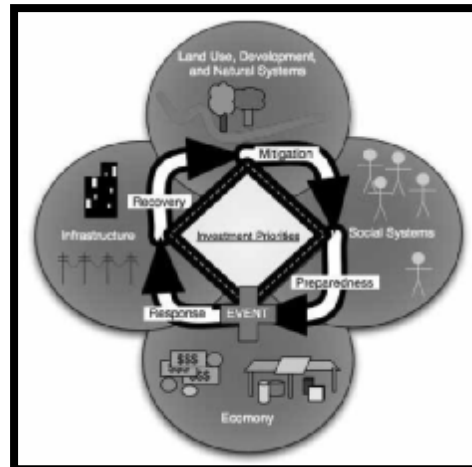
Chapter 4: People and Hazards

Chapter 5: Infrastructure: Lifelines During Disasters

Chapter 6: Land Use, Development,
and Natural Systems

Chapter 7: From Theory to Practice: Case Studies

Chapter 8: Conclusion



Security 101: A Physical Security Primer for Transportation Agencies (2009)

Chapter 1: Risk Management and Risk Assessment

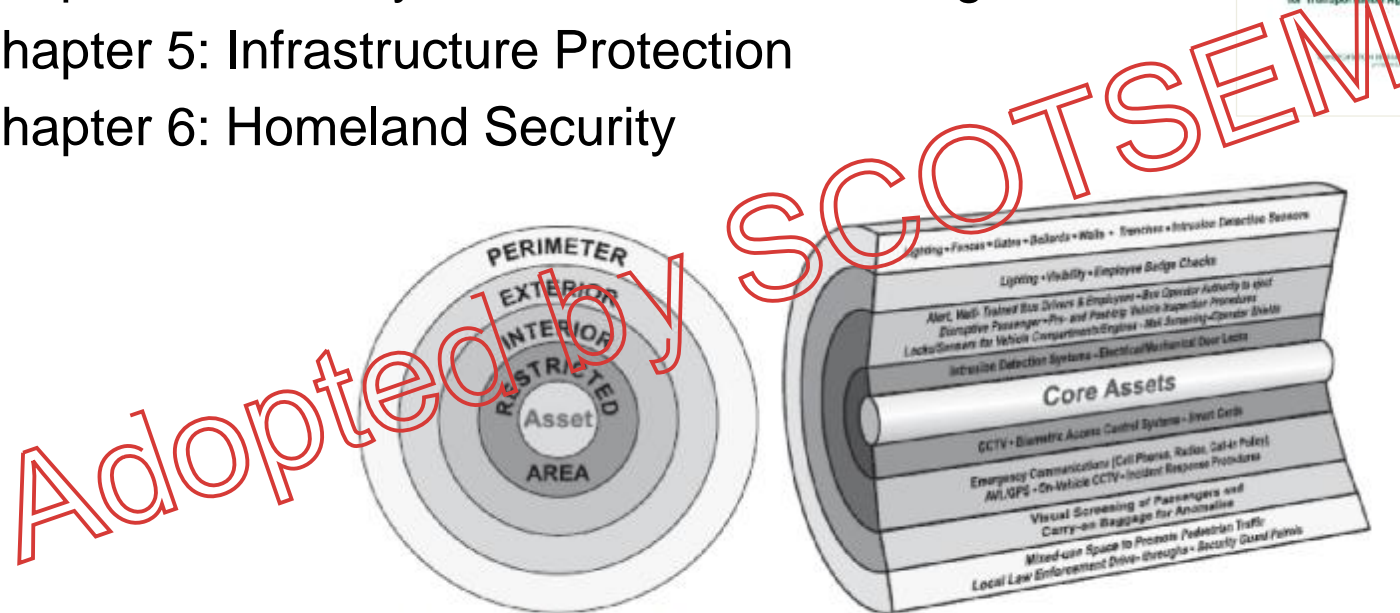
Chapter 2: Plans and Strategies

Chapter 3: Physical Security Measures

Chapter 4: Security Personnel and Training

Chapter 5: Infrastructure Protection

Chapter 6: Homeland Security



Source: FTA Security Design Considerations, 2004.

Figure 3-2. Layers of security.

NCHRP Synthesis 392

Transportation's Role in Emergency Evacuation and Reentry (2009)

- Chapter 1: Introduction
- Chapter 2: Background
- Chapter 3: Evacuation Planning and Phasing
- Chapter 4: Direction and Control on Highways
- Chapter 5: Evacuee Travel Characteristics and Assisted Evacuation
- Chapter 6: Communication, Data Exchange, and Public Information
- Chapter 7: Reentry
- Chapter 8: Current State of Practice
- Chapter 9: Conclusions and Future Needs

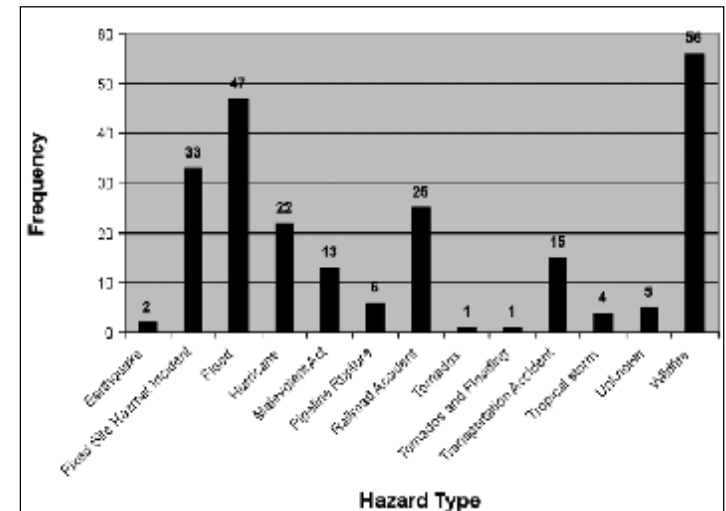
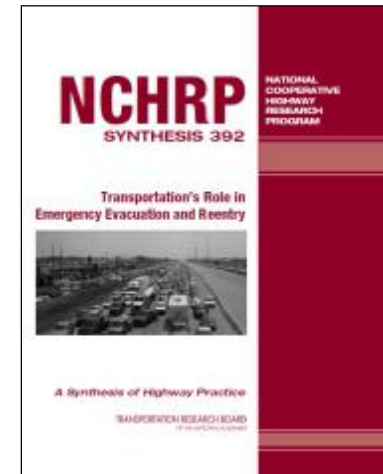


Figure 1: Evacuation frequency based on hazard type (1990-2003)
(Source: F. Walton, Sandia National Laboratory)

TCRP Synthesis 80

Transit Security Update (2009)

Chapter 1: Introduction

Chapter 2: Passenger Perception of Crime and Terrorism

Chapter 3: Security Measures

Chapter 4: Security Practices

Chapter 5: Conflict Mitigation Strategies

Chapter 6: Case Studies

Chapter 7: Conclusions

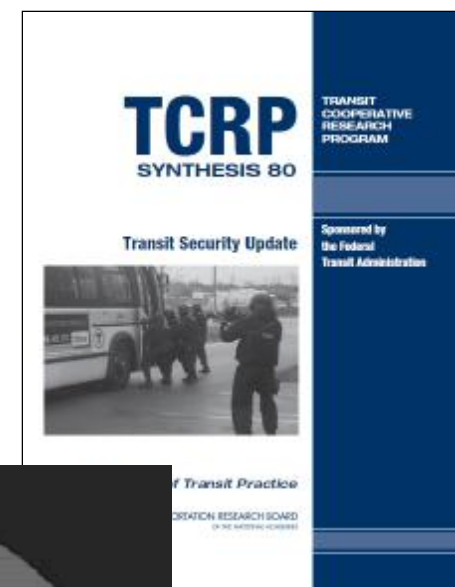


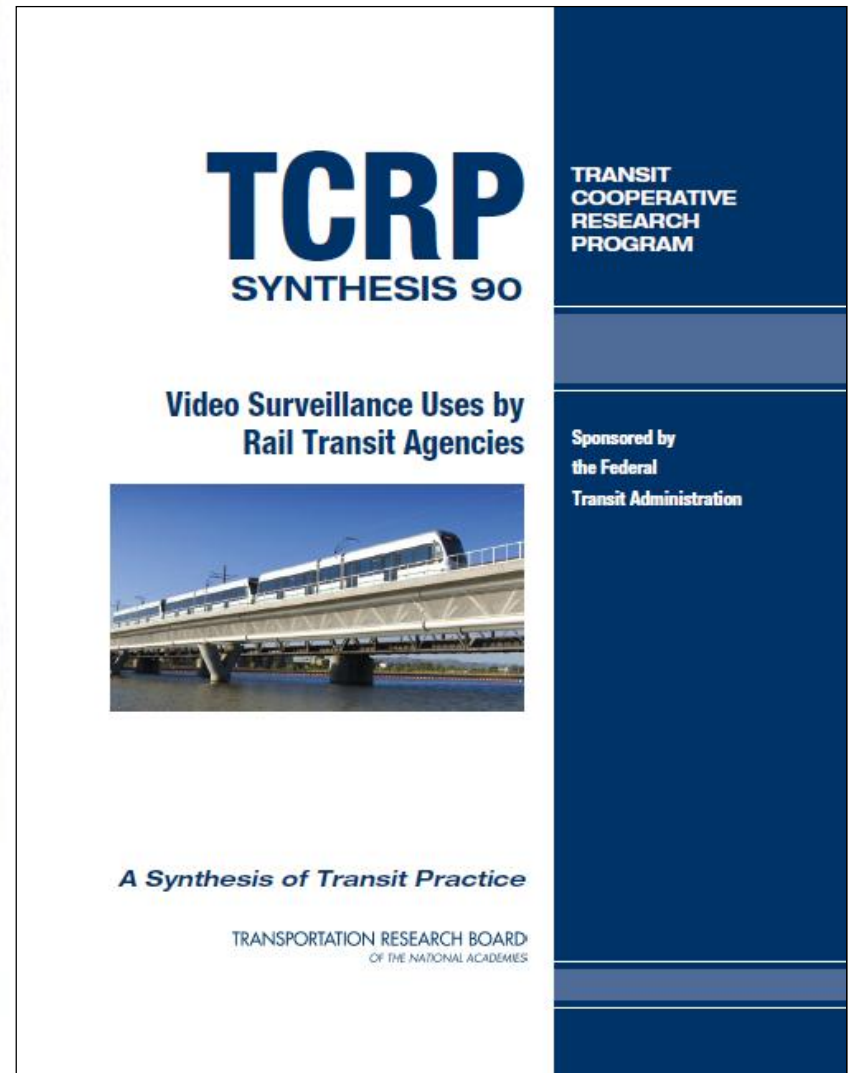
Figure 10 from Chapter 5: Physical Aggression Continuum
(Source: Crisis Prevention Institute's 2007 Webinar on
Workplace Violence Prevention)

TCRP Synthesis 90

Video Surveillance Uses by Rail Transit Agencies (2011)



FIGURE 4 The New York City Police Department posts signs on local streets indicating the presence of security cameras. This sign was across the street from a Manhattan subway station. *Photo courtesy of Dorothy M. Schulz.*



13. Stage IV

In Progress / What' s Next

Simulation, Communication, Evacuation,
Risk & Recovery:
Focus on Implementation

Exercising Command-Level Decision Making For Critical Incidents at Airports (2011)

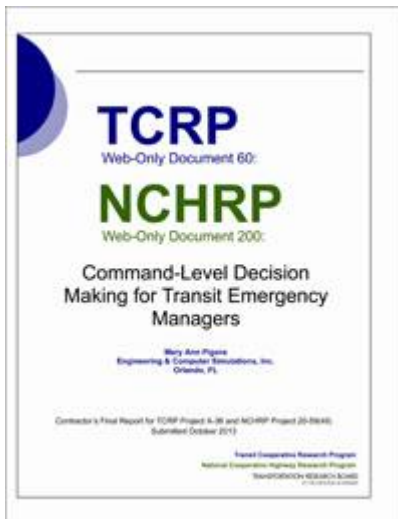
- Computer-based simulation
 - A means to exercise critical decision-making at the command level
 - Accessible through a web browser
- Broad collection of scenarios
- Standards compliant
 - National Incident Management System (NIMS)
 - 14 CFR Part 139.325, Airport Emergency Plan
- Based on the National Guard Bureau's Emergency Management Staff Trainer (EMST), a proven architecture



TCRP Web-Only Document 60 / NCHRP Web-Only Document 200

Command-Level Decision Making For Transit Emergency Managers (2014)

Objective: develop a scenario-based training system compliant with federal standards (e.g., the National Incident Management System and the Homeland Security Exercise Evaluation Program) and relevant transit industry standards and regulations. It is anticipated that the training system will be delivered through an automated, functional exercise simulation system capable of providing on-demand emergency response training and exercises.



TCRP Project A-36/ NCHRP Project 20-59(49) *Command-Level Decision Making For Transportation (2017)*

Operations Coordinator, Facilitator (San Diego, California)
Clock is running

Initiate the Incident Briefing Form (ICS Form 201)

Relay information from damage report

Schedule a Planning Meeting

Action

Assess

Consequences

TERA
TRANSPORTATION EMERGENCY RESPONSE APPLICATION

Our office has been told unofficially that some Guardsmen were at a meeting in the Federal building when the bomb went off. We may have some casualties of our own. Do we need to take any action on this?

Check all of the boxes that apply.

- ☐ This is a CCIRL.
- ☐ Get the names of the people at the meeting and arrange a press release announcing the fatalities.
- ☐ No, it's probably just a rumor. We should wait until things settle down.
- ☐ Yes, get with personnel to see if we can confirm and find out who was at the meeting.

Reply Goodbye

Click on icons to select and deselect file types

File Name	Created By	Sensitivity
Hotwash	TRB	For Official Use Only
ICS Form 202	TRB	For Official Use Only
ICS Form 203	TRB	For Official Use Only
ICS Form 204	TRB	For Official Use Only
ICS Form 205	TRB	For Official Use Only
ICS Form 206A	TRB	For Official Use Only
ICS Form 206	TRB	For Official Use Only
ICS Form 207	TRB	For Official Use Only

Earthquake Registers 7.4 on the Richter Scale

Early this morning an earthquake registering 7.4 on the richter scale struck the area, destroying thousands of buildings, both residential and commercial. Roads were damaged as well as bridges. The 7.4 measurement is based on a U.S. Geological Survey. According to historical data, "major" earthquakes occur approximately 15 times a year, happening most often in the western United States. The National Guard as well as FEMA have been notified of the situation and are en route to the scene to offer their assistance. Figures on that number of casualties and damage estimates are not yet available, but estimates are high.

NCHRP Research Results Digest 385

The Legal Definitions of “First Responder” (2013)

Objectives: (1) identify the legislation, regulations, and executive orders in which the term “first responder” is defined; (2) briefly summarize the legislation / regulation / order to understand their scope and purpose; (3) provide the definition existing in the source documents; and (4) highlight any commonalities or inconsistencies between the definitions.

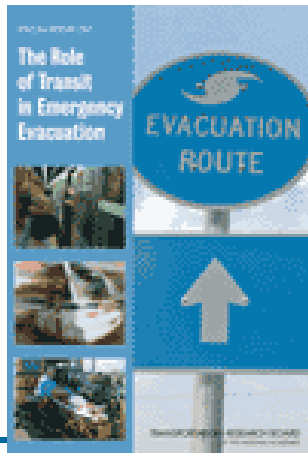
*Effective Practices for the
Protection of Transportation Infrastructure
from Cyber Incidents (December 2015)*

Objective: develop (1) a primer and (2) a briefing for transportation system owners and operators explaining the nature of cyber events and their operational and safety impacts. These products contain a list of effective practices that can be used to protect transportation systems from cyber events and to mitigate damage should an attack or breach occur.

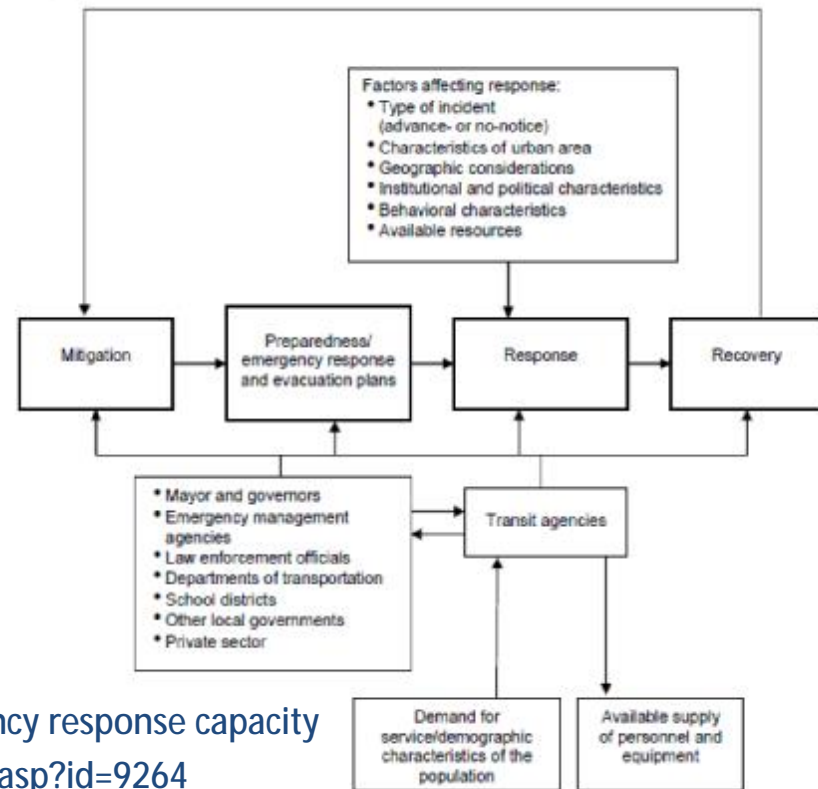
Study Charge:

Evaluate the potential role of transit systems serving the 38 largest urbanized areas (UAs) (> 1 million in population) to “accommodate the evacuation, egress, and ingress of people to or from critical locations in times of emergency.”

Source: SAFETEA-LU, Section 3046(a)(1)



TRB Special Report 294 *The Role of Transit in Emergency Evacuation (2008)*



Graphic: Factors affecting local emergency response capacity
http://www.trb.org/news/blurb_detail.asp?id=9264

NCHRP Report 740 (2013)

A Transportation Guide for All-Hazards Emergency Evacuation

Objective
to develop an all-hazards
emergency evacuation
guide for transportation and
emergency management
agencies that integrates the
broad community of
resources that are
necessary to plan, train,
exercise, and execute
evacuations.



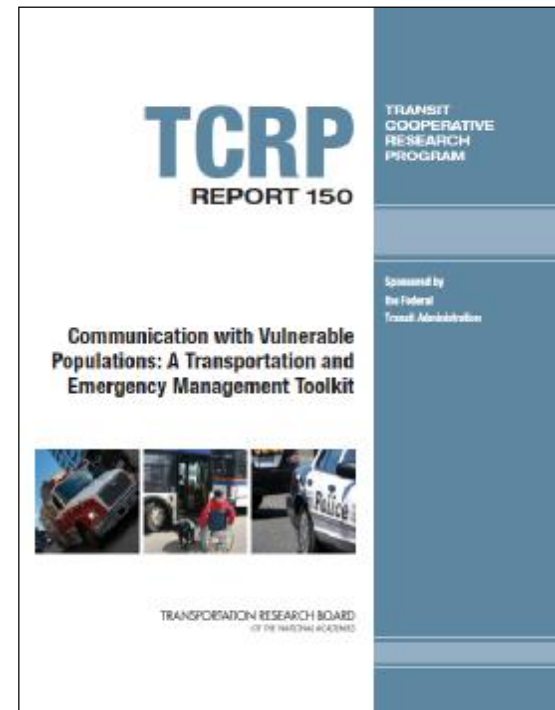
Tasks

1. Literature Review
2. Roles of Modes and Other Entities in Evacuation
3. Mode Integration
4. Matching Resources to Needs
5. "Workshop in a Box"
6. Case Studies
7. Operations Plan Templates
8. Report & Draft Outline
9. Draft & Final Guide
10. Final Report

TCRP Report 150

Communication with Vulnerable Populations: A Transportation and Emergency Management Toolkit (2011)

Objective
to develop a toolkit of
communications strategies,
policies, and practices for
transportation agencies and
emergency management
agencies that focuses on
communicating with
vulnerable populations prior
to, during, and after all-hazards
emergencies.



Graphic: Cover for TCRP Report 150, Communication with Vulnerable Populations:
A Transportation and Emergency Management Toolkit

Paratransit Emergency Preparedness and Operations Handbook (2013)

Objective

to develop a Handbook that provides guidance to paratransit service providers, including public transportation agencies and other public and private paratransit service providers, about how to prepare for all types of emergencies, including

(a) events with notification such as floods, hurricanes, blizzards, and pandemics, as well as

(b) events with no notification, including those that may cause regional disruptions such as earthquakes, power blackouts, fires, and acts of terrorism.



Photo: participants at a Handbook validation workshop

Review of DHS' s Approach to Risk Analysis (2010)

This Congressionally-mandated study by the National Academies reviewed how the Department of Homeland Security (DHS) is building its capabilities in risk analysis to inform decision-making. More specifically, the study addressed the following tasks:

- a) Evaluate the quality of the current DHS approach to estimating risk and applying those estimates in its many management, planning, and resource-allocation (including grant-making) activities, through review of a committee-selected sample of models and methods;
- b) Assess the capability of DHS risk analysis methods to appropriately represent and analyze risks from across the Department' s spectrum of activities and responsibilities, including both terrorist threats and natural disasters;
- c) Assess the capability of DHS risk analysis methods to support DHS decision-making;
- d) Review the feasibility of creating integrated risk analyses covering the entire DHS program areas, including both terrorist threats and natural disasters, and make recommendations for best practices, including outreach and communications;
- e) Recommend how DHS can improve its risk analyses and how those analyses can be validated and provide improved decision support.

HMCRP Report 12

Hazardous Materials Transportation Risk Assessment: State of the Practice (2013)



TRB's Hazardous Materials Cooperative Research Program (HMCRP) Report 12: Hazardous Materials Transportation Risk Assessment: State of the Practice documents the current practice for hazardous materials transportation risk assessment by government agencies and the private sector.

A [PowerPoint presentation](#) that describes the entire project is available.

Project: [Project Information](#)

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TRB Publication Type: [HMCRP Reports](#)

HMCRP Report 9

A Compendium of Best Practices and Lessons Learned for Improving Local Community Recovery from Disastrous Hazardous Materials Transportation Incidents (2012)

Objective: Develop a compendium of best practices that can be used by local communities to plan for recovery from disastrous hazardous materials transportation incidents.

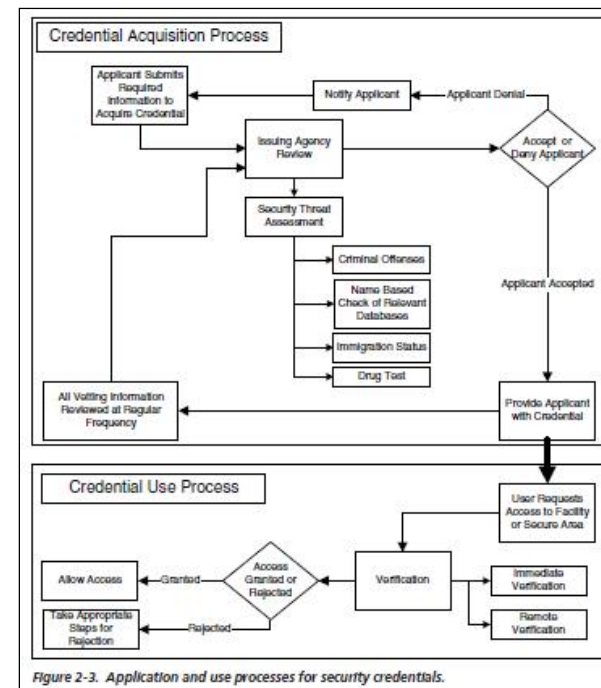
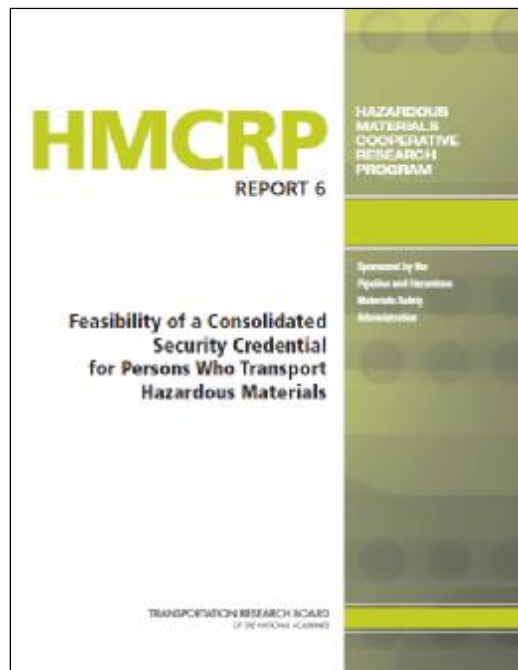
Recovery is defined as both short- and long-term efforts to re-build and revitalize affected communities.

Recovery planning must provide for a near-seamless transition from emergency response activities to recovery operations to de-briefing lessons learned, including, but not limited to, restoration of interrupted utility services, reestablishment of transportation routes, the provision of food and shelter to displaced persons, environmental restoration, business continuity, and economic rebuilding.

HMCRP Report 6

Feasibility of a Consolidated Security Credential for Persons Who Transport Hazardous Materials (2011)

Objective: to identify options for achieving the objective of a single, universally recognized credential that establishes (a) identity; (b) eligibility to access secure areas; and (c) eligibility to obtain or hold transportation-related licenses, credentials and other government certifications required of persons who transport hazardous materials by all modes in the U.S.



Methodologies to Estimate the Economic Impacts of Disruptions to the Goods Movement System (2012)

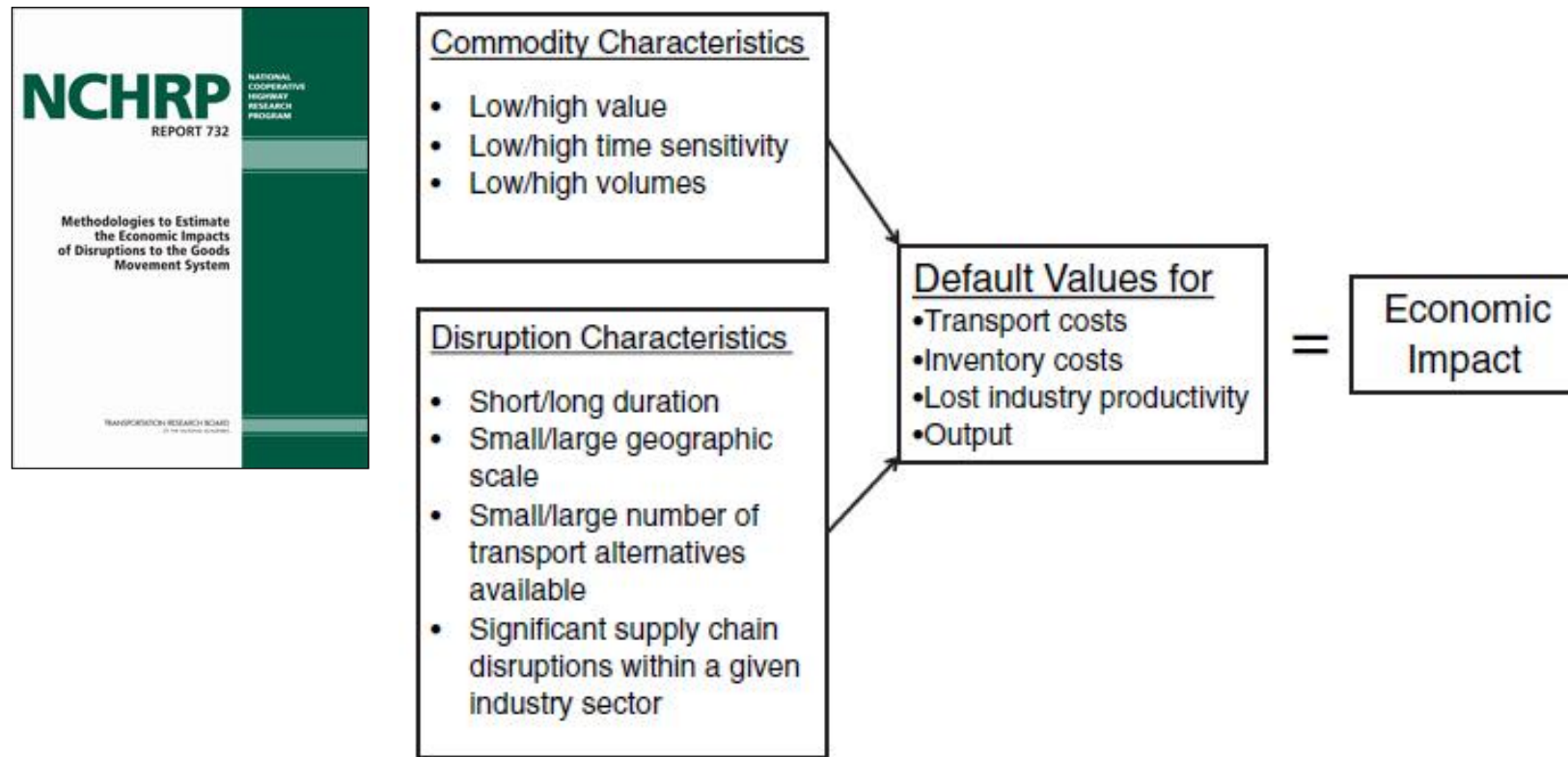


Figure S-1. Basic concepts in a high-level economic impact methodology.

NCHRP Report 753

A Pre-Event Recovery Planning Guide for Transportation (2013)

Objective : to develop a guide that provides pre-event recovery planning principles, processes, tools, and appended resource materials for use by planners and decisionmakers in pre-event planning to support transportation infrastructure recovery.

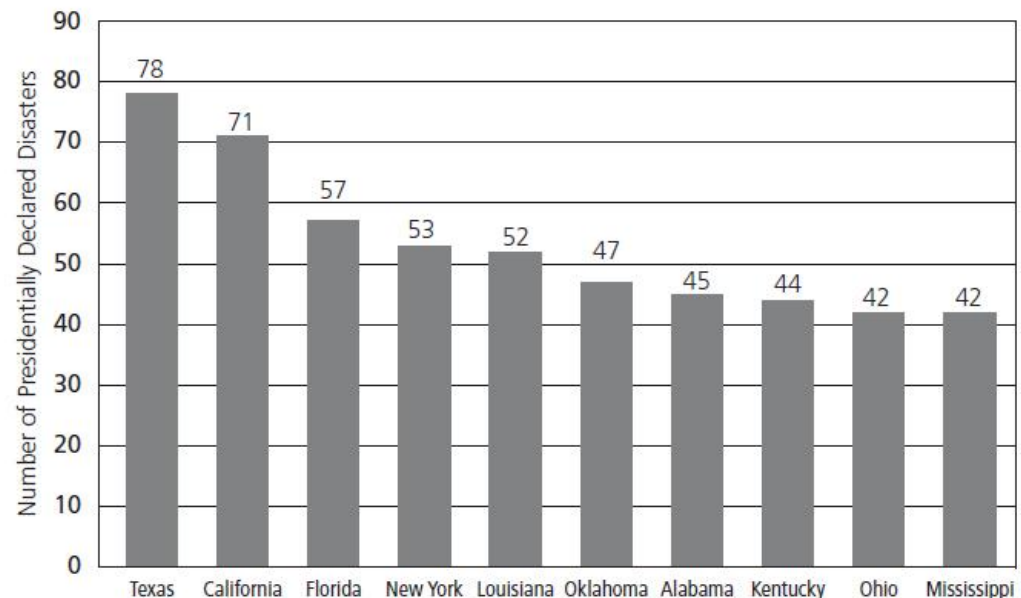


FIGURE 2-2

Presidentially declared disasters, top 10 states, 1953–2007.

NOTE: Declared disasters in these 10 states represent 32 percent of all disasters.

(SOURCE: Federal Emergency Management Agency, U.S. Department of Homeland Security, www.fema.gov/news/disaster_totals_annual.fema.)

NCHRP 20-7 Task 365

Strategic Transportation Systems Management & Operations Program Planning Lead States Initiative Development & Evaluation (2015)

The Strategic Highway Research Program (SHRP) created a capability maturity modeling (CMM) method for organizational assessment and development of state DOTs, which is being applied through the *AASHTO Guide to System Operations & Management*. The application of the guide is being facilitated through numerous SHRP Implementation “CMM Workshops”, and also coordinated with SHRP multi-state “Regional Operations Forums”. The CMM Workshops generate implementation action plans, which are being utilized by state DOTs to guide incremental development of organizational capacity to develop and deliver TSM&O programs.

The objectives of the project are to:

- Coordinate incorporation of the AASHTO Guide to System Operations Management CMM methodology into the application of the TSM&O Program Planning Framework in transportation agencies of several lead states.
- Coordinate peer comparison and evaluation of these lead state application experiences.
- Summarize lessons learned and opportunities for refinement of both the CMM methodology and the Program Planning Framework, as well as the agency-specific program planning processes utilized.
- Document guidance for continued integrated application of the CMM and Framework techniques.

***Incident Command System (ICS) Training for Field Level
Transportation Supervisors and Staff (December 2015)***

NIMS/ICS: Perform Reliably & Effectively

- Goal of NIMS/ICS: Reliable and effective response to an event, emphasizing safety of DOT staff
- Achieved through
 - Safety
 - Check-in, check out, demobilization
 - Personnel accountability
 - Food, shelter, family contacts
 - Reimbursement
 - The job you save may be your own
 - MAP-21 changes, debris removal reimbursement



Check-In, Check-Out, and Demobilization at ICP



NCHRP 20-59(14)B

***Research Support for the AASHTO Special Committee on
Transportation Security and Emergency Management
(SCOTSEM) (2015)***

The objective of this research is to produce three products to be considered for use by the AASHTO Special Committee on Transportation Security and Emergency Management (SCOTSEM): (1) the *National Needs Assessment for Ensuring Transportation Infrastructure Security (2016-2022)*; (2) the *All Hazards Security and Emergency Management Research Implementation Plan (2014-2016)*; and (3) *Fundamentals of Effective All Hazards Security Management for State DOTs (Second Edition)*.

Security Research Plan Reviewed at August 2007 Summit Led to 3-year Research Plan 2008-2010 Accepted by AASHTO Standing Committee on Research (SCOR)

Chairman Henry Hungerbeeler and Members of the Security Task Force:

In 2002, the AASHTO Transportation Security Task Force adopted twelve highway and bridge security research priorities. After adopting the highway and bridge projects, the Task Force initiated the development of intermodal security research projects. On behalf of the Task Force, the Research Working Group initiated this follow-on process to the 2002 security research priorities.

Two steps were taken to prepare these priorities. First, the Task Force cooperated with the TRB Committee on Critical Transportation Infrastructure Protection to sponsor a one-day workshop on intermodal security research needs. The workshop was held on January 12, 2003. The following day, the AASHTO Transportation Security Task Force approved a one-day working session to refine the problem statements for Task Force consideration. The candidate projects were those intermodal projects with a highway and bridge component. For this reason, the proposed research projects are described as "intermodal highway and bridge" priorities. The working session was held on February 19, 2003, in Washington, DC. The research priorities were presented at the April 17 meeting of the Task Force, where it was recommended that they should be forwarded to the NCHRP 20-59 panel for funding consideration.

This report presents the eleven research problem statements as supported by the AASHTO Transportation Security Task Force. We appreciate the opportunity to support the research mission of the AA

Mary Lou Ralls, Texas
Tom Hicks, Maryland
David Albright, New Me

May 30, 2003

Contractor's Report
Intermodal Highway and Bridge Security Research Priorities for FY '04

Requested by:
AASHTO
Transportation Security Task Force

Prepared by:
TransTech Management, Inc.
125 South Elm Street, Suite 200
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May 30, 2003

The information contained in this report was prepared as part of NCHRP Project 20-59, Task 14, National Cooperative Highway Research Program, Transportation Research Board.

NCHRP Project 20-59(25)
Security Research Plan

"Gap Analysis"

FINAL REPORT

Requested by:
American Association of State Highway
and Transportation Officials (AASHTO)
Special Committee on Transportation Security

Prepared by:

Mineta Transportation Institute
San Jose, California

October 2007

The information contained in this report was prepared as part of NCHRP Project 20-59, Task 25, National Cooperative Highway Research Program, Transportation Research Board.

National Needs Assessment for Ensuring Transportation Infrastructure Security (2009-2015)

Contractor's Final Report

National Needs Assessment for Ensuring Transportation Infrastructure Security (2009—2015)

Requested by:

American Association of State Highway and Transportation Officials
(AASHTO)
Special Committee on Transportation Security

Prepared by:

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David Yohanan
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4035 NW 43rd St
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with
Stephen Lockwood
PB Consult
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Final Report

August 29, 2008

Contractor's Final Report

National Needs Assessment for Ensuring Transportation Infrastructure Security

Requested by:

Association of State Highway and Transportation Officials
(AASHTO)
Transportation Security Task Force

Prepared by:

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October 2002

Information contained in this report was prepared as part of NCHRP Project 20-59, Task 5, National Cooperative Highway Research Program, Transportation Research Board.

White Paper on Highway Security Issues for Reauthorization

Project Number: NCHRP 20-59 (4)

Prepared For
National Cooperative Highway Research Program (NCHRP)

Prepared By
Parsons Brinckerhoff - PB Farradyne

April 14 2002

Information contained in this report was prepared as part of NCHRP Project 20-59, Task 26, National Cooperative Highway Research Program, Transportation Research Board.


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Publications

**NCRPP**
Web Only Document 4

**Legal Research Digest 49**

**NCRPP Research Report 1001: Pre-Publication 2010 - Subject to Revision**
An Expanded Functional Classification