TR NEWS
September–October 2021 NUMBER 335

STATE OF EMERGENCY

What Transportation Learned From 9/11

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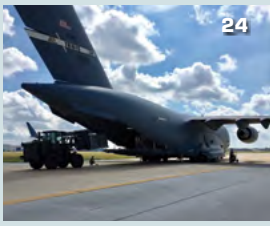

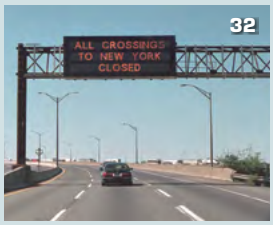

COVER A C-17 Globemaster III heads to St. Croix to deliver aid after Hurricane Maria in 2017. After 9/11, upgrades in communication systems and consolidation of logistical commands were only a few of the improvements that today help the military carry out its many humanitarian missions. (Photo: Master Sergeant Joseph Swafford, U.S. Air Force, Flickr)

TRB COVID-19 Resources

Agencies and organizations can use TRB publications and online resources for useful and timely information to help address issues related to the novel coronavirus pandemic. To read about TRB's current research and activities, and for a list of relevant publications, visit www.nationalacademies.org/trb/blog/transportation-in-the-face-of-communicable-disease.

Coming Next Issue

Airport Cooperative Research Program guidance on best design practices for ancillary airport spaces—service animal relief areas, worship spaces, lactation areas, and more—are presented in the November–December 2021 issue of *TR News*, along with articles on developing the transportation workforce and infrastructure preservation and renewal.

Many service animal relief areas—like those at Chicago O'Hare International Airport in Illinois—are indoors, so they incorporate artificial turf specifically manufactured for this purpose. Design features of these and other ancillary airport spaces are explored in an upcoming TR News *article.*

Photo: Brian Johnson and Dane Kantner, Flickr

Also in This Issue

TR NEWS

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

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STATE OF EMERGENCY

WHAT TRANSPORTATION LEARNED FROM 9/11

LAUREL J. RADOW

The author is retired from FHWA and lives in Washington, D.C. She is the chair of the TRB Critical Transportation Infrastructure Protection Committee.

This special issue of *TR News* is offered "as a way to hold out some hope. With this issue, we sought to document all that has changed for the good," to quote John Contestabile, transportation safety and security expert and issue contributor.

Since the terrorist attacks of September 11, 2001 (9/11), transportation has broadened its role to one that includes an increased operational capability, as well as more of a role in response. This role can include traffic incident management as a multiagency function within state department of transportation programs or greater participation in emergency management response. Security also has been ramped up in aviation, as well as in security-focused programs in other modes, including transit and passenger rail.

In the summer of 2019, when this issue was first discussed, the world was entirely different. The outline that was developed in early December 2019 was fairly conventional, examining the new roles transportation agencies assumed after 9/11. Although it was a perfectly good outline, by March 11, 2020, when the World Health Organization declared COVID-19 a worldwide pandemic, we knew that how we commemorated 9/11 needed to be reconsidered.

As the country began the first round of stay-at-home orders, we agreed—over Zoom calls and e-mails—that a better approach would be to treat 9/11 and the pandemic as bookends and to use these two events, 20 years apart, to compare how transportation adapted to both, as well as to disasters that occurred in the intervening years.

Parallel Timelines

Rarely are the behind-the-scenes work of an issue shared with readers. In many ways, the timeline for this issue mirrors likely milestones within the pandemic, so we thought that comparing the two would be helpful.

The first draft of this article was written in mid-April 2020, just as governors ordered an extension of their first stay-at-home mandates.

Photo, left: Robotpolisher, Flickr; photo, right: Oregon DOT

Nearly 20 years apart and on opposite coasts, roadway scenes—from the Brooklyn–Queens Expressway on 9/11 (*left*) and an Oregon highway in the early days of the COVID-19 pandemic (*right*)—show some of the very earliest effects of the devastating events: stopped traffic and lighter-than-normal traffic, respectively. These effects then ripple outward into all aspects of life and transportation, but so do opportunities to use research to prevent, mitigate, and address future disasters.

Six months after the initial draft, vaccines not only had been developed but also tested, and the rollout of several vaccines began slowly in December. According to the Centers for Disease Control and Prevention (CDC), by the end of April 2021, a third of the U.S. adult population had been fully vaccinated.

As this introduction was finalized at the end of August 2021, much has changed—the vaccines that were just being discussed a year ago are now available. On August 23, 2021, the Pfizer–BioNTech vaccine received full Food and Drug Administration approval.

Even as the editors finalize this issue, it is likely that more changes between its writing and the magazine's publication will not be reflected. The situation continues to change rapidly, particularly with the swift spread of the highly transmissible Delta variant of the coronavirus.

These parallel timelines—of this *TR News* theme issue and the pandemic—are offered to show that, whatever the initial response to a disaster is, it cannot stay static, because that early response is based on incomplete or incorrect information. Whether the event is security-centric, as with 9/11, or health-related, as was the COVID-19 pandemic, the research itself does not change rapidly. Solid and reliable research takes time.

As this issue's articles show, the research undertaken by the Transportation Research Board (TRB) through its Cooperative Research Programs, as well as post-9/11 research conducted through FHWA, the states, departments of transportation (DOTs) and other state agencies, and universities took years to develop and time for agencies to adopt, train, and implement recommended changes. Now, 20 years after 9/11, disaster response and recovery time by state and local agencies are faster and more effective because of better coordination, communication, and collaboration.

Since 9/11, various disasters and threats have captured the nation's attention. If, as a result of 9/11, the focus was terrorism and national security, after Hurricane Katrina struck, the emphasis shifted to emergency management. As computers have become a greater part of our daily lives, the need for cybervigilance is no longer the sole responsibility of the information technology community. It is now everyone's responsibility. Attention to health concerns rose to the forefront after the spread of respiratory diseases SARS, MERS, and other viruses.

Although often independent of each other, these threats sometimes converge. As we continue to learn, when we do not pay attention to these threats, we do so at our own peril. Resilience cannot be an

Photo: John Hughel, Oregon National Guard

Oregon Army National Guard medic Shaun Martin prepares to administer a COVID-19 vaccine at a mass vaccination clinic in January 2021. Many states set up these clinics using a drive-through or hybrid model, with drivers checking in, filling out paperwork, and moving to designated vaccination stations.

ideal future task but rather needs to be incorporated into the DNA of every agency and organization.

As this issue first got under way, the following question was raised: "What have we learned from 9/11 that could help with the response to the pandemic?" As a result of that tragic day, the following events and changes occurred:

- Meeting of the U.S. DOT Research and Special Programs Administration and AASHTO in October 2001 to figure out next steps;
- Establishment of the AASHTO Special Committee on Transportation Security, which ran from 2003 to 2006; its mission was expanded to become the AASHTO Special Committee on Transportation Security and Emergency Management;
- Dedicated funding from TRB via the second Strategic Highway Research Program to the National Cooperative Highway Research Program (NCHRP) Project 20-59 tasks devoted to transportation security and emergency management;
- Dedicated TRB staff person to manage NCHRP 20-59 tasks and no completion of about 175 NCHRP 20-59 products;

Image: TSA

The Transportation Security Administration's First Observer Plus video training was among the security measures presented in *NCHRP Research Report 930: Update of Security 101—A Physical Security and Cybersecurity Primer for Transportation Agencies*. This publication was one of the many products developed via NCHRP Project 20-59, "Surface Transportation Security and Resilience."

- Organization of August hazards conferences from 2006 to 2013 in Irvine, California, sponsored by TRB, AASHTO, and FHWA;
- Establishment of the TRB Standing Committee on Aviation Safety, Security, and Emergency Management;
- Establishment of the U.S. Department of Homeland Security (DHS) and the Transportation Security Administration; and
- The U.S. Coast Guard moved from U.S. DOT to DHS.

There is never a direct line from one event to another. Rather, the path is winding and broken. But when we make the collective decision to learn from one event, those facing the next event can benefit.

This issue was written for those facing a disaster five or 10 years from now. They may not have been alive for 9/11, or, because they may not have been at a transportation agency during the pandemic, they didn't consider what the event meant to transportation. Although no two disasters are alike, and not all lessons learned can be contained in this one issue of *TR News*, some of the key knowledge discussed in this issue, gained in the 20 years since 9/11, offer much as agencies seek to mitigate unknown disasters.

The *TR News* Editorial Board thanks Waseem Dekelbab, TRB, for his work assembling and developing this issue.

9/11 REFLECTIONS

ROBERT SKINNER

Role on 9/11: Executive Director, Transportation Research Board

"In the year following 9/11, TRB supported the transportation component of an institutionwide study of the role of science and technology in addressing emerging security threats. While that study took a long-term view, in the immediate aftermath of 9/11 NCHRP and TCRP were able to identify and expedite projects on critical security issues confronting highway and transportation agencies."

—ROBERT SKINNER
Transportation Research Board Executive Director (retired)
Falls Church, Virginia

9/11 20 YEARS LATER

Cyber-Resilience

A 21st-Century Challenge

C. DOUGLASS COUTO

The author is an executive technology consultant and a senior fellow at the Center for Digital Government, East Lansing, Michigan. At TRB, he is the co-chair of the Cybersecurity Subcommittee and the chair of the Systems, Enterprise, and Cyber-Resilience Committee.

Cyberthreats to transportation systems have increased over the past 20 years. These threats will continue to grow as we use more technology to plan, build, operate, and maintain transportation infrastructure and mobility systems. Recent incidents have denied a transit operator the use of the toll collection system, taken down a traffic management system, and halted operations of a global shipping company. All were costly to the transportation organization or private-sector company.

Transportation agencies are undergoing a digital transformation and are seeking innovative ways to use technology. The increasing use of massive amounts of data have added a new dimension to cyberthreats. The loss of these data or their use may totally impede operations, services, or privacy. Even worse, the cost to restore operations can be exorbitant, taking resources from other transportation priorities.

What are the challenges faced by transportation executives, and what should they do to lead their organizations securely?

What Is Cyber-Resilience?

Cyber-resilience is defined by the National Institute of Standards and Technology (NIST) as "the ability to anticipate, withstand, recover from, and adapt to adverse conditions, stresses, attacks, or compromises on systems that include cyber-resources."[1] Threats may come from an adversary attacking the agency's resources, a natural disaster, an unplanned outage (equipment failure), or a planned special event—like the Super Bowl—that stresses all systems.

Photo: Shinya Suzuki, Flickr

A Metropolitan Transit Authority (MTA) train leaves the 40th Street–Lowery Street Station in Queens, New York. In April 2021, MTA systems were targeted by hackers. The cyberattack did not do any major damage to the system or to rider safety, but it revealed the ongoing need for transportation agencies to take cyber-resilience seriously.

Lead the Way

Transportation leaders must acknowledge that there is a cyber-risk and include it as part of the agency's resilience assessments and planning. The staff will follow and begin to think about possible threats.

Include the technology team in resilience planning and exercises. The agency's information communications and technology systems become critical during

[1] This definition is from *NIST Special Publication 800-160, Vol. 2* (see Resources).

an event. Many large agencies are adding a chief information security officer to the staff. Small agencies are partnering with other jurisdictions or with the private sector to access these skills.

To help people understand the risk and how to reduce it, invest in people and training. Social engineering attacks that get staff to give up business details or open infected e-mails are a primary threat that requires constant attention. Create an organizational culture that is cyberaware.

Employee Resilience During and After a Disaster

Employee response during a disaster may be 50 percent or less. This is understandable because employees also may be victims, concerned about their family's safety and securing their own property.

In the past decade, and especially during the COVID-19 pandemic, a migration to work-from-home programs allowed workers to create a home office. These remote workers need to be supported with network connections, office equipment, and a set of tools that would be available in a traditional office setting. Resilience is better achieved through planning and regular exercises that anticipate various scenarios.

Secure Communication Channels

Internal and external communications become vital during an event. Agency leaders must keep staff informed about developments and internal status reports. The public also will be thirsty for information about the event's impact on the community.

Consider all channels, including social media, public service announcements, print media, news conferences, e-mail, blogs, and the like. The best advice during a crisis is to communicate, communicate, and communicate.

Conduct Regular Assessments

Determine internal and external risks. Prioritize applications, data, and systems that are critical to the agency. Identify ways to backup and secure these systems.

Pay attention to systems that need an air gap security measure between operational connections and storage. This could mean the difference between being able to restore operations or not. A disruption to the Traffic Operations Center could cause a major disruption on roadways.

Collaborate with Other Agencies

You are not alone. Work with other agencies within your jurisdiction to share threat information and backup resources. Local law enforcement, homeland security agencies, and federal agencies have a wealth of resources to help with intelligence, threat assessments, and recovery.

There is a wealth of information available to transportation agency leaders; for example, there are many TRB publications about cybersecurity (see Resources). These case studies are illuminating because each offers a unique perspective and lessons learned.

There is no way to avoid a cyber-incident. The challenge is to understand what might happen and determine how to mitigate the impact on operations and the users. This is cyber-resilience. Welcome to the 21st century!

RESOURCES

TRB Snap Search on Cybersecurity. TRB's involvement in research on cybersecurity from 2017 to 2021 can be found at http://onlinepubs.trb.org/onlinepubs/snap/cybersecurity.pdf. A good compilation of TRB cybersecurity activities and products, the page is updated periodically.

NIST Report. *Developing Cyber Resilient Systems: A Systems Security Engineering Approach, NIST Special Publication 800-160, Vol. 2*, by Ron Ross, Victoria Pillitteri, Richard Graubart, Deborah Bodeau, and Rosalie McQuaid, is available free of charge from https://doi.org/10.6028/NIST.SP.800160v2 or https://nvlpubs.nist.gov/nistpubsSpecialPublications/NIST.SP.800-160v2.pdf.

9/11 REFLECTIONS

FREDERICK (BUD) WRIGHT

Role on 9/11: Associate Administrator for Safety, FHWA

"It is inevitable—and likely appropriate—that the emphasis on many of those things that were the highest priority in 2001 and 2002 has waned over the years. What FHWA learned from these events over the past 20 years enabled resiliency to be incorporated into agencywide activities."

—FREDERICK (BUD) WRIGHT
Principal
Bud Wright Transportation Policy Consultants
Alexandria, Virginia

Left photo: Scott Reed, U.S. Air Force; right photo: Michael Rieger, FEMA

EMERGENCY EVACUATION

20-YEAR EVOLUTION OF RESEARCH AND PRACTICE

BRIAN WOLSHON

The author is the Edward A. and Karen Wax Schmitt Distinguished Professor and the director of the Gulf Coast Research Center for Evacuation and Transportation Resiliency at Louisiana State University, Baton Rouge.

Above: Mere days after Hurricane Katrina caused devastating floods in New Orleans in August 2005, a U.S. Army helicopter uses the freeway to evacuate displaced residents (*left photo*), and evacuees needing medical assistance arrive at the New Orleans airport (*right photo*). The lack of strategic coordination among federal, state, and local agencies created evacuation crises before, during, and after the hurricane.

For many in transportation, the need to integrate evacuation planning and preparedness into the routine day-to-day operations and management of transportation modes and systems in America began on September 11, 2001 (9/11). This article highlights evacuation policy, planning, and operation innovations that have occurred in the 20 years since 9/11, as well as a brief history of conditions before 2001 and the direction of the field of evacuation.

Although many agencies believed they were prepared to deal with catastrophic emergencies and natural disasters before the terrorist attacks, 9/11 emphasized how ill-prepared most transportation agencies across the country truly were—and, in most cases, still are—to deal with such events. The tragic events of 9/11 kick-started research to better understand the effects of harmful and disruptive events on transportation systems and the ways that transportation itself may contribute to these effects.

Over the past 20 years, policy changes have been implemented to guide the application of transportation infrastructure, modal assets, and personnel to support emergency preparedness and response planning and operation. These have fundamentally transformed how many state and regional transportation agencies view their roles in disasters and emergencies.

Policy changes also have fostered the adaptation and creation of new practices to counter the growing list of threats and disruptions. The past 20 years also have shown that these changes came easy and naturally to transportation organizations, many of which have been separate from such roles historically.

Pre-9/11

Before 9/11, evacuations tended to receive little attention from the transportation community, like many emergency-related transportation issues. Other than emergency planning for nuclear power plants and hurricanes, most transportation agencies viewed their role in emergencies as limited to maintaining safe and efficient systems. In general, very little specific attention was

given in advance to the needs of mass emergencies.

History suggests that evacuations have been (and continue to be) perceived as rare events that are the responsibility of nontransportation agencies. Evacuations also have been regarded as a regional issue—one mostly experienced by hurricane-prone regions and one in which available resources could not guide or accommodate the overwhelming demand anyway. Largely because of these perceptions, evacuations tended to just happen organically rather than to be planned or actively managed. Thus, until the late 1990s, travelers evacuated using whatever routes and modes of transportation were available.

In some cases, evacuation needs were so overlooked that ongoing maintenance and construction hampered—if not completely thwarted—emergency travel on some routes. Similarly, there were no provisions for non-auto-based modes of transportation such as rail, bus, air, and water, nor was there planning for low-mobility and immobile populations such as those without cars; infirm, elderly, or economically disadvantaged people; or protected and incarcerated populations.

Although efforts to address some of these needs started before 9/11, the terrorist attacks of that day, along with the disasters since then, have focused attention on the need to integrate emergency conditions into routine transportation practice.

Research and the Evolving Creation of Knowledge

As a division of the National Academies of Sciences, Engineering, and Medicine, the Transportation Research Board (TRB) promotes innovation and knowledge creation in transportation through research. This included a committee dedicated to the study of evacuations, which began just before 9/11 and is still active.

With enormous collaborative support from the U.S. Department of Transportation (U.S. DOT), the National Cooperative Highway Research Program (NCHRP), and AASHTO, the TRB Standing Committee on Emergency Evacuation served as a national focal point to encourage research and the dissemination of emerging knowledge in the field of evacuation. Via hundreds of technical papers, many special-edition journals, and the National Evacuation Conference, practitioners used the work of the committee to learn about and adapt to new information to improve how evacuations are planned, managed, measured, assessed, and understood.

U.S. DOT, in particular, led the development of three significant evacuation guidance documents related to with-notice and no-notice evacuations and evacuations for persons with functional needs. For further reading, see the box on page 12.

Photo: Metropolitan Transportation Authority

In preparation for Hurricane Irene in 2011, New York's Metropolitan Transportation Authority readied Access-a-Ride vehicles to evacuate residents of a nursing facility in Queens. Transportation agencies play a crucial role in effective disaster responses.

Photo: Ken Lund, Flickr

A Coastal Evacuation Route sign along NJ-35 in Eatontown, New Jersey, directs vacationers, residents, and other evacuees away from the coast. Along the Atlantic Coast, evacuation routes run westward.

Practice Innovations and Results

Although evacuations are often assumed to be rare mass events, research shows that they occur with regular frequency and typically involve fewer than 1,000 people (*1*). In fact, on average, an evacuation occurs every two weeks somewhere in the United States and involves fewer than 5,000 people. Interestingly, the vast majority of evacuations also occur without notice or warning.

This relative frequency of evacuations has given some transportation agencies the ability to identify problems and needs and then to develop and implement new policies, strategies, and technologies to address them. Arguably, the most significant and effective practice advancements have not required major financial expenditures but have come from better cooperation and creative approaches.

First and foremost, improved evacuation planning among transportation agencies has developed from a recognition of problems and needs and collaboration with emergency management and law enforcement counterparts to address them. In locations across the United States, this has resulted in proactive evacuation planning

Photo: Erica Knight, U.S. Army National Guard

South Carolina National Guard soldiers assist highway patrol officers during a lane reversal of Highway 501 in Conway, South Carolina, in 2018. The lane reversal helped citizens evacuate the Myrtle Beach area ahead of Hurricane Florence.

and management: taking an active role in evacuations rather than just letting them happen. Collaborative innovation among transportation, emergency management, and law enforcement also can be seen in a variety of other no- or low-cost but effective measures, including the following:

- **National Incident Management System (NIMS).** NIMS protocols and procedures since 9/11 have created uniform procedures for communications, coordination, and mutual assistance across jurisdictions and disciplines involved in the response and recovery from disasters. They include expansion of training and education, which support increased capabilities.
- **Contraflow.** These strategies, which reverse the inbound lanes of a controlled-access roadway to accommodate outbound flow away from a threat, have been shown to increase outbound capacity by 75 percent, with little additional capital cost.
- **Signal coordination.** These strategies change the traffic signal settings and timing in urbanized areas to facilitate movement away from the central business district in the event of a no-notice attack or hazard. These have been shown to increase outbound capacity to levels similar to those of evening commute periods, with little additional capital cost.
- **Multimodal, transit, rail, or bus evacuations.** These approaches use transit system modal resources—with potential routing and headway modifications—to facilitate the evacuation of carless and mobility-limited populations. This method was used in New Orleans to evacuate about 14,000 people (including tourists without cars) during Hurricane Gustav.
- **Intelligent transportation systems and remote sensing systems.** These systems include traffic cameras, volume and speed sensors, variable message signs and highway advisory radio, real-time en-route navigation, and more to monitor traffic conditions in real time and to issue guidance information, better utilizing capacity and decreasing traffic delay and clearance time.
- **Use of other modes (e.g., air, water, and ambulance).** Similar to the use of transit resources, airborne and waterborne transportation have been used to move elderly and hospital patients in need of care rapidly and over longer distances. Such modes often are coordinated and managed through contract services directly with care facilities, but some have been coordinated through the Federal Emergency Management Agency (FEMA) and military agencies, particularly during major disasters.
- **Evacuation modeling and simulation.** Before 2001, the ability to

Photo: Jacinta Quesada, FEMA

Buses bring evacuees to the New Orleans Union Passenger Terminal, where they boarded trains and other buses to leave ahead of Hurricane Gustav in 2008.

Photo: Caltrans

The California Department of Transportation (Caltrans) was part of an agency effort to put up signs, provide equipment, and keep roadways clear during the deadly Valley Fire in Lake County in 2015. Caltrans worked closely with other agencies during evacuation efforts.

evaluate evacuations was limited in terms of fidelity detail and temporal and spatial scale. Since then, the understanding of evacuation travel behavior and trip making—combined with increased computational capability—permits evacuation traffic processes to be examined in much greater detail and across greatly increased geographic regions and durations.

The Future and Continuing Needs

Looking to the future, transportation agencies expect that innovations in research and practice will increase the ability of transportation to respond to the national need for evacuations. It is worth noting that many of the techniques, systems, and capabilities used to assess and plan evacuations are being applied to other disruptive and surge events. Recently, these have included issues such as mass cross-border movements of refugees and global pandemics like COVID-19 (*2*–*4*).

Transportation technologies that are in their relative infancy today also will likely make significant future contributions. Connected and autonomous vehicles, for example, can triple or quadruple the capacity of evacuation routes. Increasingly sophisticated remote sensing and route guidance technologies have shown promise to permit a more effective utilization of network capacity and guidance for evacuees to find emergency shelter (*5*). These emerging systems also will likely be integrated with predictive weather and traffic simulation to anticipate congestion, travel time, and weather hazards hours—if not days—in advance (*6*).

Ultimately, it also is likely that evacuation, along with the spectrum of emergency transportation security, preparedness, and response, will coalesce under a broader umbrella of transportation resilience. An overarching resilience approach to transportation disruptions and surges can be effective because it promotes the adaptability, flexibility, and scalability that permit responses to be scaled up or down based on any event or temporal–spatial need.

A resilience approach also encourages similarly adaptive and flexible protocols that overlap modes, infrastructure systems, sensing technologies, control systems, freight movements, and expertise to respond to any disruption large or small, immediate or long term, harmful or routine.

The most important component in any response has been, is, and always will be people and the ability of agencies to communicate, coordinate, cooperate, and plan across agency and jurisdictional barriers. To promote resilience, transportation organizations need to integrate emergencies across business obstacles and make preparedness and response issues an organizational priority.

In the past, evacuations have tended to be overlooked within transportation agencies because no one clearly owned the problem. An all-in approach can help agencies plan and utilize transportation systems and resources most effectively.

Planning Is Crucial

The issues that existed before 9/11, Hurricane Katrina, and the Camp Fire in Paradise, California, still exist today.[1]

[1] See also "Implications of the California Wildfires for Health, Communities, and Preparedness" in the March–April 2020 issue of *TR News* at http://www.trb.org/Main/Blurbs/180720.aspx.

These include the obligation to address the needs of at-risk, low-income, disadvantaged, and minority communities, which may not have access to the resources and formal communications channels that support preparedness, evacuation, sheltering, and other important transportation services. Unfortunately, another lesson of 9/11 continues to be true: Improvements and planning often only occur *after* tragic consequences happen.

Many believe they are prepared, but in reality they are not. Mistaken perception of preparedness comes from a lack or inaccurate understanding of human behavior, threats, and transportation limitations needed to address emergencies. This is often further reinforced by policies and practices in which transportation agencies do not view evacuation as their responsibility or as a problem they can change. Sadly, major catastrophic disasters will occur, as will loss and suffering from inadequate planning.

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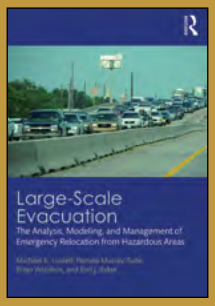

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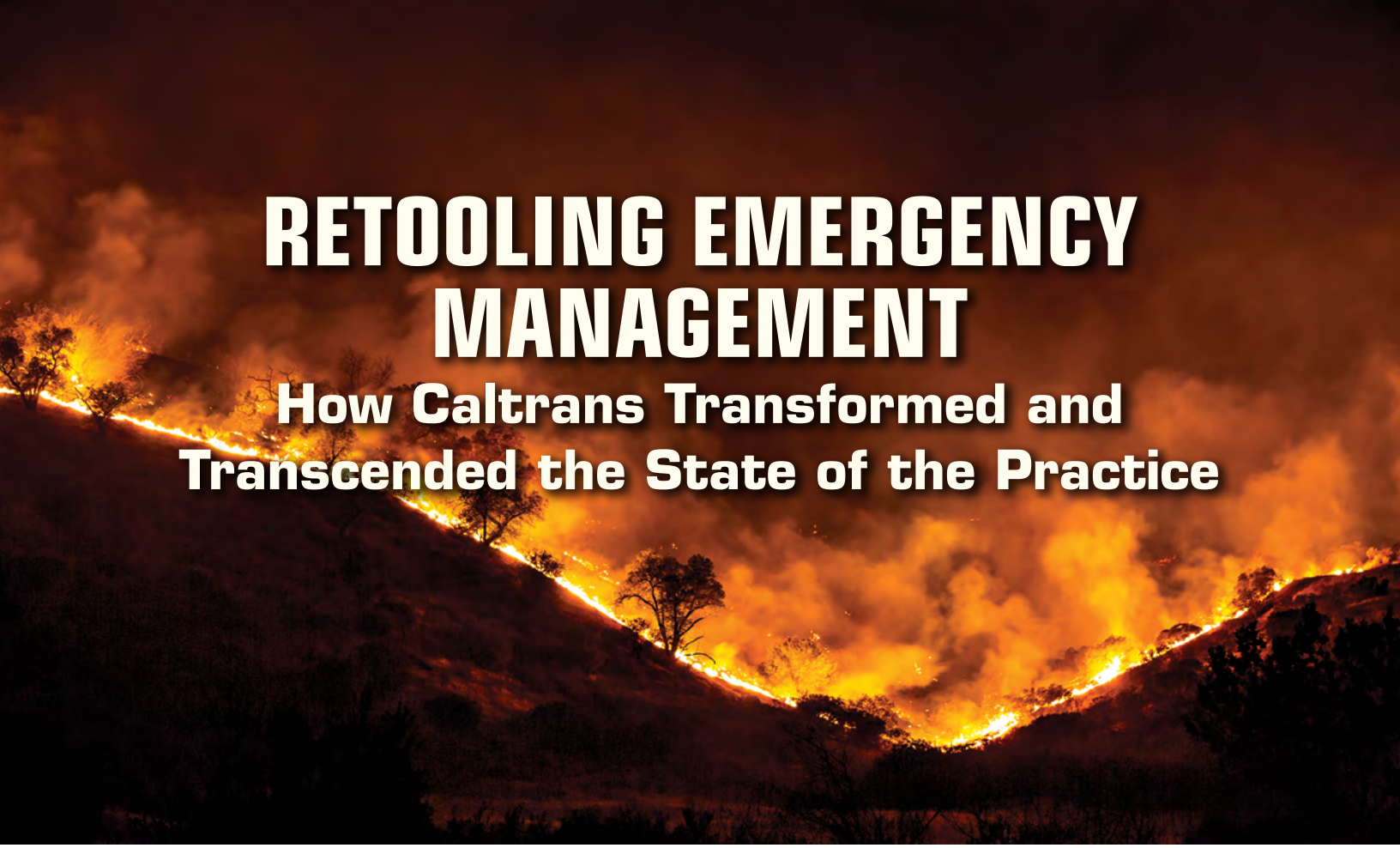
9/11 REFLECTIONS

JANET BENINI

Role on 9/11: Deputy Director of the Office of Emergency Transportation, U.S. Department of Transportation

"The U.S. Department of Transportation (U.S. DOT) learned many lessons from TRB—not only about response and planning but also about mitigation and recovery. That knowledge has become so integral to U.S. DOT's essence, it would be hard to tease out at this point. Four years after 9/11, Hurricane Katrina reminded everybody that terrorism is not the only disaster with catastrophic potential. Certainly, the emphasis on resilience and the change in authorization to not only allow but to facilitate building back better are key results of the efforts following these two events. In a way, the normalization of emergency management within U.S. DOT has enabled it to be more resilient as a department. U.S. DOT no longer considers emergencies as odd events that occur every decade or so but recognizes that they happen all the time and require various levels of response. Additionally, mitigation, land use, and long-term planning—considering climate change, as well—facilitate improved transportation systems that are inherently more resilient."

—JANET BENINI
Independent Consultant
Washington, D.C.



RETOOLING EMERGENCY MANAGEMENT

How Caltrans Transformed and Transcended the State of the Practice

Photo: Peter Buschmann, Flickr

HERBY G. LISSADE

The author is the executive director at Tortuga Planning, Engineering and Consulting in Sacramento, California; principal transportation engineer (retired) for the California Department of Transportation; and the first director of the department's Office of Emergency Management and Infrastructure Protection. He also is chair of TRB's Transportation Emergency Management Practices and Innovations Subcommittee.

Above: California, the U.S. state with the highest population, is prone to every type of disaster known to the U.S. Federal Emergency Management Agency (FEMA). Fires, floods, and earthquakes are the state's most prevalent disasters.

Starting with little more than evacuation plans before 9/11, the California Department of Transportation (Caltrans) took many actions and activities to be better able to respond to the large range of disasters the state faces daily. Caltrans transformed their emergency operations into internationally known best practices for all elements of transportation emergency management. Sharing lessons learned with other state departments of transportation (DOTs) via the Transportation Research Board (TRB) and AASHTO helped make California stronger and shaped transportation emergency management throughout the United States and the world. This collaboration went far beyond Caltrans' original expectations after 9/11.

Addressing Preparedness and Response Gaps

Shortly after 9/11, Caltrans established the Office of Emergency Management and Infrastructure Protection (OEMIP) as it conducted activities that included an examination of its existing emergency management needs and issues, as well as embracing innovative and disruptive technologies. This was not always easy, since it was a change in the way people and agencies did business.

In tandem with these innovations, OEMIP (staffed with engineers, maintenance field workers, planners, and administrative personnel with operational experience in emergency management) shared its knowledge with neighboring states and the international transportation community. Collaboration—often spoken about before 9/11—has since become critical to strengthening emergency management efforts in California, throughout the country, and around the world.

Caltrans became more involved with emergency management exercises, which covered the most likely disasters that the state would face. These included the three big disasters that the state faces often: fires, floods, and earthquakes. Some of these activities were led by the California

Office of Emergency Services (CalOES) and others were led by Caltrans. In either case, there was some level of collaboration between the two government entities.

In 2008, OEMIP participated in Golden Guardian, their first functional exercise. Led by CalOES, this multiagency, private-sector exercise focused on an earthquake in Southern California. Golden Guardian helped Caltrans identify gaps in preparedness and response, such as communications in its traffic management centers and deficiencies in the department operations center. After the exercise, those gaps were addressed via funding and staff training to ensure that the department was better prepared for a real event.

This milestone exercise prepared Caltrans for future actual responses to emergencies and disasters by setting the stage for what would be expected of the department when a disaster occurred. Although every disaster is different, there are commonalities in preparedness and response to all of them.

In the following years, OEMIP performed exercises for everything from terrorist threats and active shooters to fires, floods, earthquakes, power disruptions, and dam failures. Meanwhile, OEMIP responded to actual disasters and emergencies, as well as other calamities throughout the state. California is unique, as it is prone to every disaster type that the FEMA recognizes. The state has been described as "the Disneyland of disasters," but unlike Disneyland, California does not shut its doors at the end of the business day.

Leveraging Collaboration

Since 9/11, OEMIP worked with the Transportation Security Administration, FHWA, U.S. Department of Transportation, CalOES, local governments, neighboring states, and international partners and governments to help identify critical transportation infrastructure and harden those assets as best and as economically as possible. OEMIP has focused on minimizing disruptions and making those assets resilient. This change in culture from siloed to collaboration with so many entities and at all levels of government—domestic and international—was undertaken with a key strategy in mind: to protect commerce.

Photo: California Department of Water Resources

Repairs to the Oroville Dam required more than 1.2 million cubic yards of concrete. Disaster response can require massive amounts of materials and interagency coordination.

Almost 40 percent of all international inbound freight flows through the Ports of Long Beach and Los Angeles and are destined to locations throughout North America. These ports are economically critical to California, the nation, and international partners. The freight leaves the ships and moves onto California's transportation network before heading for points east.

OEMIP also identified and addressed soft targets, such as the state's computer networks that support intelligent transportation system assets. This is an ongoing process.

All of these efforts were transparent. But where transparency would lead to security concerns, OEMIP instituted a process to provide information to those with a need to know. There is much more work needed in this area to protect sensitive information at state DOTs.

Fostering Innovation Through Research and Training

TRB has become an invaluable resource to state DOTs in their emergency management and security efforts by providing research in near real time that emergency management practitioners can use as guidance and implement recommendations as needed. All of this is available for free and online to state DOTs and to the world.

Specifically, Caltrans looked at lessons learned within the state, throughout the country, and around the world. The agency embraced and implemented technology such as ShakeCast (Figure 1), an open-source Web application developed in collaboration with the U.S. Geological Survey that has become part of Caltrans' earthquake preparedness

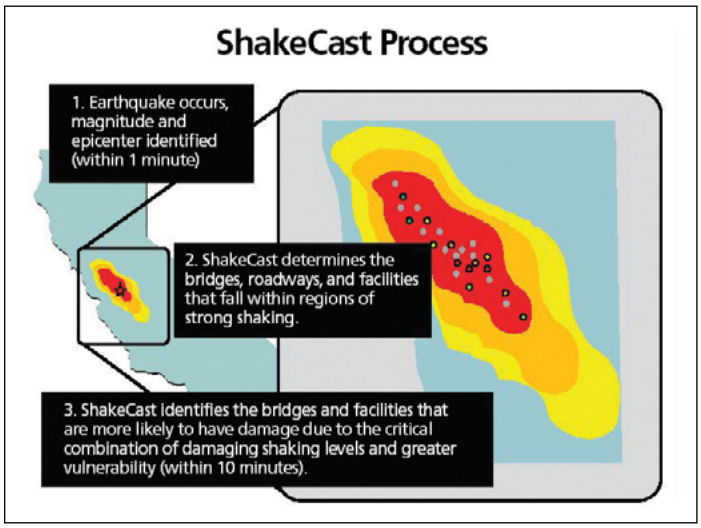


FIGURE 1 ShakeCast retrieves measured shaking data within minutes of an earthquake.

and response for the built environment. ShakeCast provides real-time alerts to first responders and helps direct and prioritize emergency bridge, roadway, and facility inspections. It also is used as a planning tool to evaluate system performance and supply chain response capabilities. Bridges, buildings, and roadway infrastructure have been modeled and incorporated into ShakeCast.

As important as it is to have the correct technology, it is equally important to have the proper workforce. Over time, OEMIP had to learn how to hire the right people and give them the appropriate training, as was done for the department's emergency management personnel. This training was provided to Caltrans' engineers, field maintenance workers, general staff, administrative personnel, and management.

Caltrans also conducted and implemented a range of need-based research following 9/11. In addition to ShakeCast, this included the following:

- FloodCast, developed by TRB in National Cooperative Highway Research Program (NCHRP) Project 20-59(53), "FloodCast: A Framework for Enhanced Flood Event Decision Making for Transportation Resilience," identifies the impacts of flooding on transportation infrastructure (*1*).
- FireCast, developed at Caltrans, assesses the propensity for fire and fire danger ratings that are shared to field staff throughout the state so they can plan their work accordingly.
- Other implemented research and research currently under development includes guidance for pandemics, which has been released for implementation.

Understanding Governance

While the workforce was being trained, department management was kept informed as a way to understand the governance behind the department's emergency management responsibilities before a disaster happens.

No matter in which state, emergency management staff need to understand the governance behind what they do. In California, OEMIP is mission tasked to do emergency response through the governor's office. Usually, this is a capabilities-based request. One day the office may be designing a roadway as part of regular duties, while at the same time helping to design a mass evacuation center during a disaster. The California Emergency Services Act provides guidance and governance to emergency management within the state. For example, the capabilities of what a state DOT is resourced to do may go beyond that in an emergency environment. That state DOT may provide their governor engineering services such as construction management, engineering design, equipment—the list goes on.

Photo: Brian Baer, California Department of Water Resources

During the Oroville Dam incident in 2017, Caltrans live-streamed video of the damaged dam to the governor, CalOES, and others. Such efforts helped officials decide to use ground-penetrating radar on the embankment encompassing the chute to acquire data critical for understanding the cause of the failure and for repair design.

Ensuring Management Buy-In

When managing disaster response at the CalOES headquarters during California's 2017 Oroville Dam incident, the first task was to coordinate and pay for the design of a haul road to get massive amounts of repair materials to the damage site. At the same time, it was necessary to explain to administration staff that Caltrans was mission tasked by the governor to provide geotechnical engineers to use ground-penetrating radar on the dam spillway to look for voids. Caltrans moved forward and provided staff to handle the request, while upper management—who understood the implications of the request—explained the magnitude of the work to administrative staff so they would make funding and needed resources available without delay. It is important to create those critical relationships before an incident so they are in place at 2 a.m. during a crisis. Know who to call before it happens.

Inciting Transformative Change

The changes brought about by analyzing deficiencies, promoting a culture change that embraced collaboration, and using research to foster innovation were not easy, but their results were visible. Today, all levels of government in the United States, international communities and governments, academia, and many others look to Caltrans for information, support, and guidance for their transportation emergency management needs.

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The Forecast Is for Better Transportation Management

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For transportation managers to be successful, they must ensure the safe and efficient movement of people and goods under all circumstances. This includes the need to prepare for—and act upon—nonrecurring events such as crashes or other incidents, work zone setups, and adverse weather—the last of which is arguably the most difficult to manage. Weather events can take many forms with profound impacts that range from an immediate flash freeze to a multiday rainstorm. Each year, adverse weather occurrences result in more than 5,300 lives lost, hundreds of thousands of injuries, and excessive delays.

Solutions to such challenges are at hand, but more needs to be done. Over the past two decades, investments in extensive research and development—combined with wide-ranging deployment efforts—have proven that practitioners can reduce the effects that weather inflicts upon the transportation system.

The winter maintenance community was the first to embrace road weather management via the implementation of road weather information systems. By installing environmental sensor stations along the road network and feeding that data into road weather models, they could see that there is a difference between a weather forecast and a road weather forecast. Weather forecasts can help determine future atmospheric conditions, but only road weather forecasts can provide impact-based information about the road network. And it is the road weather forecasts that maintenance managers need for knowing when to pretreat roads with salt brine before a snowstorm. Similarly, transportation managers need the road weather forecasts to proactively manage traffic flow and to minimize the effects of a given weather event.

Photo: Cunigunde, Pixabay

Road conditions can change quickly, but continued investment in road weather management can lead to further safety improvements.

Maintenance managers started using this information for more effective snow and ice control in the 1990s, and in the ensuing years road weather information moved from the maintenance garage into the transportation operations center, where operations managers learned its value, too. Today, we see extensive traveler information systems that provide up-to-the-minute road weather information.

We also see information being shared between state departments of transportation and the National Weather Service as a means to ensure that the traveling public is receiving consistent reporting and is able to act upon this in an effective manner.

Maintenance, traffic, and emergency managers also have learned that weather is not static. More extreme weather events with different, more-intense effects are now annual, which forces managers to adjust their actions while pointing to the need for better road weather forecasts. For example, an agency accustomed to dealing with frequent snowstorms may have to adjust for more ice storms now. Agencies with the technology infrastructure already in place to provide timely and accurate road weather information are closer to being able to handle these new types of challenges.

But what happens in areas of the country experiencing events that are far outside the norm, such as the winter storm that blanketed all of Texas this year? Without the foundational support systems and equipment, the repercussions are far more extensive, such as the 133-vehicle pileup in Fort Worth, Texas. This leads agencies to make difficult investment decisions. Do they invest in resources that may only be used once every three to five years? Or do they take the risk of not investing and hope that it doesn't happen again? Perhaps there are lessons similar to those of 9/11 about risk management and making investments for rare occasions.

Great strides have been made in road weather management over the past few decades. These achievements were the result of a fairly robust road weather research and development program. Current funding levels are insufficient to make further improvements in highway safety and efficiency, however. More investments are needed to continue to move to a mature operational environment, especially in cases in which adverse weather events are rare or occur less than annually.

Photo: leungchopan, Shutterstock

Is It Safe Yet?

Fear and What Can Be Done to Mitigate It

PATRICIA BYE

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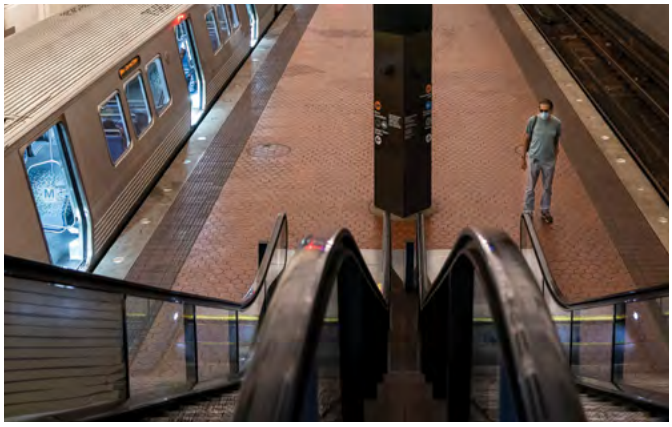
Above: Showing a marked increase in the United States since the terrorist attacks of September 11, 2001 (9/11), fear of flying manifests itself as an internal war between intellectual reason and cold, visceral panic. Now, in the midst of a deadly pandemic, the paralyzing effects of fear persist in every facet of life, including transportation.

The shock of the attacks on September 11, 2001 (9/11), resulted in significant public fear. A poll that same year found that 58 percent of respondents were worried that they or a family member would become a victim of terrorism (*1*). There was a fear of flying; passenger air traffic was down 30 percent when commercial travel resumed, and the Transportation Security Administration (TSA) was put in place (*2*). Many years later, a Gallup survey indicated that some people are still afraid; 24 percent of survey respondents agreed that 9/11 still made them less willing to fly. As of September 2019, 46 percent of survey respondents were still worried about terrorism, even if most Americans did not think a terrorist attack would happen to them (*1*).

In 2020, almost 20 years after 9/11, U.S. airline traffic dropped significantly again. This time it was not international terrorists people feared, but each other. COVID-19, a deadly virus spread by people



Courtesy International Monetary Fund Photo/Cory Hancock

A lone passenger waits for his train on a once bustling platform at the Eastern Market Metro Station in Washington, D.C. In 2020, at the height of the deadly COVID-19 virus, fearful passengers avoided the close confines of public transit, when possible. As a result, ridership fell 70–90 percent.

> "Fear: Degree to which subjective beliefs about danger deviate from objective assessments of risk."
>
> **—Gary Becker and Yona Rubinstein**
> *Fear and the Response to Terrorism: An Economic Analysis*, 2011

with not always obvious symptoms, resulted in an initial 96 percent reduction in air travelers. Public transit ridership fell 70–90 percent, and highway traffic was down by 70+ percent at the start of the pandemic as people sheltered at home (*3*). The 20 years spanning 2001–2021 have become a period bracketed by fear, a universal emotion that signals danger and causes a higher perception of risk everywhere.

What Do We Have to Fear? Fear and Transportation

Individuals experience fear when they feel that they are vulnerable or powerless in the face of a threat. This biological–neurobiological response to a threatening situation has evolved to keep us alive (*4*). However, the intensity of the fear depends on the amount of uncertainty, the duration, the degree of randomness, and the source of the event. Fear enhances memory, sometimes making it more vivid; therefore, past events can make people more fearful. Fear also affects quality of life, driving individuals to avoid certain places and restrict activities. The fear of crime, for example, and its impact on women's travel patterns has been well documented, even when the objective risk of crime may be relatively low (*5*).[1]

Fear plays a part in the lives of transportation workers, who experience more health and safety problems than the general workforce because of accidents, unruly public interactions and assaults, and, most recently, COVID-19 (*6*). The fear produced by these events is commonly accompanied by increased stress levels and other health issues. Last year, research on New York City transit workers during the COVID-19 pandemic found that 60 percent were anxious and unable to control worry, 15 percent felt depressed, and 10 percent had trouble sleeping (*7*).

Disproportionate media coverage can stimulate fear in the public. Because accidents and assaults are infrequent, they tend to receive significant media coverage and raise fears. Fear also can be fed by rumors and lurking unexamined beliefs.

Photo: Ana Paula, Pexels

Fear of being vulnerable in places perceived as unsafe drives women's transportation choices and travel patterns. Research shows that they will avoid dark areas and some will carry mace and knives, all in an effort to ward off physical harm, sexual harassment, and other threats.

Sensational, inaccurate, or false information can increase harmful social reactions. Researchers concur that the constant replay of terrorist events on television, as well as reading such headlines on the front page of the newspaper, is psychologically damaging. Most recently, press coverage of the COVID-19 transmission risk on transit has created more fear than is warranted by the evidence (*8*).

Is It Safe to Travel? Perception Is Everything

Risk management, informed by risk assessments, is a common approach to reduce vulnerabilities and identify security risks (*9*). Studies of security installed after terrorist attacks show that such measures may be ineffective in reducing fear and can increase feelings of insecurity by making the risk more visible (*10–11*).

To reduce fear, security measures must provide reassurance or reduce the

Video: TSA

Flight attendant Gina Hernlem (*at right*) participates in a TSA Crew Member Self-Defense class. With incidents of unruly airline passengers on the rise, TSA has escalated its self-defense training so that crew members can keep passengers—and themselves—safe. (See video at https://youtu.be/u5HxuRuWQxo).

[1] For more, read "Women's Constrained Travel Behavior: Austrian Case Study" at http://www.trb.org/Publications/Blurbs/179900.aspx.

"I will trust local government if it trusts me enough to be prepared to tell me the whole story."

—Patricia H. Longstaff and Sung-Un Yang

Communication Management and Trust: Their Role in Building Resilience to "Surprises" Such as Natural Disasters, Pandemic Flu, and Terrorism, 2008

"When the threat is in our heads, alleviating the fear becomes much harder."

—Alvin Chang

Americans' Sustained Fear from 9/11 Has Turned into Something More Dangerous, 2019

perception of vulnerability and the sense of uncertainty and uncontrollability. If transportation agencies are transparent about the risks and what the agency is doing to keep everyone safe, then that creates understanding instead of fear. Visible measures such as personnel in distinctive vests or uniforms, security cameras, and good lighting can instill confidence. High-visibility cleaning and sensory clues, such as scented cleaners, has reassured the public that the transportation system has been safe during the COVID-19 pandemic (*12*).

Establishing Trust

Trust plays a role in reducing perceived risks of various hazards. When people do not have personal experience, they rely on experts whom they trust. Perceptions of competence and credibility strongly influence trust. Science-based guidelines historically provide confidence in protective measures, conspiracy theories aside. Trust-building requires honesty, candor, and openness to admit what is not known and to explain decisions along with any alternatives considered. Shared value systems also are important for trust. Local authorities are perceived as more trustworthy because they are more likely to share the same perspective as the local communities (*13*).

Trust relationships are two-directional, sharing relationships. If people feel they can communicate their concerns and that those concerns are taken seriously, then perceptions of threats are reduced. Understanding differences in opinions—especially with ethnic, racial, and other minorities who may not trust authorities as credible sources of information—and working toward building consensus is central to facilitating (and sustaining) trust. Community and social services agencies are often already trusted messengers. They are aware of the local concerns and can be called upon to locate and communicate with many of the most vulnerable residents (*14*). Pre-crisis preparedness can lead to significantly more trust during and after an event.

Photo: Marc A. Hermann, MTA New York City Transit

Establishing credibility is important. Being first, right, and credible establishes trust before speculation and rumor can create confusion or mixed messages (*15*). Although there may be changes over time as situations evolve, one voice with clear, consistent messaging is much more effective in maintaining credibility than many voices. In a crisis, people do not want to pick one among many messages;

Photo: Marc A. Hermann, MTA New York City Transit

Well stocked and ready, members of New York's Metropolitan Transportation Authority (MTA) Police Department distribute masks to passengers at Brooklyn's Avenue X Station. Understanding replaces fear when the public sees that transportation agencies are concerned about and actively addressing their safety.

they want to follow the best message or the right one (*16*). Transportation agencies need to be active in all forms of media with a coordinated message. When not only information but also emotions are shared, common narratives and social capital develop (*17*).

Leading the charge, members of the Mask Force—including MTA's Director of Communications Tim Minton—kick off the public safety effort by distributing free masks to New York City subway and bus passengers. Since July 2020, some 1,100 volunteers in yellow t-shirts deploy one day a month to fight the spread of the COVID-19 pandemic.

Empowering People

Empowering the public and employees makes a difference. Accurate, widely distributed, and timely information reduces anxiety and strengthens people's sense of self-efficacy.

Simple, direct instructions for actions that people can take—even symbolic or preparatory actions such as making a plan—can be effective in reducing fear. Effective directives are understandable and fair and allow people some amount of autonomy (*18*). People are more likely to respond to requests for support and cooperation if they believe an agency is concerned for their welfare and trying to meet their needs. Emphasizing the social contract and mutual respect can increase cooperation. A shared resilience promotes communal solidarity and can alleviate fear.

Assuring Employees

A multilayered approach—protective measures, policies, communication, and education—can create confidence in employees. Clear policies and procedures, developed with involvement of employees and unions, if applicable, that include information about why these policies should be put in place, can reassure transportation employees.

Iaisha Thornton, a driver for Detroit, Michigan's, Suburban Mobility Authority for Regional Transportation, weighed in about measures to protect employees against COVID-19. "I had my hesitations," she said. "Now that I'm seeing [them], I'm feeling much better about [them]."

Employees must be assured that their safety and concerns are important to the agency. Regular training programs for employees—with information from experts and trusted sources—can emphasize that the agency and the employee both have a stake. By eliminating uncertainties, communication can mitigate fear. Keeping lines of communications open with employees can identify issues early, facilitate feedback, and allow adjustments to be made when necessary. Security and threat assessment committees, designated staff members, or other established means such as safety hotlines can collect employees' concerns and resolve issues.

It is important to recognize the stress and psychological impacts of employee fears. A constant barrage of good information, including updates and effective approaches to manage stress and resources available to help (such as Employee Assistance Programs), can reassure employees and help reduce fears. More research is needed on how to address the stresses and fears of transportation workers. The upcoming TCRP Project F-29, "Mental Health, Wellness, and Resilience for Transit System Workers," will research and identify measures that can address both chronic and acute stressors.

Resilience and Coping

Resilience is the ability to bounce back or return to normal following adversity. The way an individual is able to be resilient in response to fear depends on the perception of both the threat and the available actions. Sometimes the need for action in the face of an event can push fear aside. Moderate levels of fear can motivate us to be prepared and to make positive changes, such as participating in preventive programs.

A frequently suggested action during a crisis is to look for the helpers. Fear can make people feel powerless, so advice to seek out the people in charge resonates. However, this advice—originally intended to ease the fears of children—can provide a false sense of reassurance or "passive hope" in adults (*19*). Depending on the authorities does not create a feeling of control, which is key to reducing fear. Confidence in one's own abilities, combined with preparation, can overcome fear and build resilience. Past events show us that we are resilient and that actions can overcome the risks and the fears. Practicing "active hope"—or becoming active participants—allows us to see beyond immediate threats and focus on possibilities (*20*). Active hope is about recognizing our present conditions, identifying solutions, and taking active steps to move ourselves and those around us in the direction that we envision (*21*).

Realistically, there is a limit to what individuals can do. The transportation system has a responsibility to be resilient, to be able to withstand disruptions, and to quickly restore services when they are impacted.

Conclusion

Fear is a fundamental, adaptive defense mechanism that cannot be eliminated, but it can be managed. Perceptions of vulnerability can be reduced by learning about threats and what can be done to mitigate them. By engaging in action, we can become resilient. Unfortunately, fear does not motivate preparedness in the majority

"Imagine if the National Weather Service gave up hurricane warnings for fear of panic and evacuation."

—Rebecca Solnit

A Paradise Built in Hell: The Extraordinary Communities That Arise in Disaster, 2010

of people (*22*). However, trust can motivate people to act in times of uncertainty. It also can help people reconnect after a traumatic or overwhelming event.

Along with emotion, social networks and group identity also matter. A resilient community that works well together in times of crises has strong relationships, trust, and a spirit of cooperation. Communities that lack social cohesion and trust tend to have a more difficult time recovering from disasters (*23*). By listening to different points of view and understanding the concerns and issues of others, people build community and social capital.

What future research can help transportation employees and the public reduce their fears and related stress, build social capital, and provide for domestic resilience?

Just before 9/11, there was recognition that "a change in thinking is needed—from the short to the long term, from within singular disciplines and solutions, to across hazards and disciplines" (*24*). Research that involves diverse teams working together in novel ways to transcend disciplinary and organizational boundaries is needed to address the challenges of new risks and the uncertainty of the future and to promote collective well-being, especially in those populations who have higher levels of fear or vulnerability, or both (*25*).

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TWENTY YEARS SINCE 9/11

The Military Transporter's Perspective

Photo: Master Sergeant Joseph Swafford, U.S. Air Force, Flickr

DAVID METCALF, JON MEYER, AND JON KASKIN

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Above: Delivering humanitarian aid to St. Croix, U.S. Virgin Islands, after Hurricane Maria in September 2017, a C-17 Globemaster III gets a pre-flight check at Joint Base San Antonio–Lackland Kelly Field, Texas. Such emergency missions count among many undertaken by U.S. military transporters.

The militaries of the United States and the North Atlantic Treaty Organization (NATO) must be prepared to move the equivalent of small cities and to do so quickly. A major military operation transports vast quantities of heavy equipment, such as trucks, tanks, and armored personnel carriers, as well as aircraft, hospitals, supplies, and ordnance. Each has specific requirements for storage, handling, and disposition. The transportation mission is immense, and no discussion of transportation is complete without an examination of how the military will use a country's transportation network. The military's expertise and vast resources will always be valuable to have in reserve for a national emergency.

Impact of 9/11

The events of September 11, 2001 (9/11), put the military transporter on notice: Life was about to get very busy. This is not to say that it had been quiet. Since the Gulf War in 1991, U.S. and NATO militaries had been engaged in deployments to support operations in Somalia, Haiti, Bosnia, and Kosovo. At the same time, U.S. and NATO forces were reorganizing and streamlining their logistics commands to take advantage of automation and post–Cold War threats.

Upgrades in computer technology and communications brought about improvements in the management and control of cargo and equipment en route. Systems to provide in-transit visibility were put into use before 9/11. In addition, logistical commands were being consolidated, and the U.S. Army began combining the previously individualized functions of transportation, supply, field services, and engineering into one heavily automated Sustainment Command.

The creation of the U.S. Navy's sealift capabilities was very significant to the military transporter in this pre-9/11 timeframe. The Navy's Fast Sealift Ship and Large, Medium-Speed Roll-on/Roll-off Ship added new capabilities. However, military logisticians knew that taking advantage of

Photo: Journalist 3rd Class Eric L. Beauregard, U.S. Navy

On the northeastern shores of the Persian Gulf at the Port of Ash Shuaibah, Kuwait, two Military Sealift Command Bob Hope Class ships aid in the February–April 2004 transition of forces. Each of these Large, Medium-Speed Roll-on/Roll-off Ships can transport several hundred C-17 loads.

Photo: Military Material, Pixabay

Larger and heavier than its predecessors, the C-17 is a well-used upgrade that helps transporters keep pace with today's challenges.

sealift would require upgrades in port capability, surface links, and unit capabilities.

While the Navy was increasing its sealift fleet, the U.S. Air Force initiated the C-17 program as a replacement for the aging short takeoff and landing C-141 fleet. The C-17 program also was designed to augment the C-5 fleet with larger, heavier capabilities than the C-141 could provide. Although the program was originally targeted to be 120 aircraft in the 1980s, changing requirements related to the Global War on Terrorism and associated extended ground support operations ultimately expanded the program to 223 aircraft.

Operation Iraqi Freedom put the preparations of the multinational coalition forces' transporters to the test. This large-scale operation involved more than 100,000 personnel, most of whom were based in the continental United States. They moved entire division-size forces from fort to port to theater. All modes—air, rail, and highway—were used to get military troops and materiel to the ports of debarkation. Civilian and military resources and cooperation were tested. Lessons were learned.

Although Operation Iraqi Freedom was "the heavy lift" since 9/11, the Global War on Terrorism, other missions, challenges, reorganizations, major initiatives, investments, and policy changes continued during and after coalition operations in Iraq.

Realigning the Military Community

The Base Realignment and Closure (BRAC) of 2005 was another pivotal event after 9/11. This round of BRAC was approved in 2007 and completed by 2012. It brought transportation challenges such as changes in traffic patterns and the potential for increased congestion to many BRAC communities. It highlighted to the Transportation Research Board (TRB) Standing Committee on Transportation for National Defense that transportation issues in the communities surrounding a military installation, including congestion at an installation's gates or access for buses, are a topic in need of research and study. The Transportation for National Defense Committee established a Military Communities Joint Subcommittee to focus on these issues.

The Transportation for National Defense Committee (formerly the Standing Committee on Military Transportation) has originated programs, research, and networking covering a broad spectrum of transportation topics. The committee brings together local, state, federal, and defense department transportation professionals, transportation service providers (railroads, truck lines, airlines, and ship and barge companies), members of academia, and consultants to work on the key challenges of military transportation.

Many committee sessions and working groups focus on transportation in the

Transportation is complex in, around, and to military communities. At Joint Base Lewis–McChord, a free shuttle for service members, Department of Defense civilians, family members, and sponsored guests eases base traffic.

community. In one session, the commander of Joint Base Lewis–McChord convened community and state leaders to discuss how the community and the base could work together to improve access and mitigate congestion. The committee also sponsored research to determine how the predicted traffic impacts of BRAC matched actual post-BRAC conditions.

Humanitarian Relief and Business Continuity

One significant outgrowth of discussions during meetings of the Transportation for National Defense Committee was recognizing how important the U.S. military is to humanitarian relief. Also recognized through the committee's input was the importance of business continuity in times of significant weather events. As a result of these discussions, TRB established a task force to address the issues and determine the viability of a standing committee. The task force and subsequent Standing Committee on Humanitarian Relief and Business Continuity addressed several significant weather events, tackled the logistics of humanitarian relief, and participated in the development of *National Cooperative Freight Research Program (NCFRP) Research Report 39: Freight Transportation Resilience in Response to Supply Chain Disruptions*.

This guide for public and private stakeholders mitigating and adapting to supply chain logistical disruptions covers unanticipated and anticipated adverse events. For more, visit http://www.trb.org/Main/Blurbs/179096.aspx.

9/11 REFLECTIONS

FREDERICK (BUD) WRIGHT

Role on 9/11: Associate Administrator for Safety, FHWA

"After 9/11, national security and emergency management became an FHWA priority that continued for some time. One of FHWA's earliest activities was to do what was possible to ensure the safety and security of national highway assets, particularly bridges and other structures. Because the federal government does not own and operate such facilities, much of this work relied on considerable cooperation from state departments of transportation and local governments. There was great concern that the loss of certain key facilities through terrorist action could immobilize the national highway network, so identifying those facilities and taking appropriate actions to safeguard them—ranging from deploying armed military and law enforcement to closing access beneath structures—became an overnight priority. Actions also were taken to classify as secret the bridge design plans of many key facilities so as not to give information to potential terrorists."

—FREDERICK (BUD) WRIGHT
Principal
Bud Wright Transportation Policy Consultants
Alexandria, Virginia

Photo: John Orrell, U.S. Army

An M-113 armored personnel carrier from the 1st Armored Brigade Combat Team, 1st Infantry Division, is offloaded from a ship at port in Antwerp, Belgium. After being staged in January 2019, the equipment was forward deployed via rail and line haul in support of Operation Atlantic Resolve.

Autonomous Vehicles, Big Data, and Other Emerging Trends

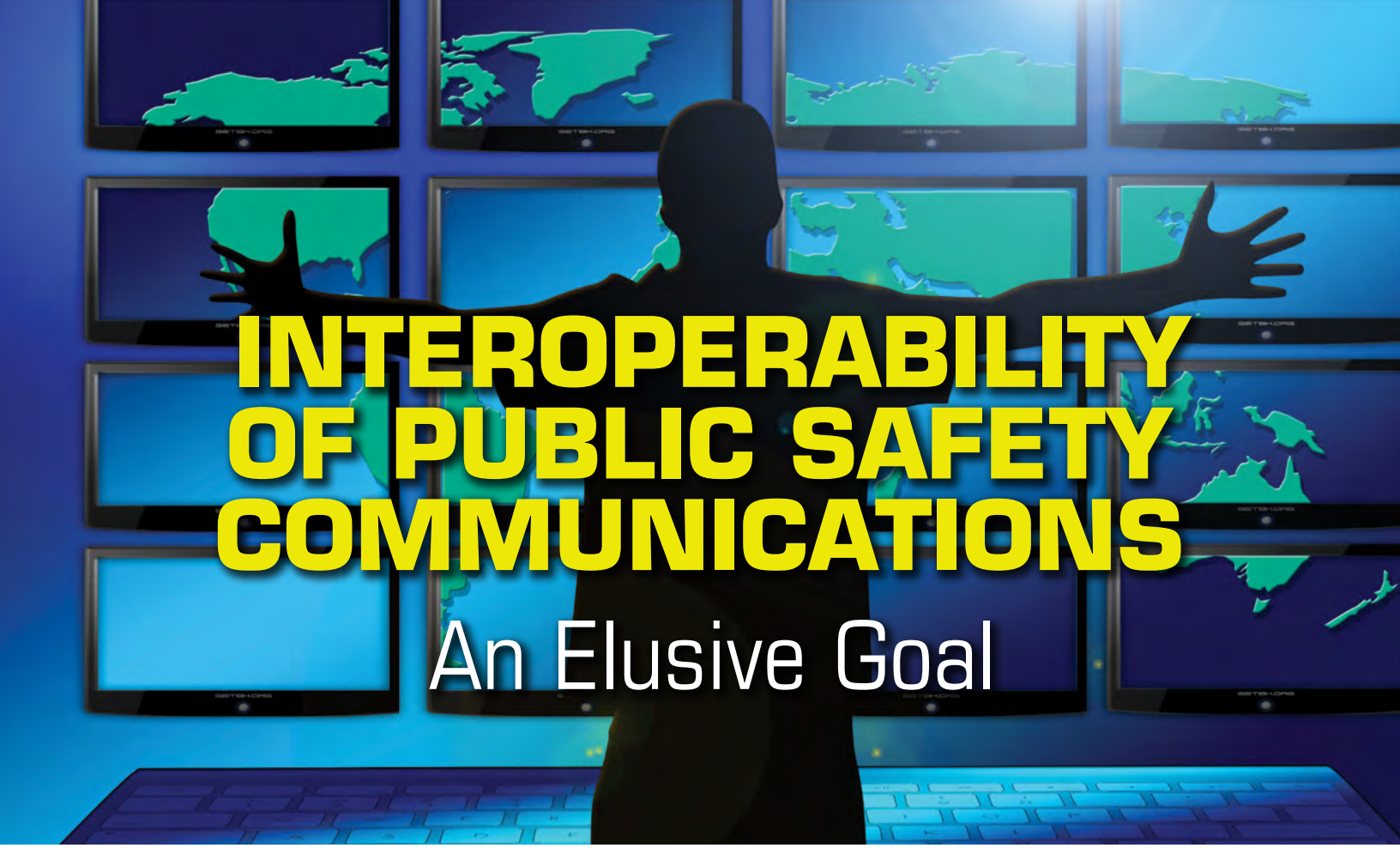
The military has always been a source of innovation and advanced technology. Military installations are leaders in the use of autonomous shuttles, robotics, and Smart City technologies. The Transportation for National Defense Committee has held several sessions to share military experience in improving transportation by using technology.

The military also is developing autonomous logistics vehicles for surface, air, and sea. Even space transport—from origin to destination—has been suggested. These are just some of the issues for which the Transportation for National Defense Committee brings together the academic, commercial, and military communities so they can learn from each other.

Military transporters have seen their transportation networks become congested because of economic globalization and threats from climate change. Planners have to work with increasingly congested ports and terminals, some of which are threatened by rising sea levels and weather events. The use of military resources to assist in humanitarian missions arising from hurricanes and unusually severe storms—such as those that caused the Texas power crisis in February 2021—is becoming more frequent. Likewise, the global pandemic placed new demands on the transportation network and influenced how military troops and materiel are deployed. Recently, the emergence of peer competitors is adding increased complexity to the mission of the U.S. military and other free-world militaries.

Given these emerging challenges, a major focus of local, state, national, and military transporters is to maintain resilient operations and infrastructure to deploy military support during times of national emergency. In recognition of this focus, in 2019, the Transportation for National Defense Committee was placed in TRB's Transportation Systems Resilience Section under the Transportation Sustainability and Resilience Group.

The events of 9/11 shifted the focus of the free world's militaries to the Global War on Terrorism, which was marked by large operations in Iraq and Afghanistan, as well as numerous smaller operations. The military and civilian transportation community will continue to plan for major military operations and rely on the rapid support that military transporters are trained to provide. In turn, the Transportation for National Defense Committee will continue to sponsor research and provide a forum for all stakeholders.



INTEROPERABILITY OF PUBLIC SAFETY COMMUNICATIONS

An Elusive Goal

Image: Gerd Altmann, Pixabay

JOHN CONTESTABILE

The author is the director of public safety solutions for Skyline Technology Solutions in Glen Burnie, Maryland; chair of TRB's Critical Infrastructure Committee; and past chair of the Resilience Section.

Above: Despite massive amounts of data collection, communication between individuals and agencies remains challenging. Interoperable communications can allow authorized officials access to data from different networks and devices—quickly and reliably—when needed.

Since September 11, 2001 (9/11), public safety organizations such as police, fire, and emergency medical services (EMS)—and the allied transportation, utilities, and public works agencies that support them—have had a growing need to communicate effectively. Emergencies, especially large incidents, require close coordination by all the agencies and entities involved. After-action reports of major emergency incidents confirm the need for good, reliable, and timely communications. It only takes a look at "Recommendation 13.3: Unity of Effort in Sharing Information" in *The 9/11 Commission Report* to recognize that poor communications could cost lives (*1*).

The U.S. Department of Homeland Security (DHS) has focused much of its grant funding to states and locals on this issue of interoperable communications. Although notable progress has been made, particularly regarding land mobile radio systems, much work remains. This has been challenging partly because of a lack of consensus on how to approach the interoperability problem, particularly as it applies to data. To understand this issue, the nature of the interoperability challenge is described, and a conceptual approach to addressing this challenge via a three-layer information-sharing framework (ISF) is examined.

Improving Real-Time Situational Awareness

Trends over the past decade have set the stage for discussion about public safety communications interoperability—the ability to exchange and use information so that groups can effectively work together—and its nexus with transportation. First, society has become increasingly connected. Social media platforms, the evolution of the Internet, and the increasing capabilities of smartphones have allowed for instant communication among large groups of individuals. Second, the evolving Internet of Things—devices embedded with sensors, software, and other technologies that allow them to connect

Image: Gerd Altmann, Pixabay

With the increasing capabilities of mobile devices, a flood of real-time data, and instant mass communication via social media, there is more information available to public safety officials than ever before—that is, if they can access, analyze, and retrieve it in a timely manner.

to the Internet—is fueling an explosion of real-time data. Now, weather information, infrastructure data, personal health data, video data, and more are instantly available. Third, advances in mobile devices like smartphones and tablets, as well as their related wireless 5G networks, make data accessible virtually anywhere.

These three trends—connectedness, real-time data, and mobile computing—set the stage for improved real-time situational awareness (RTSA) like never before. For the purposes of this article, RTSA is the ability to know in near real time what is happening on a system in relation to its environment. RTSA is essential to transportation, as well as public safety and most other organizations, to understand the current situation on roadways, in the transit system, at airport terminals, at port facilities, and so on.

Congestion management, motorist aid programs, and traveler information systems are designed to contribute to and communicate RTSA to various audiences, which include the public, traffic operations centers, rail operation centers, operations control centers, and the like. Transportation has deployed pavement sensors, weather stations, video cameras, and motorist aid patrols in an effort to improve their RTSA and better serve their customers. Likewise, public safety entities (e.g., fire, police, and EMS) also rely on RTSA so they can respond appropriately to service calls.

Challenges

Why is RTSA so important to transportation and public safety operations? Multiple after-action reports from emergency incidents reveal that communications between individuals and agencies are almost always a challenge. Those challenges range from technical (e.g., radio systems on different frequencies) to procedural (e.g., no concept of operations or standard operating procedure on how and when to connect) to personal (e.g., a lack of trust between parties). But good communication is essential during emergencies because it helps detect an event that may have just happened so that agencies respond to the event appropriately and recover effectively from that event.

This is especially true for large-scale events in which multiple agencies are involved. In fact, the degree of information sharing between agencies and individuals is related to how successful the detection of, response to, and recovery from that event will be. Successfully sharing information across transportation and public safety agencies and jurisdictions (i.e., municipal, county, state, and federal) requires a certain amount of data interoperability so that groups can effectively work together. Figure 1 illustrates the concept that the need for interoperability increases with incident scale. Incident scale is not just the physical footprint of the incident but also its reach, which is especially true for cyber and supply chain disruptions. Further, this graphic illustrates that public preparedness

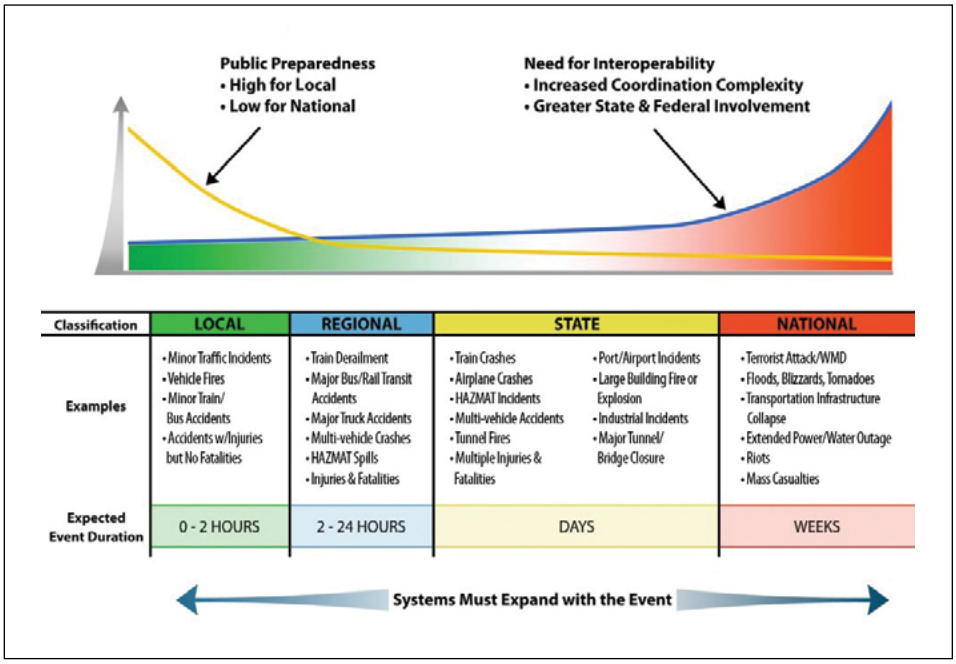


FIGURE 1 Public preparedness incident scale (WMD = weapon of mass destruction).

Photo: CDC, Unsplash

Information sharing between agencies and individuals is critical—whether performing contact tracing for the Centers for Disease Control and Prevention during COVID-19 or in law enforcement searching for the cause of a major highway crash. Improving the speed of information sharing through communications interoperability can save lives.

is high for local routine events but is less so for large-scale events.

Good interagency and interjurisdictional communication is important during emergencies, especially for large-scale events. DHS has made communications interoperability a priority almost since the beginning of its grant programs to the states. For example, as a requirement of the Public Safety Interoperable Communications Grant, each state was to develop a plan for improving public safety communications interoperability and name a statewide interoperability coordinator. Many states maintain this position today, and a National Council of Statewide Interoperability Coordinators has been created.

With this focus, public safety and other agencies have increasingly requested access to transportation data sets for their business and operational needs. However, improved RTSA does not just happen, despite continuing trends toward more connectivity and a proliferation of data and devices upon which to view and manipulate that data. That is because situational awareness comes from combining various data together spatially and temporally in context so that inferences as to what is happening can be drawn. Because no single agency has the complete picture, additional data sets will likely come from other agencies and sources. To combine various data sets effectively, the data interoperability challenge must be addressed. Figure 2 illustrates these issues using the people, process, and technology rubric.

The people issues involve a lack of consensus among all stakeholders on the need to share information. The process issues involve not having a protocol—or concept of operations—to guide the necessary information sharing. Even if there is agreement among the parties to share information (and a protocol and governance structure to guide the information sharing), technology issues and security considerations must be addressed. That is, data are not easily accessed or combined with other data because of differing formats, file structure, network constraints, and the like. Success will only occur when there is alignment across each of these aspects of the interoperability challenge.

A Step Forward

Early in 2021, the DHS Cyber Infrastructure Security Agency released an ISF that a user can apply to help solve data interoperability issues. This framework seeks to address the technology aspect of the people, process, and technology rubric. As shown in Figure 3, the ISF imagines three layers (including a data layer where the source data lie and a presentation layer where the source data are needed, presumably by the end user). In between lies the integration layer where the data are transformed to make this information more accessible to the end user.

An integration layer is needed because most data layer systems or data sets were not designed with information sharing in mind. Often, these are proprietary systems or older legacy systems that may not comport to current-day standards. Similarly, today's presentation layer is often

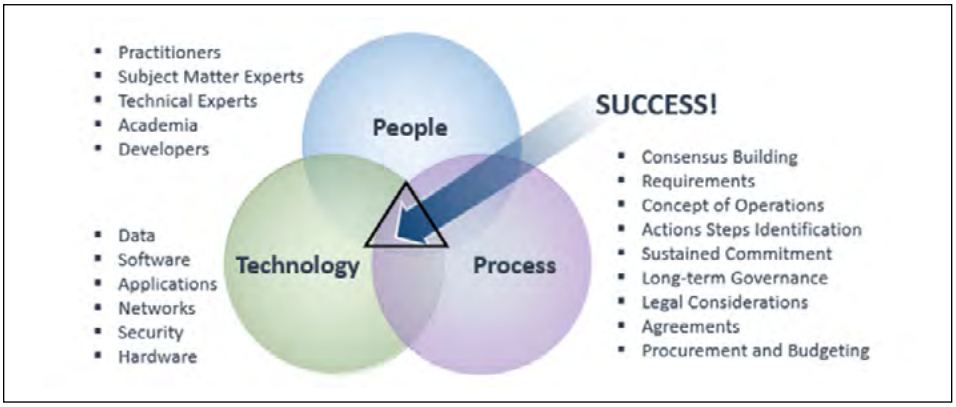


FIGURE 2 People, Process, and Technology rubric.

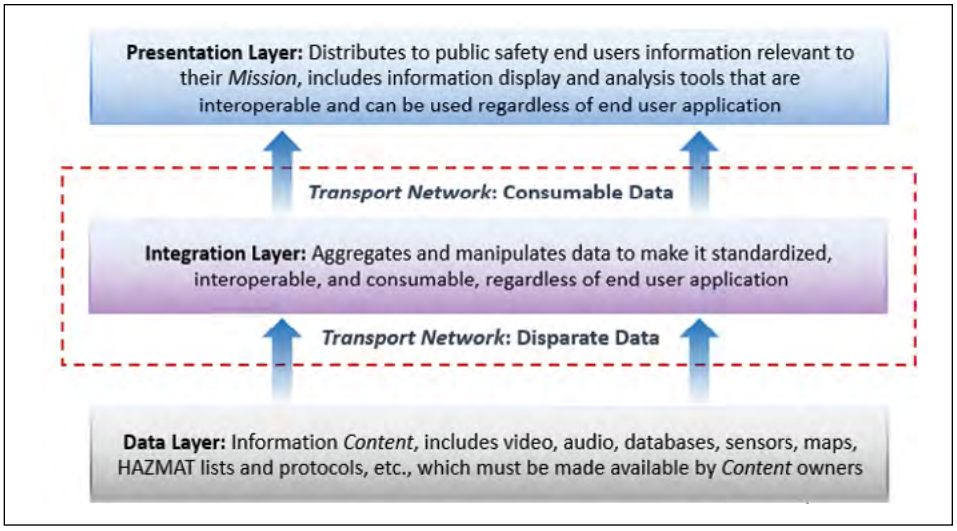


FIGURE 3 Data, Integration, and Presentation layers.

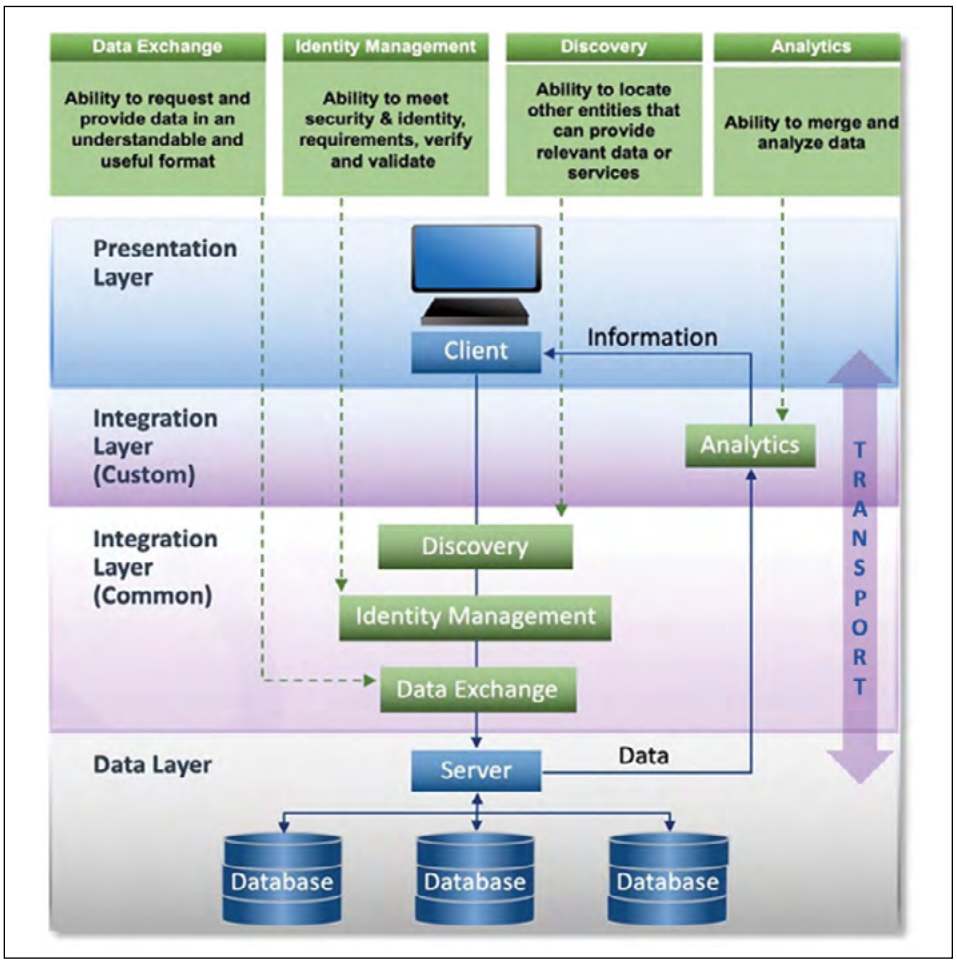


FIGURE 4 Functions of the Integration Layer.

comprised of smart mobile devices that have wireless transport and screen-size or form-factor limitations. RTSA requires data sets to be combined temporally and spatially so that everything can be seen in context. Therefore, the lack of data interoperability must be overcome in order to provide that combined view. This is best done by an integration layer that performs the necessary translation.

A close look at the integration layer in Figure 4 shows that it must perform five functions. For example, if a public safety official end user situated in the presentation layer needs to find a traffic camera with a view of a recent accident, that official must do the following:

1. **Discover** the right camera. Who owns it? What is the URL to access it? Select from multiple video camera systems in the data layer.
2. **Confirm** identity. This establishes the official's right to access the data layer video system(s).
3. **Exchange** the data. This allows the right video camera to send the information to the official's device.
4. **Analyze** the data. For example, provide only the video from the past hour involving a blue truck.
5. **Transport** the results. Send the appropriate video clip to the official's smart device in a format that it can consume and display.

The Human Factor

The ability for the public safety official to successfully negotiate the steps in the previous example will aid greatly in the timeliness and effectiveness of their actions. The ISF focuses the effort on building the technical pieces in the integration layer that will enable greater interoperability between data sets. This pragmatic approach hopes to focus investment in more standardized methods of performing the five functions of the integration layer so that data can be shared more easily and combined into actionable information.

Improved RTSA is needed to maximize effective disaster response. Solving the data interoperability challenge is a necessary precursor. The ISF is an important step in the right direction.

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Strong Connections, Shared Challenges

TRANSCOM Reflections on 9/11

Photo: Paul Morse, National Archives and Records Administration

BERNIE WAGENBLAST

The author is the president of Bernie Wagenblast Communications, LLC, a transportation communications company in Cranford, New Jersey.

Above: A variable message sign warns travelers on September 11, 2001, that New York City is closed. The roadways and transit lines all shut down following the terrorist attacks.

When TRANSCOM, a coalition of 16 transportation and public safety agencies in the New York–New Jersey–Connecticut metropolitan region, moved into its offices along the Hudson River in Jersey City, the view of Lower Manhattan was one of the benefits. Little did anyone suspect that the location would provide a front-row seat to one of the most tragic days in U.S. history: September 11, 2001 (9/11).

TRANSCOM was spearheaded in 1986 by the Port Authority of New York and New Jersey (PANYNJ) to serve as a coordination hub for transportation and public safety agencies in the tri-state area (*1*). In a region where jurisdictions change frequently within just a few miles, TRANSCOM offered a central place for dozens of agencies to share incident and construction information and coordinate with one another.

TRANSCOM has a 24/7 Operations Information Center that gathers and shares real-time information. From the moment the first airliner flew into the north tower of the World Trade Center on 9/11, TRANSCOM updated member agencies on what was happening to the transportation network. TRANSCOM's role extended beyond sharing information among agencies to telling the public what was happening and what they should do to avoid adding to the problems.

Springing into Action

The transportation coordination story of 9/11 involves both technology and relationships. TRANSCOM had already implemented a well-established computer network that was used to share information in real time. This network experienced its first terrorism challenge eight years before 9/11, when a truck loaded with explosives blew up in the garage beneath the World Trade Center complex.

Equally solid were the relationships that had been created and strengthened in the 15 years since TRANSCOM's establishment. These interconnections were essential when technology no longer

worked, when responding to the unprecedented needs on 9/11, and during the days and weeks that followed. The associations were reinforced by the long-standing connections among member agency staff and TRANSCOM's management staff, who had worked together for many years.

The priority of every agency in the region at that crucial time was to coordinate their own response to what was happening. Some agencies—such as the New York Police Department, the New York City Fire Department, New York City Department of Transportation, and PANYNJ—were at the epicenter of the attack, and saving lives was their first priority. Almost immediately, roadway and transit access to Manhattan was shut down.

To avoid having people outside Manhattan try to enter the city or its immediate surroundings, TRANSCOM used preestablished procedures for member agencies to use resources—such as variable message signs and highway advisory radio—to inform the public that New York City was closed and travel to the region should be avoided.

Not only were resources deployed in the tri-state area, but because TRANSCOM served as the communications coordination center for the I-95 Corridor Coalition, it was able to use resources throughout the Northeast and Mid-Atlantic states to alert long-distance travelers that travel into or through the New York metropolitan area was strongly discouraged.

Simultaneously, TRANSCOM enabled emergency resources from outside the region to find the best available access.

Challenges and Solutions

Among the challenges was a flood of information, including incomplete and inaccurate details. TRANSCOM worked diligently to sift through these notes and create reliable reports that were frequently updated, summarizing what was happening. As a regional hub, TRANSCOM was the only source that provided a full picture of what was happening in the metropolitan area from a transportation perspective.

One of the reasons TRANSCOM decided to relocate to the building it still occupies today was the promise of resilience the location offered. Selling points included redundant power supplies and hardened telecommunications infrastructure. But 9/11 caused TRANSCOM, its members, and transportation agencies throughout the United States to redefine what resilience and redundancy meant.

Photo: robotpolisher, Flickr

As he watches smoke drift over the East River from the fallen towers on the afternoon of 9/11, a Verizon repairman on Sedgwick Street in Brooklyn is overwhelmed by the complete collapse of the telephone system. To keep crucial information flowing until cell and telephone service resumed, TRANSCOM boosted the capability of a fax network it had built several years before.

For example, parts of the communications network that connected the agencies went down when the buildings in Lower Manhattan were destroyed. No longer could the agencies use that network to communicate. TRANSCOM turned to the telephone to share information among agencies; however, this too was affected by the damage to the telecommunications network. It became increasingly difficult to make calls as the telephone network was overwhelmed by the number of people using it. Even when the phone lines did work, the sheer volume of information and the rapidly increasing number of agencies requesting updates made it unmanageable.

With two of its primary communications tools mostly down, TRANSCOM relied on another tool to get information out: the fax. About a decade before 9/11, TRANSCOM had created a fax network to provide updates during snowstorms and for construction information. The size of the network was modest, with fewer than 100 recipients.

TRANSCOM was able to repurpose the fax network so that it could send updates to more than 400 recipients. The hub of the network was in Florida and included more than 100 modems, so there was little lag time from creation of the reports to getting them into the hands of the agencies. This fax network provided updates for weeks.

Another lesson TRANSCOM learned was the importance of having not just backup servers but of locating that technology outside the region so that a catastrophic event didn't shut down the network. That lesson proved valuable in 2012, when Superstorm Sandy damaged transportation and communication systems throughout the Northeast.

Human Resources and Resilience

Although much of the focus on resilience centered on technology, equally important was the resilience of the human resources behind it. That Tuesday morning began like most other weekday mornings, and

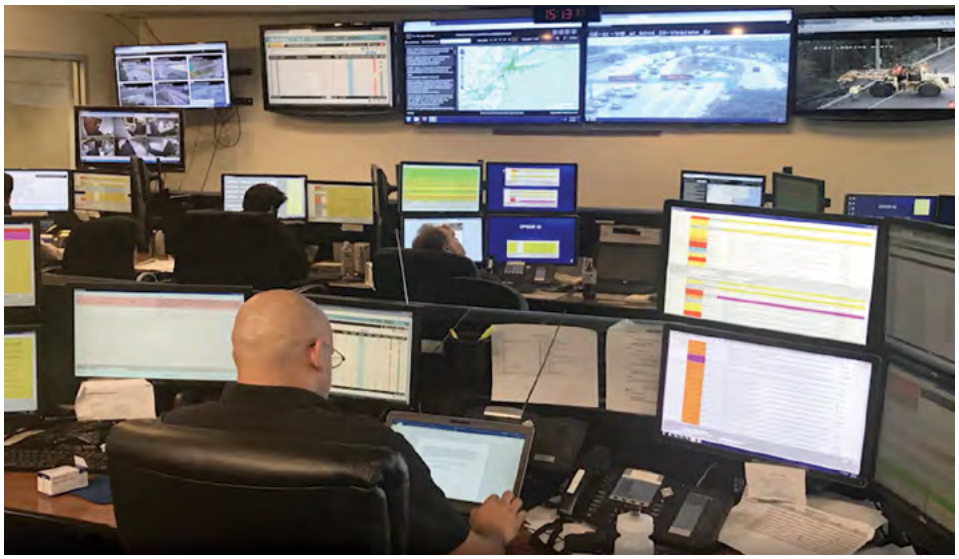

Photo: TRANSCOM

TRANSCOM operations center staff ensure smooth traffic flow throughout the region. The strong interpersonal relationships at TRANSCOM and member agency staff proved instrumental in maintaining lines of communication on and after 9/11.

there was no expectation of adding staff or preparing workers for what they were about to witness. The first indication of something amiss was a staff member seeing smoke coming from the top of one of the towers. A call to the PANYNJ's central police desk confirmed that there was a fire but provided little other information.

Unlike most other transportation and public safety agencies, which relied on television monitors and second-hand accounts of what was happening, TRANSCOM was able to look out the window and see events unfold. Although this showed the staff much of what was occurring, the emotional impact was tremendous. Because TRANSCOM was formerly part of PANYNJ, many former colleagues and family members worked in the World Trade Center. At least one staff member had a spouse—who survived—in the towers.

With everything going on, it was almost impossible to communicate with those inside the buildings to check on their safety. Some staff members wept as they watched what was happening, yet they still continued to work to fulfill TRANSCOM's mission.

TRANSCOM was so close to the World Trade Center that when the buildings collapsed, people at TRANSCOM could feel the ground shake and could watch the dust cloud as it crossed the river. The emotional toll this took on staff members was something for which no one could have planned.

Another unexpected impact occurred when TRANSCOM staff were ordered to evacuate the premises by building management. Although the building was touted for its resilience, the unknown scope of the attacks caused most businesses and buildings in the immediate area to shut down. TRANSCOM staff had to convince the building management of their critical role and to allow staff members to remain in the building.

Much like our current experience with COVID-19, 9/11 redefined what was normal for the New York City region's transportation network. TRANSCOM has continued to operate during snow storms, Hurricane Sandy, terrorist attacks, and now a global pandemic. These types of events require special considerations for continuity of operations.

Like other operating agencies, TRANSCOM learned from COVID-19 that virtual operations—although not preferred—can be effective and will be part of future planning. Many people do not know that the World Trade Center complex sat atop a transportation hub that was closed for years as a result of the attacks. Traffic and transit patterns changed, and security became a heightened concern. Because there was little capacity in the transportation system at that time, this required constant monitoring and readjustment, particularly when interagency coordination became essential as parts of the highway and transit systems resumed.

TRANSCOM has always stressed the importance of the interpersonal relationships it developed with people at its member agencies. Those relationships proved invaluable on 9/11 and in the days that followed. Agencies were being asked to do things they had never been asked to do before and, at times, to go outside their comfort zone. It was only because of the trust developed over years that agencies were willing to go beyond their own needs to not only help other agencies, but to proactively assist them. Although technology allowed TRANSCOM and its agencies to do their work, the relationships truly made it possible.

The lessons learned by TRANSCOM on 9/11 were not only to grasp the importance of redundancy, but to redefine it exponentially by locating equipment outside the tri-state area. Redundancy also was redefined by looking at people's needs. You can plan for a storm or a scheduled event, but you also need to think about how you're going to care for your staff and meet your organization's needs in case of the unexpected.

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9/11 20 YEARS LATER

Bridge and Tunnel Security Resources

VINCENT CHIARITO

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Security depends on detecting, deterring, delaying, or defending against intentional hazards that can exploit vulnerabilities known and unknown. Protective or mitigating measures, based on assessing risks of vulnerabilities, may include certain design enhancements, such as the hardening of selected structural components or preparations to respond to an intentional event.

Resources are available to help stakeholders assess the risks to critical bridge and tunnel assets from non-natural and extreme hazards, vulnerabilities, and related consequences. Mitigating strategies can help stakeholders understand how to reduce risks to an acceptable level.

After the terrorist attacks of September 11, 2001 (9/11), FHWA and AASHTO convened a group of experts, policy makers, and practitioners—known as the Blue Ribbon Panel (BRP)—to discuss and identify issues regarding bridge and tunnel security (*1*).

Since 9/11, FHWA has collaborated with experts and partners to develop physical security resources and solutions for critical bridges and tunnels. BRP set the vision in 2003 to address bridge and tunnel security; and in 2006, FHWA created a research roadmap to fulfill that vision (*2*). AASHTO also helped develop the 2011 *Bridge Security Guidelines* (BSG) via a National Cooperative Highway Research Program (NCHRP) project (*3–4*). An updated edition of the BSG is expected in 2022.

Duwadi and Munley summarized FHWA's research and development effort to address security threats focusing on bridges and structures and cited results from the agency's collaboration with others (*5*). One example of such collaboration is the Anti-Terrorist Planner for Bridges, also known as ATP-Bridge (*6*). The ATP-Bridge initiative developed a fast-running, accurate engineering tool to facilitate rapid in situ vulnerability assessments of existing bridges, allowing stakeholders and designers to decide how to improve the bridge design against selected non-natural threats.

(continued on next page)

Note: The photos on the following pages are meant to illustrate this article and did not appear in the author's original draft.

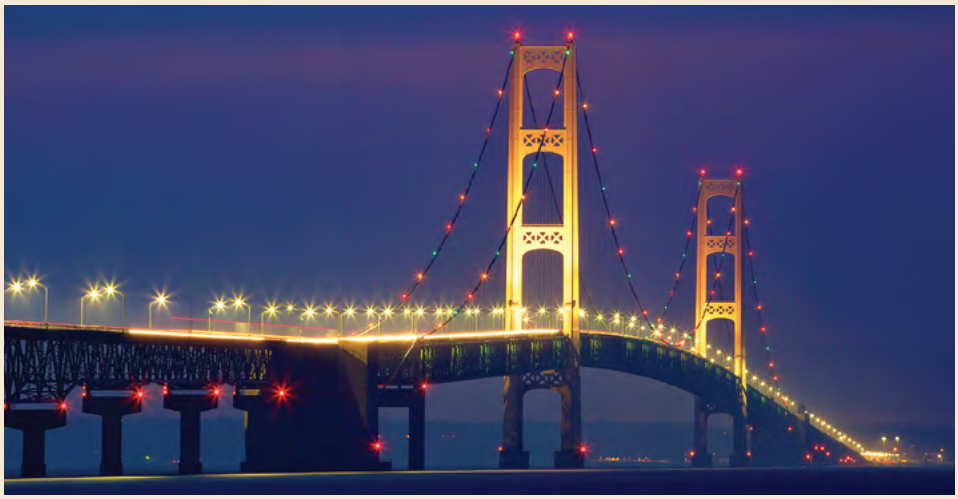

Photo: Chris Smith, Flickr

In June 2021, after a bomb threat closed the Mackinac Bridge in Northern Michigan to traffic, public safety officials worked with the Mackinac Bridge Authority to investigate the threat and reopen the bridge. Physical security resources and solutions for the safety of critical bridges and tunnels was the mission of an expert panel convened by FHWA and AASHTO after 9/11.

(continued from page 35)

Photo: Washington State DOT

Workers repair the Beebe Bridge over the Columbia River in Washington State after a truck crash caused damage to the bridge structure. Support for response and recovery must be included in bridge safety strategies.

FHWA continues to lead efforts and collaborate with experts and partners to develop mitigation measures to secure bridges and tunnels. The BRP outlined vulnerability assessment procedures, and researchers described how to use the procedure and created steps to follow from the BRP recommendations (*6*).

Safety and security work together as necessary components in infrastructure resilience: safety to protect against natural and unintentional hazards and security to guard against intentional hazards. Adequate support for response, recovery, and adaptation is an issue to consider in safety and security design.

Research efforts focus on developing practical engineering procedures for technologies to protect and improve the physical barriers that mitigate risks against intentional collisions, explosive threats, and fire scenarios (*7*). Other training courses are in development as well, from webinars, short virtual courses, and on-site courses to other presentations in person or via virtual seminars.

Resources and references to such resources are available at https://www.fhwa.dot.gov/bridge/security/.

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9/11 REFLECTIONS

JOHN CONTESTABILE

Role on 9/11: Director of Administrative Services, Maryland Department of Transportation

"We have come a long way since 9/11 and instituted many of the capabilities needed to prepare for, respond to, and recover from a disaster. But the challenges and hazards are ever evolving, and we must continue to get better. We cannot take our eye off the ball as we go forward."

—JOHN CONTESTABILE
Director of Public Safety Solutions
Skyline Technology Solutions
Glen Burnie, Maryland

Photo: Wilnora, Flickr

Learning from the Past to Prepare for the Future

Adapting Freight and Supply Chains to Resilience Factors

ANNE STRAUSS-WIEDER

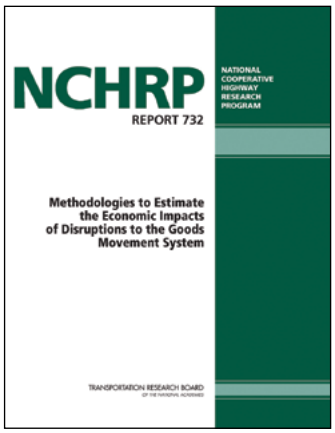
The author is the director of freight planning for the North Jersey Transportation Planning Authority. At TRB, she is the chair of the Transportation Systems Resilience Section and an emeritus member of the Freight Transportation Planning and Logistics Committee.

Above: The effects of 9/11 on the freight system were vast and, in some cases, prolonged: From late 2001 to 2011, commercial traffic was prohibited in the Holland Tunnel between New York and New Jersey.

September 11, 2001 (9/11), started as a beautiful day with a picture-perfect blue sky and ended in a tragedy that shook the world. The emotions remain, but in the 20 years since this horrific event, assessments of 9/11's impacts on supply chains have informed responses and transformed the movement of goods. This article summarizes some of the key changes and effective practices that have emerged, along with the ways in which this tragic event has influenced planning and responses to major disruptions.

Tragic Legacy

Published in 2012, *National Cooperative Highway Research Program (NCHRP) Report 732: Methodologies to Estimate the Economic Impacts of Disruptions to the Goods Movement System* analyzed the local impacts of the terrorist attacks of 9/11 on the New York–New Jersey region (*1*). The report notes that the immediate impacts on freight movement involved closures of borders, airports, seaports, and area roadways, as well as a slowing of rail service. For example, the Port of New York and New Jersey was closed as a precaution; it resumed operations on September 14. The bridges and tunnels between New York and New Jersey were similarly affected, particularly the Holland Tunnel, which



For more information on *NCHRP Report 732: Methodologies to Estimate the Economic Impacts of Disruptions to the Goods Movement System*, visit https://dx.doi.org/10.17226/22702.

was closest to Ground Zero. Many food companies, smaller delivery trucks, and trucks bound to John F. Kennedy International Airport (JFK) could no longer use the Holland Tunnel, which was closed to truck traffic from 9/11 until January 2011.

Despite the extensive destruction in lower Manhattan and the significant transportation infrastructure operations affected, no one in the region went hungry, and the supplies needed by the population and businesses continued to flow. The can-do spirit of private-sector supply chain professionals and the efforts of the public sector were evident.

Some immediate impacts and actions had longer-term consequences, however. Among these changes were business losses and shifts, enhanced and redefined security measures, new supply chain practices and efficiencies, and expanded collaborations.

BUSINESS LOSSES AND SHIFTS

All airports were closed and U.S. airspace shut down immediately after the attacks. Although air service was largely restored a week later, international air cargo still had to be off-loaded at the first U.S. airport at which it landed; it then was moved to its final destination by surface transportation modes. JFK airport, which had also been affected by road closures, saw a longer-term negative impact on its air cargo business.

As noted in the NCHRP report: "By being forced to try alternative gateways and finding these alternatives better for serving certain markets, shippers and forwarders changed their long-held practices. JFK, the New York–New Jersey region's predominant international airport, lost business and is working hard to regain market share" (*1*).

New supply chain vulnerabilities and risks became evident, particularly with the emergence of longer global supply chains that relied on seamless multinational movements. The border closures immediately following 9/11 affected manufacturing operations in North America. Production lines had become global in nature and many companies had reduced inventory levels to quantities needed "just in time." This method had relied on the predictable and unimpeded flow of goods among countries. Multiple auto assembly lines in Canada and the United States halted operations. Companies revisited their use of just-in-time inventory levels.

Photo: Matt Hintsa, Flickr

An Airborne Express cargo plane waits at JFK in New York in 2003. The events of 9/11 negatively affected JFK's cargo business for several years.

ENHANCED AND REDEFINED SECURITY MEASURES

Although pre-9/11 acts of terrorism had led to increased screening and security, supply chain security measures more often focused on reducing cargo theft. The events of 9/11 turned transportation equipment into weapons and underlined the potential for cargo to be used for nefarious purposes.

On November 27, 2001, U.S. Customs Commissioner Robert C. Bonner summarized the objective of the new enhanced national security measures in a statement to the National Commission on Terrorist Attacks upon the United States: "We must reaffirm the importance of knowing your customer, and consider the overall 'air-tightness' of your supply chain, from factory floor, to loading dock, to transportation to our border. Every single link in that chain must be made more secure against the terrorist threat."

Trade security measures were implemented, including the Customs-Trade Partnership against Terrorism, the Container Security Initiative, the Known Shipper Management System, and the Safe Ports Act of 2006. These measures tightened security, required substantially more data exchange, and created new relationships and requirements within the supply chain and between the public and private sectors.

Photo: Nuno Morão

An x-ray scanner waits for containerized cargo traveling into the Port of Lisbon, Portugal, one of the many international ports that participates in the Container Security Initiative.

NEW SUPPLY CHAIN PRACTICES AND EFFICIENCIES

The increased scrutiny and data needed for security had additional benefits: The measures created tighter understandings of each element and organization involved in supply chains and generated new data and tools that enhanced the visibility and expedited the movement of shipments. In an article published on September 11, 2017, Jon Slangerup, CEO of American Global Logistics, commented:

> With increased preshipping data requirements due to post-9/11 security concerns, the supply chain was forced to create efficiencies in the hand-offs, where money and time are often wasted. As a result, the cost to move goods is a smaller proportion of the sale price to the end user than it was 10 years ago (*2*).

In some respects, the new security requirements accelerated the development of the information and management systems that have become as important as the physical elements needed to move goods in efficient supply chains.

EXPANDED COLLABORATIONS

More and better collaboration and closer working relationships emerged as new security requirements were implemented. Individual government agencies coordinated more effectively to secure transportation systems and supply chains. The new data required from each element of the supply chain also necessitated greater organization and interaction among all the companies involved in the movement of goods, including sources, transportation providers, and customers.

As Slangerup noted: "What we encountered since 9/11 was an understanding of how silo-driven the management of those supply chains were, and to some extent still are. The various agencies involved in protecting people and assets pulled together very quickly" (*2*).

Evolution of Supply Chains and Freight Movement

Unfortunately, disruptive events continue, whether caused by nature or humans. Although in many cases effective practices and lessons learned from previous events have already been applied, substantial and expensive changes in supply chains and freight resilience may only occur after repeated incidents.

In 2011—just 10 years after 9/11—many natural catastrophic events occurred in the span of a single year (Figure 1, page 40). Some had profound effects, similar to those of 9/11, on globally interconnected supply chains and on companies' continued focus on maintaining low inventory levels. As noted in logistics company DHL's 2016 white paper: "Supply chain risk has been a major unintended consequence of two significant trends in recent decades: globalization and lean production" (*3*).

Affected again by disruptions in one part of the world that affected production operations elsewhere in the world, companies needed to address the risk. It was clear that supply chains would remain global. But relying on a single location or supplier—particularly after the 2011 earthquake and tsunami in Fukushima, Japan—was no longer prudent. As a result, organizations pursued diversification of production locations and suppliers.

Working together has become more important with every disruptive event, and the positive impacts of this change extend beyond disruptive events. Collaboration, cooperation, and communication are the three critical Cs in disruption preparedness and response.

The Council on Port Performance (CPP), formed by the shipping community of the Port of New York and New Jersey in 2014, largely was an outcome of the collaboration, cooperation, and communication that enabled public- and private-sector partners to restart port operations just days after the significant damage caused by Superstorm Sandy in 2012.

9/11 REFLECTIONS

ANNE STRAUSS-WIEDER

Role on 9/11: Principal and Founder, A. Strauss-Wieder, Inc., with nearly 18 years prior experience at the Port Authority of New York and New Jersey at the World Trade Center. She was present during the 1993 bombing and worked on one of the recovery teams.

"During those early weeks after 9/11—and with deep sorrow and mourning for colleagues lost and injured—we focused on helping (where possible) to get the agency and others back on their feet and to keep the goods flowing. Everyone helped where they could. The collaborations, teamwork, and can-do spirit would continue to serve the region well as it faced major disruptions and challenges in the years that followed."

—**ANNE STRAUSS-WIEDER**
Director of Freight Planning
North Jersey Transportation Planning Authority
Newark, New Jersey

The CPP's members represent all facets of waterborne movement, including governmental agencies, ocean carriers, terminal operators, labor unions, shippers, trucking companies, railroads, and third-party logistics organizations. The council has worked to address and resolve issues proactively. When the COVID-19 pandemic struck, the CPP moved to more frequent meetings to tackle the new challenges.

COVID-19 and Supply Chain Resilience

Every disruption is unique. Although we learn and adapt from previous disruptions, new catastrophic events continue to pose challenges.

The pandemic has been the latest challenging disruption. It is global but has not physically affected infrastructure. However, the pandemic abruptly changed the demand for certain products, and some production facilities went offline. It became even more critical to protect the health of essential workers. Each country had to consider its own needs.

Without the robust information systems created and maintained since 9/11, the situation would have been quite different for businesses and consumers. Without the development of collaboration, cooperation, and communication skills, it would have been far tougher to respond.

Pre-pandemic supply chain trends accelerated, including the use of e-commerce, diversification of production locations, augmentation of domestic production capacities, and the expansion of information and automation technologies.

As supply chains are rebooted and reshaped, the effective practices and lessons learned will continue to prepare us for the future.

FIGURE 1 Natural disasters worldwide in 2011. (Source: DHL.)

Photo: NOAA National Ocean Service

The National Oceanic and Atmospheric Administration (NOAA) ship *Thomas Jefferson* launches a high-tech survey boat to check the waterways in the Port of New York and New Jersey a few days after Superstorm Sandy made landfall in fall 2012. NOAA was among the agencies working together to restart port operations.

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Working together has become more important with every disruptive event.

Managing Operational Risks to the Air Transportation System

From 9/11 to COVID-19

Photo: Sandie Clarke, Unsplash

BART ELIAS

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The views expressed are those of the author and do not represent the views of the Congressional Research Service or the U.S. Library of Congress.

Above: Although airways reopened within days of 9/11, fully restoring public confidence took years. The COVID-19 pandemic has likewise left much of the flying public feeling up in the air about the safety of air travel. Both events are changing how we determine what to change.

The September 11, 2001 (9/11), terrorist attacks caused unimaginable grief for those who lost loved ones and those who suffered the long-term effects of that fateful day. For some time, the events cast a collective public fear that air travel was no longer safe and secure. Although the airways over the United States reopened within days, it took several years to fully restore public confidence. Research and policy studies since the attacks have informed decision-makers about ways to best address major risks to the civil aviation system posed by manmade and natural disasters (including pandemics, such as the ongoing battle with COVID-19), as well as persisting security threats posed by terrorist groups. Actions to address these threats include policy changes, the application of risk assessment methods, and the implementation of specific risk mitigation strategies.

In the United States, swift and sweeping changes were made to aviation security after the 9/11 attacks. Key actions included the federalization of the airport screening workforce, requirements for explosives detection screening of all luggage, greatly expanded deployment of federal air marshals to guard flights, and the installation of hardened cockpit doors. A year later, the federal agency created to oversee and administer aviation security in the United States, the Transportation Security Administration (TSA), was aligned with the newly created U.S. Department of Homeland Security (DHS), a conglomeration of federal agencies charged with protecting land and sea borders, transportation assets, and critical infrastructure, as well as coordinating the federal response to disasters and national emergencies.

The U.S. government also established the 9/11 Commission to perform an in-depth study of the systemic failures that left the air transportation system vulnerable to these terrorist attacks. Based on the commission's findings, the United States implemented additional measures to bolster aviation security as part of a coordinated and multilayered risk-based approach,

Photos: TSA

The PreCheck program (*left*) and canine teams are part of TSA's multilayered risk-based strategy. Dusan, a Dallas–Fort Worth International Airport explosives detection dog (*right*), helps remind humans to adhere to COVID-19 restrictions.

including enhanced background checks and security threat assessments of aviation workers, prescreening of airline passengers, and vetting and screening of air cargo.

The evolution of aviation security in the two decades since the 9/11 attacks has been contentious at times. TSA has faced considerable criticism for overreaching and for implementing overly invasive and burdensome measures without demonstrable security benefits, but it has taken steps to address many of these concerns. The resulting present-day aviation security system is largely predicated on risk-based practices that have, thus far, been effective in deterring and thwarting terrorism while striving to minimize impacts on the traveling public and the flow of air commerce.

In addition to framing aviation security policy, a risk-based multilayered approach has been an integral part of the ongoing strategy to address contagious disease spread through the aviation system, particularly with respect to domestic air travel in the United States, and has been applied to address pervasive threats posed by natural and manmade disasters, including potential cyberattacks and threats from extreme weather events. Researchers have helped inform policy decisions concerning how to better assess risks; improve individual layers of security, preparedness, and emergency response; and coordinate efforts to form a cohesive integrated security and emergency management framework.

Understanding the Aviation Network

The global aviation network is vulnerable in part because flight operations are highly concentrated around a relatively small number of critical hub airports and because the system is so highly interconnected (Figure 1). Disruptions affecting major airports, like Chicago's O'Hare International, Charles de Gaulle in Paris, or London Heathrow, can have cascading systemwide impacts (*1*). In contrast, the impact of events at small airports may be considerably more limited.

However, simply putting elaborate security measures in place at major airports is an incomplete solution, because major hubs are directly accessible from smaller airports throughout the world. Some of the 9/11 terrorists exploited this facet of the aviation network by first boarding a commuter flight to connect to larger jets. A thorough understanding of the aviation network through systems analysis and various modeling and simulation tools has informed decisions regarding system vulnerabilities and security measures, such as how teams of air marshals are

FIGURE 1 The highly interconnected global aviation network is centered on a relatively small number of key hub airports in the United States, Europe, and Asia (*1*).

Photo: Clay Banks, Unsplash

Disruptions to a major airport hub like Chicago O'Hare can impact a region or—potentially—the entire airline system.

deployed. Aviation network modeling and analysis also played an important role in understanding contagious disease spread through aviation and the public health risks posed by global air travel (*2*).

Risk-Based Framework

The risk-based approach can be summed up by the advice of 18th-century Prussian king Frederick the Great: "To defend everything is to defend nothing." Instead of spreading limited resources too thin, risk-based security and emergency management focus defensive and protective measures based on careful analysis of the following critical risk components:

1. The likelihood of an undesirable event like a terrorist attack or natural disaster,
2. The vulnerability of the system to such threats, and
3. The potential consequences of a disruptive event.

The study of security threats is largely an intelligence-driven endeavor based on careful assessment of available information about terrorist aspirations and capabilities to carry out specific attacks. The study of vulnerabilities and consequences, on the other hand, relies heavily on aviation security experts with first-hand knowledge of security measures and coordination among responsible federal agencies, state and local law enforcement, airports and airlines, air cargo agents, airport tenants, and other stakeholders. Additionally, operations researchers offer many analytical techniques, as well as modeling and simulation tools to assess system vulnerabilities, susceptibility to undesirable outcomes, and the potential consequences of terrorist attacks and other disruptive events.

The work of intelligence analysts, security experts, and researchers has helped guide decisions and strategies regarding the layers of security that have been put in place to protect the flying public. These same approaches have been used to study aviation system risks posed by potential manmade and natural disasters, including pandemics, cyberattacks, and extreme weather events.

Layered Mitigation Measures

A layered approach to aviation security was in use long before the 9/11 attacks, but the 9/11 Commission found that the layers in place on that day had serious gaps (*3*). The commission advocated for a comprehensive, multilayered approach to security, stressing that each layer must be effective in its own right and that the various layers must be carefully coordinated to create redundancies to catch possible lapses in any of the layers. The recommendations of the commission and subsequent research and policy addressing aviation security has focused on fortifying each layer of security and ensuring that they work effectively together to create a cohesive strategy to protect against terrorist threats.

A layered approach comports with British psychology professor James Reason's "Swiss cheese" model of system vulnerability, seen in Figure 2 (*4*). Reason argued that causal chains leading to catastrophic outcomes involve highly unusual circumstances where failures permeate every layer of defense. He argued that events where the holes or gaps align, while rare, unveil latent gaps and vulnerabilities in the system. In the case of the 9/11 attacks, several latent gaps were exploited—small box-cutter knives were not prohibited aboard aircraft, cockpit doors were not reinforced, air marshals were rarely deployed on domestic flights, and hijacking protocols at the time instructed air crews to capitulate to hijacker demands.

The layered approach also has been a key part of the strategy to mitigate contagious disease spread in the air

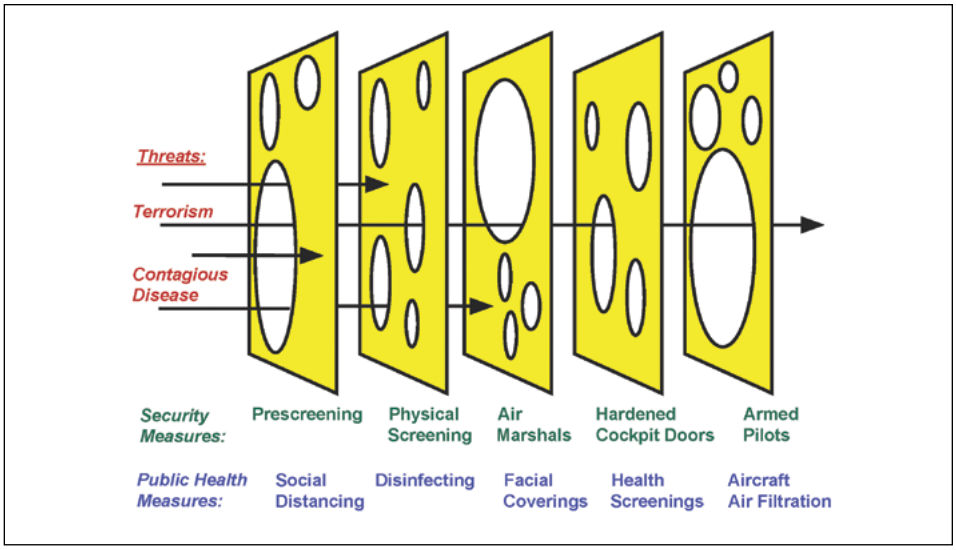

FIGURE 2 The Reason "Swiss cheese" model illustrates the benefits of a layered approach to aviation security and contagious disease mitigation. (Source: Bart Elias, adapted from James T. Reason.)

transportation system amid the COVID-19 pandemic (*5*). Layers include practicing social distancing; disinfecting aircraft and high-traffic areas in airports; mandating facial coverings; maximizing use of aircraft cabin air ventilation and filtration systems; and, on a more limited basis, conducting passenger health screenings, implementing protocols for isolating ill passengers, and conducting contact tracing.

Future operational measures also may include the implementation of "health passports" or credentials to document that travelers have been vaccinated. Modeling tools, such as those developed to study the security risks of chemical and biological agents, as well as models of contagious disease spread, can help assess the efficacy of these layered measures. They also can help inform decisions about when targeted measures, such as travel bans to specific regions, might be appropriate. Targeted, risk-based restrictions may serve as an alternative to broadly applied international travel bans that can significantly impact the entire air transportation system.

Additional layers to protect aviation involve measures that address the resiliency of infrastructure to withstand a terrorist attack or a natural or manmade disaster. These include design considerations for airports to bolster security and improve resilience and effective emergency management practices and response plans (*6–8*).

A Balancing Act

Aviation security policy since 9/11 has involved considerable research and debate over how to appropriately balance the following competing goals:

- Efficiently transporting people and goods via air with minimal hassles,
- Implementing effective defenses and deterrents to thwart terrorist and criminal threats, and
- Protecting the privacy and dignity of the flying public.

TSA strives to keep average passenger wait times at screening checkpoints under 15 minutes. To help meet that objective, TSA launched PreCheck, which offers streamlined, expedited screening to passengers who pass voluntary background checks. PreCheck also bolsters screening effectiveness by focusing resources on passengers who pose an unknown or elevated risk.

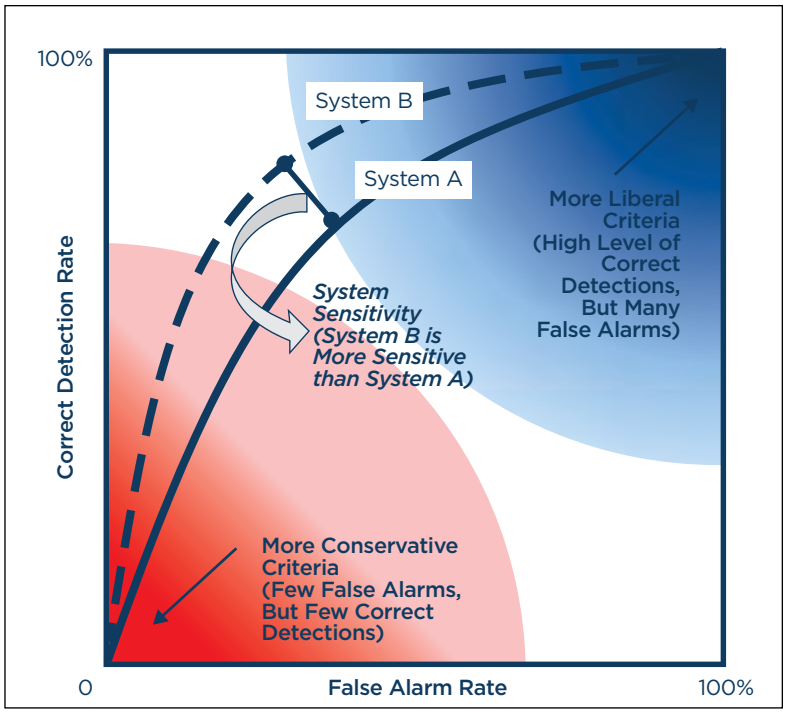

FIGURE 3 Signal detection theory provides a framework for examining system performance and the tradeoffs between threat detection and false alarms. (Source: Bart Elias.)

Operations research methods, including simulation and modeling tools, have proven invaluable in studying and improving the efficient flow of passengers, baggage, and cargo through security screening systems and processes (*9*).

As seen in Figure 3, signal detection theory (SDT) provides an ideal analytic framework for examining tradeoffs between high levels of threat detection and nuisance false alarms associated with aviation security screening systems (*10*). SDT was developed in the 1950s to study the performance of human observers like radar operators aboard Navy ships. It has since been used to evaluate performance in various other settings such as medical diagnostics (*11*). For evaluating security screening, SDT allows researchers to assess how capable systems are at detecting threats and differentiating threat objects from nonthreat items that may produce a similar image or signal. Using SDT, researchers can also determine a system's sensitivity or discriminability—a measure of detection capability—by comparing correct detections to false alarms under varying levels of uncertainty.

SDT analysis can be used to evaluate and compare systems. It also can be used to assess how to set system decision criteria most appropriately to balance the need for accurate threat detection with the need to minimize false alarms that increase workload and delays in security screening.

Over the past decade, engineering of security screening systems has emphasized the development of automated threat detection algorithms. SDT analysis is useful for assessing and comparing these algorithms. Screening technologies and embedded automated threat detection algorithms have advanced considerably and are continuously evolving. They offer a more balanced approach to security that is effective at detecting threats while minimizing false alarms and associated system disruptions.

Finally, protecting the privacy and dignity of air travelers remains a topic of focus

for legal studies and policy debate (*12*). Transportation researchers have made important contributions to understanding how measures to protect traveler privacy and dignity can impact security efficiency and effectiveness using quantitative analyses that can help inform policy discussions regarding these matters. Technology also can help ameliorate privacy concerns. For example, equipping full-body scanners with automated threat detection capabilities eliminated the need for human observers to examine full-body images generated by these systems (Figure 4).

FIGURE 4 TSA full-body scanners now rely exclusively on automated threat detection algorithms that eliminate the need for human image observers. (Source: TSA.)

Future Directions

The air transportation system is susceptible to disruption from many causes, from extreme weather events and terrorist attacks—including possible cyberattacks—to contagious disease outbreaks. Such events can have broad and long-lasting economic impacts. It took several years for the airline industry to recover financially from the 9/11 attacks. The COVID-19 pandemic triggered a significant decline in passenger bookings that was only partially offset by increased air cargo demand spurred by e-commerce.

A full recovery to pre-pandemic levels is expected to take several years. Continued research to understand network dependencies, system risks, the effectiveness of multilayered mitigation measures, and ways to appropriately deploy these measures with minimal impact to operations and the flying public can help guide future policy and strategy to address constantly evolving threats to aviation and their operational and financial impacts on air transportation.

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9/11 REFLECTIONS

MICHAEL C. SMITH

Role on 9/11: Member of Y2K consulting team, Science Applications International Corporation (later renamed Leidos)

"My role on the Y2K consulting team was the first time I had become involved with planning for a potential crisis in the transportation sector. Although my previous experience with defense systems security was outside of the transportation industry, both roles helped prepare me for what was to come after 9/11: identifying threats, asset vulnerabilities, and consequences associated with major damage or destruction of those assets."

—**MICHAEL C. SMITH**
Senior Scientist, Surface Transportation Solutions, Leidos, Reston, Virginia

Laurel Radow

Retired, FHWA, U.S. Department of Transportation

The career path that brought **Laurel Radow** to transportation did not begin in engineering. Graduating with a degree from the University of Maryland, she worked in banking and associations and on Capitol Hill, developing expertise in communications and conducting research. In 1985, she joined the National Trust for Historic Preservation as an information specialist. From there Radow made the leap into transportation, joining the American Public Transportation Association as a senior policy analyst and drawing upon a background in research to write reports on energy, clean air, the environment, rural issues, transit, and the economy.

The challenges of the future require collaboration among colleagues and stakeholders of diverse backgrounds, Radow comments. "Physical infrastructure must now be designed by those who understand the threats of climate change, today's extreme weather, and other attacks to our critical infrastructure. With a surface transportation network that isn't likely to expand greatly in the coming years, to ensure as resilient a system as possible, the design needs to include the needs of those operating the system, whether in transportation or public safety," she adds.

In 1996, Radow joined FHWA at the U.S. Department of Transportation (DOT). From 1998 to 1999, she was a key member in FHWA's and U.S. DOT's preparation for the transition from 1999 to 2000—also known as Y2K—including the planning of the July 1998 U.S. DOT Y2K Summit, preparing FHWA divisions for the rollover event, and working in FHWA's Crisis Management Center (CMC) on New Year's Eve.

A little more than a year later, Radow then was tapped to work on FHWA's effort after September 11, 2001 (9/11). She was a member of FHWA's Emergency Response Team and served as FHWA's emergency coordinator from 2002 to 2004.

"On September 10, 2001, I managed FHWA outreach to public interest groups, working to get states and local agencies to buy computer-based technology for transportation—variable message signs, transit passes, and so on," Radow recalls. "I fully expected to do that or similar assignments for the rest of my time at FHWA."

But on 9/11, Radow approached U.S. DOT's CMC, with which she was familiar from previous work, to see if FHWA was needed. The next day, she began to gather information from the states—assessing their transportation infrastructure of national significance. By the end of the week, she served a shift as CMC deputy operations chief, logging all the information provided by various modes and compiling a situation report to present to the White House. On the second Sunday, she was serving as operations chief.

"As a profession, we are well prepared to take on challenges. If you don't know the answer to something, ask."

"I managed tasks for FHWA on topics that hadn't even appeared in our lexicon before 9/11 and explained them to state and local agencies," Radow comments.

Until she retired from FHWA in 2016, Radow served on the FHWA Office of Operations Traffic Incident and Events Management team. She was program manager for the agency's planned special events and evacuations and emergencies programs. She guided the development of many traffic incident management (TIM) publications, as well as training materials.

"Because we didn't know when the next disaster would happen or the type of disaster it would be, we developed material trying to get 80 percent of the information correct and into the hands of those who needed it," Radow notes. "I learned that, for the most part, we figured out what to do based on what we had learned the day or month before."

Among Radow's TIM and planned special events initiatives were the publications *Making the TIM Business Case and Climate Change Adaptation Guide for Transportation Systems Management, Operations, and Maintenance*, as well as deployment of the TIM Incident Management Outreach Toolkit. Radow also authored the *2017 Solar Eclipse Transportation Fact Sheet for State and Local Departments of Transportation*.

Radow is chair of the Transportation Research Board's (TRB's) Standing Committee on Critical Transportation Infrastructure Protection, which she first joined in 2007. She authored the centennial paper detailing the history of the Critical Transportation Infrastructure Protection Committee. She also served as co-chair of the planning committee for the 2018 Transportation Resilience Innovations Summit and Exchange.

Outside of TRB, Radow serves as the co-chair of the Local Planning Working Group for the American Astronomical Society's Solar Eclipse Task Force, helping to prepare for the next solar eclipse on April 8, 2024.

"As a profession, we are well prepared to take on challenges. If you don't know the answer to something, ask—the person in the next office or in another mode has something to offer," she muses. "We will always face disasters. What we need to develop is a way to be less reactive."

John Contestabile

Skyline Technology Solutions

John Contestabile has made his mark in the transportation, emergency management, and public safety fields. But getting there meant taking a turn from a more traditional path. "I was following the typical civil engineering career path," Contestabile shares, "doing preliminary highway improvement designs for a highway agency and following the National Environmental Policy Act process. But while we may plan our careers, sometimes life events take us down a different road. For me, that was 9/11. That tragedy led me to emergency management and then to homeland security responsibilities, including a stint as the acting deputy homeland security advisor under former Maryland Governor Robert Ehrlich, Jr."

Contestabile has been director of public safety solutions for Skyline Technology Solutions since 2019. He works closely with the public safety community, developing solutions to meet their operational needs. Many such solutions involve cybersecurity, video interoperability, communications, and network operations.

After earning a bachelor's degree in civil engineering from Worcester Polytechnic Institute in Worcester, Massachusetts, Contestabile later earned a master of business administration from the University of Baltimore in Maryland. He began his career as a project engineer with the Maryland State Highway Administration, a modal agency of the Maryland Department of Transportation (DOT). In the 15 years he spent in the unit, he rose through the ranks to become director of the Engineering Access Permits Division. Over the years, he managed key projects in Maryland such as widening I-495 (Capital Beltway), relocating U.S. Route 220 near Cumberland, and widening I-695 (Baltimore Beltway).

In 1993, Contestabile left the unit but continued with Maryland DOT, where he would spend the next 15 years advancing from deputy director—and then director—of the Office of Management Services and Audits; director of the Office of Administrative Services; director of the Office of Engineering, Procurement, and (added later) Emergency Services; and acting assistant secretary for Administration.

"Don't be afraid to change with the times and circumstances that life puts in front of you."

In 2007, Maryland Governor Martin O'Malley named Contestabile the director of the Maryland Statewide Public Safety Communications Interoperability Program, reporting to the superintendent of the Maryland State Police. Contestabile was charged with overseeing the state's efforts to establish public safety interoperable communications systems. He developed the request for proposals for the statewide 700–800 megahertz radio system in use today and a statewide computer-aided dispatch system. He helped launch one of the first statewide geographic information systems (GIS) and developed a statewide interoperable closed-circuit video system. Contestabile also applied for, received, and managed approximately $30 million in grant funding, as well as identified and designated more than $100 million in capital funds toward various system implementations. "That role, which overlapped my position at Maryland DOT until I left the latter job in 2008, led me into technology as it applied to public safety," he recalls.

By 2009, when Contestabile became the manager of the Emergency Preparedness and Response Systems Program at Johns Hopkins University Applied Physics Laboratory, he was well established in emergency management and public safety. In that role, he oversaw several projects, including a U.S. Department of Homeland Security (DHS)–funded effort that involved implementing video over datacasting using the public television spectrum and developing a GIS–based real-time evacuation planning module. "I have been blessed," Contestabile states. "Over my career, I have been involved in highway design, transit safety and security, homeland security, public safety communications, and now—more broadly—technology. My advice to younger colleagues is to look at your career as a journey rather than a destination. Don't be afraid to change with the times and circumstances that life puts in front of you."

Contestabile praises those he has encountered along the way. "I have worked for some great employers and really great leaders," he adds. "And I have volunteered for some fine organizations." One of those organizations is the Transportation Research Board (TRB), where Contestabile is chair of the Resilience Section, a member of the Standing Committee on Transit Safety and Security, and has served on many National Cooperative Highway Research Program panels. He is a past member of the DHS Science and Technology Directorate Video Quality in Public Safety leadership team. He recently completed a mayoral appointment to the District of Columbia Homeland Security Commission and a gubernatorial appointment as the Maryland representative to the Washington, D.C. Metrorail Safety Commission.

Contestabile's industry involvement also includes memberships in such organizations as the American Society of Civil Engineers, the International Association of Emergency Managers, the National Public Safety Telecommunications Council, and the National Domestic Preparedness Coalition. He also is a highly sought after speaker and has published many works.

The knowledge Contestabile has gained from research has been invaluable. "After 9/11, there was little published research on transportation security," he notes. "If not for FHWA, AASHTO, and TRB setting aside funding (and the support of the state DOTs and the Cooperative Research Programs staff), we would not have the body of knowledge we have today."

INFLUENCER

Ryan Dittoe

Ryan Dittoe is an aviation planner at Mead and Hunt in Chicago, Illinois. He serves as vice chair of TRB's Young Members Council–Aviation. He also is a member of the Airport Cooperative Research Program (ACRP) project panel on Quick Response: Airport Organizational Redesign and serves as chair for the ACRP project panel to update ACRP Report 135: Understanding Airport Air Quality and Public Health Studies Related to Airports.

How did you first hear about and become involved in TRB?
I first heard about TRB as a teaching assistant while in graduate school. My instructor, who told me about it, regularly attends the Annual Meetings in Washington, D.C. That enabled me to get a more detailed sense of what it's like to attend from a member's perspective, as opposed to just browsing the website, for example. After I began a full-time position, I started working on session planning with the Young Members Council–Aviation and eventually took on various leadership roles within the group. A little more than three years later, I'm the vice chair and will move into the chair position in 2022.

How has TRB influenced your career so far?
TRB is immeasurably beneficial for many reasons, but networking with others in the industry at the Annual Meeting is always my favorite part of the week. I'm fairly early in my career, and TRB has allowed me to meet professionals who have made incredible contributions to the transportation industry—or will soon with their research. Creating and maintaining these relationships has introduced me to various mentors over the years and reinforced my draw to aviation.

What was one of your most memorable TRB Annual Meeting moments?
It's hard for me to think of a favorite moment, but it's always striking to see the work you've been pursuing with your colleagues being presented at the Annual Meeting to an audience of professionals from around the world. Outside of the sessions, D.C. is extraordinary! I have too many memories from there to count!

Transportation Influencer highlights the journey of young professionals active in TRB. Have someone to nominate? Send an e-mail to TRNews@nas.edu.

MEMBERS *ON THE MOVE*

Natalie Barnes, former associate director of publications for TRB's Cooperative Research Programs, has been promoted to director of publications.

Brittany Bishop is a new program officer for TRB's Consensus and Advisory Studies.

Jordan Christensen has joined Cooperative Research Programs as a senior program officer for ACRP.

Waseem Dekelbab, former NCHRP senior program officer specializing in bridges and structures, has accepted the position of NCHRP associate program manager.

Heather DiAngelis is the new associate publications director for Cooperative Research Programs.

James F. Hinchman, chief operating officer for the National Academies, retired in July after 22 years. During his tenure, he also served as deputy executive officer, general counsel, and chief financial officer.

Anusha Jayasinghe has been promoted to program officer in the Technical Activities Division.

Timothy Tait, Arizona DOT communications director for 15 years, has accepted the communications director position for the Arizona Judicial Branch in Maricopa County. Tait has supported the TRB Committee on Public Engagement and Communications and is chair of the NCHRP project panel on Development of Business Case and Communication Strategies for a State DOT Resilience Program.

Creating Connections in TRB Contracting

The Transportation Research Board (TRB) Airport Cooperative Research Program's (ACRP's) online portal, IdeaHub, offers a platform for creating and developing airport-related research ideas. IdeaHub also allows users to help cultivate another person's ideas by voting on them and adding comments. Once fully developed, ideas are considered "problem statements," undergoing a formal review process before ACRP's Oversight Committee considers them for selection.

These problem statements then may become a research project, a synthesis of practice project, or a legal study, all of which are overseen by panels of experts and carried out by academic or private-sector contractors.

Recently, ACRP developed an innovative way to use IdeaHub to allow proposers to better connect with minority- and women-owned businesses, improving diversity and inclusion in project teams. Those seeking to partner with others will be able to post within IdeaHub on a web page specific to a project about their own expertise or expertise they are hoping to add to their team. Users then provide contact information, and anyone viewing will be able to contact them directly to further discuss how they can team up on an ACRP project.

As a pilot program, this new capability requires registration on IdeaHub. MyTRB account holders will be able to use those credentials to log in.

The new IdeaHub capability allows proposers to more easily and quickly identify potential team partners whose specific expertise will complement the proposal they submit to ACRP in response to a request for proposals.

(*Left to right*) Panelists Clyde Otis, Rod Borden, Renee Hendricks, and Elizabeth Smithers join Airport Cooperative Research Program (ACRP) manager Marci Greenberger and panelist David Bannard in a panel meeting for ACRP Project 11-01, "Analysis of Laws, Regulations, and Case Laws Regarding Airport Customer Facility Charges." A new ACRP IdeaHub feature allows proposers to easily identify potential team partners, helping increase diversity and inclusion on project panels.

Notes Chris Hedges, director of TRB's Cooperative Research Programs: "This new way of using IdeaHub shows great potential to enable more minority- and women-owned businesses to connect as contractors and subcontractors, thus allowing a larger pool of small businesses the opportunity to participate in CRP research contracts."

This use of IdeaHub is aligned with one of the strategies in TRB's Diversity, Equity, and Inclusion Plan: Identify practices for minimizing barriers to achieving greater diversity among TRB contractors and their lead staff, whether suppliers or research consultants. The new IdeaHub feature will be available in time for ACRP's FY 2022 projects when requests for proposals are posted in late 2021.

IdeaScale, the company that produces IdeaHub, is excited to find another use for its product—and specifically one that helps TRB achieve its diversity and inclusion goals.

—Marci Greenberger and Karen Febey, Transportation Research Board, National Academies of Sciences, Engineering, and Medicine, Washington, D.C.

Learn More
For more information about this new IdeaHub feature, see https://ideahub.trb.org.

Successful Communication During Disruptive, Crisis Situations

14TH ANNUAL COMPETITION IDENTIFIES BEST PRACTICES

TERRI H. PARKER

The author is the assistant agency director for marketing, communications, and agency relations at Texas A&M Transportation Institute, College Station, Texas.

Image: Arizona DOT

With downloadable activity sheets, videos, and more, the ADOT Kids website taps into children's interest in science, technology, engineering, and math.

With strategies ranging from homeschooling kits for parents and teachers to a clean commuting campaign to community toolkits in 17 languages, the winners of the 14th Annual Communicating Concepts to John and Jane Q. Public Competition illustrated best practices in how to communicate during disruptive, crisis situations. The tools and techniques used by the competition winners, showcased at the virtual Transportation Research Board (TRB) Annual Meeting in January 2021, epitomized the spirit of communicating complex information in an uncomplicated manner amidst the COVID-19 pandemic.

In recent years, various types of disasters—from hurricanes, floods, wildfires, tornadoes, and earthquakes to COVID-19—drastically affected all modes of transportation. These disruptions have shaken the safety, resiliency, and very survival of the transportation system, as well as the daily lives of the traveling public and the industries that depend on the worldwide supply chain. Many lessons have been learned about successfully communicating with system users, stakeholders, and communities during crisis situations.

COMPETITION WINNER

The winner of the John and Jane Q. Public competition was "ADOT Kids," submitted by the Arizona Department of Transportation (DOT). With thousands of parents teleworking and homeschooling their children at the same time during the pandemic, the Arizona DOT communications team developed fun, interactive activities to educate and entertain children and spark their curiosity about the transportation system.

Arizona DOT launched weekly ADOT Kids activities on the agency's blog.[1] Children participated in games, chalk art drawings, safety message development, and more. The blog also offered a weekly recap celebrating the children' submissions with a slideshow and a video in which a subject-matter expert answered transportation questions.

RUNNERS-UP

Three additional entries were honored as runners-up in the competition. Metrolink, the Southern California Regional Rail Authority, submitted "Emerging from a Global Pandemic: Smarter, Better, and Essential," which described the communications strategies used to regain customer confidence during the COVID-19 pandemic. These included a clean commuting campaign with a video showing the cleaning regimen for the trains and communicating to essential workers that they could travel safely on their train. Metrolink launched an online tool that allowed riders to check recent ridership on their train to ensure social distancing could be achieved.

King County Metro's "How to Social Distance on Transit: Engaging Community-Based Messengers on Developing and Disseminating COVID-19 Information" also garnered runner-up honors in the competition. The Washington State transit agency deployed community organizations to help get the word out about reduced service and schedule changes and developed a toolkit of digital and print content in 17 languages for riders in different ethnic communities. King County Metro created an "If you must go, be in the know" public service announcement campaign that referred riders to the King County Metro website to learn about COVID-19-related schedule changes and precautions.

The entry "Adapting to New Times: A Virtual Shift in Project Connect Community Engagement Efforts," from Capital Metropolitan Transportation Authority (CapMetro) in Austin, Texas, offered information on how the agency shifted its community engagement efforts during the pandemic. In-person outreach efforts and open houses in preparation for the new comprehensive transit plan, "Project Connect," had been under way before the pandemic. CapMetro staff quickly switched their efforts to virtual open houses and virtual community meetings in English and Spanish, engaging thousands of stakeholders through videoconferences, social media, and radio. These virtual strategies allowed the planning to continue during the pandemic, and the new transit plan subsequently was approved.

To learn more about this annual competition, visit the website for the TRB Standing Committee on Public Engagement and Communications: https://sites.google.com/view/trbaje40/jjpcompetition.

[1] For more, see azdot.gov/ADOTKids.

IN MEMORIAM

James Burnis McDaniel, 1938–2021

Legal expert and retired Transportation Research Board (TRB) senior program officer James (Jim) Burnis McDaniel died in Potomac, Maryland, on August 2, 2021. Born in Welch, West Virginia, McDaniel grew up in Floyd and Christiansburg, Virginia, and graduated from The Ohio State University with a bachelor's degree in history. He served in the U.S. Army from 1961 to 1963 and in 1966 received a J.D. from Howard University Law School in Washington, D.C.

McDaniel's long legal career spanned the U.S. Justice Department and District of Columbia government before he joined TRB. As senior program officer supporting the legal committees in the Technical Activities Division, McDaniel facilitated collaboration, knowledge sharing, and best practices among many hundreds of members in the transportation legal community. TRB's summer meeting of legal committees was a "must attend" event for state department of transportation attorneys. McDaniel also worked closely with Transit Cooperative Research Program manager Gwen Chisholm-Smith on legal research digests in the Cooperative Research Programs.

"James was always gracious, friendly, and dedicated to providing excellent service to the volunteers on the committees that he staffed," comments TRB Executive Director Neil Pedersen.

Photo courtesy Russell Houston

FACE TO FACE—Gathering in person for the first time in a while, members of the Transportation Research Board Executive Committee discuss programs and initiatives at their mid-year meeting, July 19, 2021, in Woods Hole, Massachusetts.

COOPERATIVE RESEARCH PROGRAMS NEWS

Guidebook for Mechanical Methods for Snow and Ice Control Operations

Winter weather affects the transportation network across North America, so snow and ice control is a prime winter maintenance activity for many state and local departments of transportation (DOTs). Most of these control strategies employ chemicals (primarily sodium chloride), mechanical means for snow and ice control, or both. Reducing the dependence on use of chemicals and adopting more mechanical strategies—such as brooming, plowing, scraping, and ice breaking—would yield environmental, economic, and safety benefits to agencies.

Wilfrid A. Nixon & Associates, LLC, has received a $264,269, 24-month contract (National Cooperative Highway Research Program [NCHRP] Project 06-19) to develop a guidebook on the use of mechanical methods for snow and ice control operations.

For further information, contact Amir N. Hanna, TRB, at 202-334-1432 or ahanna@nas.edu.

Photo: Washington State DOT

A snow blower takes a first cut through a section of Washington State's North Cascades Highway, which was recently cleared with a tracked over-snow vehicle. An NCHRP project is developing guidelines for mechanical snow removal practices.

AASHTO COMMITTEE ON BRIDGES AND STRUCTURES STRATEGIC PLAN, OPERATING GUIDELINES, AND RESEARCH ROADMAP DEVELOPMENT

The AASHTO Committee on Bridges and Structures (COBS) supports the bridge community by maintaining and improving its strategic plan and working closely with NCHRP to obtain research funding and implement research results. But technology advances and industry innovations mean that the COBS strategic plan needs to be reevaluated and revised to meet current needs.

Clough, Harbor & Associates, LLP has received a $120,000 contract (NCHRP Project 20-123[10]) to refine and refocus the AASHTO COBS strategic plan and to develop operating guidelines, as well as a research roadmap for short- and long-term goals. The project is expected to be completed by June 2022.

For further information, contact Waseem Dekelbab, TRB, at 202-334-1409 or wdekelbab@nas.edu.

METHODS FOR ASSIGNING SHORT-DURATION TRAFFIC VOLUME COUNTS TO ADJUSTMENT FACTOR GROUPS FOR ESTIMATING AADT

Annual average daily traffic (AADT), which represents traffic on a typical day of the year, is used by DOTs for reporting requirements, allocating resources, informing decision making, and supporting various agency functions. But commonly used methods for estimating AADT do not adequately address how short-duration counts should be assigned to adjustment factor groups.

Texas A&M Transportation Institute has been awarded a $500,000, 30-month contract (NCHRP Project 07-30) to develop rational methods for assigning short-duration traffic volume counts to adjustment factor groups for estimating AADT for all functional classes of roadways and traffic volumes.

For further information, contact Amir N. Hanna, TRB, at 202-334-1432 or ahanna@nas.edu.

GUIDELINES FOR THE MAINTENANCE AND CONSTRUCTION OF RUMBLE STRIPS

Centerline, edge line, and shoulder rumble and mumble strips are road safety features to alert inattentive drivers when they are in danger of leaving the lane. Often these strips are a pattern of grooves milled into the pavement surface. But if they are added to inadequate pavement, this may lead to premature deterioration. Guidelines are needed to address the different aspects of constructing and maintaining rumble and mumble strips on flexible and rigid pavements.

Texas A&M Transportation Institute has received a $449,441, 30-month contract (NCHRP Project 14-46) to develop guidelines for the maintenance and construction of rumble strips on different types of pavements.

For further information, contact Amir N. Hanna, TRB, at 202-334-1432 or ahanna@nas.edu.

Photo: Vermont Transportation Agency

New NCHRP research examines construction and maintenance of rumble and mumble strips on flexible and rigid pavements.

CONSIDERING GREENHOUSE GAS EMISSIONS AND CLIMATE CHANGE IN ENVIRONMENTAL REVIEWS: RESOURCES FOR STATE DOTS

Many state DOTs seek ways to improve how greenhouse gas (GHG) emissions and climate change effects are addressed in environmental reviews, specifically the analysis and documentation required by the National Environmental Policy Act and state environmental policies, environmental justice and equity analyses, community impact assessments, or planning and environmental linkages studies. State DOTs also can support statewide climate action plans or climate resilience initiatives by considering the GHG emissions and climate change impacts of their projects and programs.

Cambridge Systematics, Inc., has received a $375,000, 22-month contract (NCHRP Project 25) to develop and pilot a handbook for state DOTs with resources and approaches for addressing GHG emissions and climate change impacts in environmental reviews.

For further information, contact Ann Hartell, TRB, at 202-334-2369 or ahartell@nas.edu.

GUIDE FOR INTERSECTION CONTROL EVALUATION

Transportation agencies use many intersection control evaluation processes and metrics to evaluate intersection geometry and control alternatives and to identify an optimal geometric and control solution for an intersection. A guide is needed that incorporates rational processes, objective performance metrics, and appropriate tools to provide a consistent and objective intersection control evaluation.

Kittelson & Associates, Inc., has received a $400,000, 24-month contract (NCHRP Project 17-98) to develop a guide for intersection control evaluation for adoption by AASHTO.

For further information, contact Amir N. Hanna, TRB, at 202-334-1432 or ahanna@nas.edu.

Search and Rescue Dogs

Humans' Best Friend

Searching for survivors unable to call for help, hidden beneath rubble, or thrown from a vehicle onto steep terrain with thick vegetation is difficult for humans—but not for search and rescue (SAR) dogs. Their athletic bodies and graceful leaps make the job look easy, but this belies years of training and, according to the National Disaster Search Dog Foundation, "takes an extraordinary dog with extreme boldness, drive, energy, strength, agility, and focus."

Training, which begins as early as 6 weeks old, is like a game—run through a tunnel, balance on a yoga ball, climb on rubble to find a toy hidden in the training course. Then, stand your ground, and bark to broadcast an alert. Each dog has a specific human handler trained to give consistent direction. Hand gestures, nods, and clear commands intermingle with respect for a job well done or needed corrections.

Media coverage during 9/11 highlighted the bravery of these teams that go where it may be loud, dark, wet, hot, smoky, or terrifying. Unlike humans, SAR dogs wear no protective gear. They sometimes return with singed fur or burnt pads. Relying on their acute sense of smell, they risk inhaling toxic chemicals, illegal drugs, or smoke. Trained to rescue, SAR dogs—like their human counterparts—may suffer from depression after recovery operations.

Photo: Jamie Street, Unsplash

Would this puppy make the cut? With training—maybe. Hounds, retrievers, shepherds, or mixes of these breed groups perform well in search and rescue situations.

Learn more at searchdogfoundation.org.

Is There a Low Bridge Ahead?

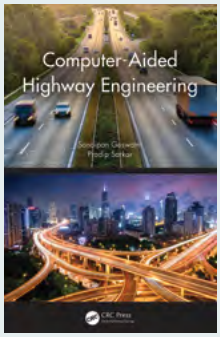
Although many of the details of driving something the size of a small apartment are self-evident—it won't fit where you park your Tesla—a surprising number of new recreational vehicle drivers (RVers) never note the vehicle's exact height. Worse, many RV sales and rental companies neglect to provide this information or make sure their customers realize its importance.

On roads traveled by large commercial trucks, bridge and overpass height is often sufficient for large RVs. When approaching an overpass with a curved underside, a common RV tactic is to stay in the middle lane where the span is tallest. Danger emerges when new RV drivers rely on navigation apps they use in a car. These apps, like Waze or Google Maps, have yet to include a setting for vehicle height or a low bridge warning. For RVs without the latest GPS technology built into the dashboard, this can be an accident waiting to happen.

For more information on avoiding low bridges, see https://www.doityourselfrv.com/low-bridge-rv-clearance-tips.

Photo: Airstream, Inc., Unsplash

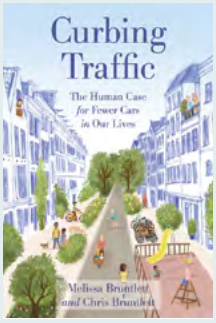
Truck apps account for vehicle height but are not intended for the noncommercial motorist. Other apps exist, but can be inaccurate and give a false sense of safety.



Computer-Aided Highway Engineering

Sandipan Goswami and Pradip Sarkar. CRC Press, Taylor & Francis Group, 2021, 518 pp., $170, 978-0-367-49338-7.

This book aids in the development of professional knowledge in highway planning, designing, and implementation with exposure to hands-on computer software training in designing road infrastructure worldwide. Discussed are digital terrain models using satellite data, including highway geometric, pavement, and tunnel design supported by relevant tutorials. Also addressed is quantity estimation, cost estimation, and production of various types of construction drawings, along with theory and tutorials backed by real project data.



Curbing Traffic: The Human Case for Fewer Cars in Our Lives

Melissa and Chris Bruntlett. Island Press, 2021, 240 pp., $30, 978-1-642-83165-8.

Mobility experts Melissa and Chris Bruntlett detail why cities designed for people—rather than motor vehicles—support individual and societal health and well-being. Relating experiences living in the Netherlands with research and interviews with experts and locals, the authors outline the benefits of thoughtfully curbing traffic: creating urban environments that are child-friendly, connected, trusting, feminist, quiet, therapeutic, accessible, prosperous, resilient, and age-friendly.

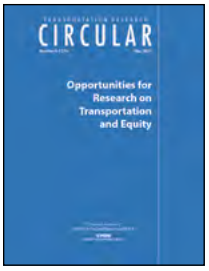
Soft Target Hardening: Protecting People from Attack, 2nd Edition

Jennifer Hesterman. Routledge, Taylor & Francis Group, 2019, 486 pp., $192, 978-1-138-39110-9.

This award-winning book provides a comprehensive and unique overview of soft target vulnerabilities, threats, and hardening tactics. Retired Air Force colonel and counterterrorism expert Jennifer Hesterman cross-applies lessons learned while protecting military installations from criminal, terrorist, and insider threats. Starting with an examination of human factors, the book presents case studies and a range of all-hazards mitigation tools related to physical, infrastructure, and personnel security.

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

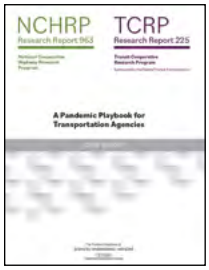
TRB PUBLICATIONS



Opportunities for Research on Transportation and Equity
Transportation Research Circular E-C270

This volume presents the outcome of a TRB brainstorming session prioritizing research on transportation equity issues, part of an effort to take a hard look at where inequity exists and to identify ways to address it with actionable solutions.

For more information, visit www.trb.org/Main/Blurbs/182089.aspx.



A Pandemic Playbook for Transportation Agencies
NCHRP Research Report 963/TCRP Research Report 225

Created to improve transportation agency responses to a pandemic, *A Pandemic Playbook* concentrates on what needs to be done, when, and by whom. It summarizes effective practices currently used by transportation agencies based on interviews with state departments of transportation (DOTs) and transit agency leaders and operational personnel, supplemented with national and international research results.

2021; 86 pp.; TRB affiliates, $55.50; nonaffiliates, $74. Subscriber categories: public transportation, security and emergencies, society.

Protocols for Network-Level Macrotexture Measurement

NCHRP Research Report 964

This report provides state DOT pavement engineers and other practitioners with recommended protocols for macrotexture test measures, equipment specifications, and data quality assurance practices.

2021; 164 pp.; TRB affiliates, $66; nonaffiliates, $88. Subscriber categories: materials, pavements, maintenance and preservation.

Mitigation of Weldment Cracking in Steel Highway Structures Due to the Galvanizing Process

NCHRP Research Report 965

Proposed in this report are improved design, materials, and construction specifications of galvanized steel highway structures to mitigate weldment cracking caused by the galvanizing process.

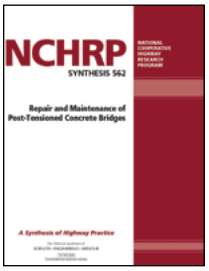
2021; 94 pp.; TRB affiliates, $55.50; nonaffiliates, $74. Subscriber categories: bridges and other structures, construction, materials.

Posted Speed Limit Setting Procedure and Tool: User Guide

NCHRP Research Report 966

This report provides and explains a speed limit setting procedure (SLS-Procedure) that considers factors beyond the 85th percentile speed, including driver speed choice and safety associated with the roadway. Also provided are instructions for using an automated version of the SLS-Procedure via a spreadsheet-based speed limit setting tool.

2021; 68 pp.; TRB affiliates, $51; nonaffiliates, $68. Subscriber categories: highways, operations and traffic management, safety and human factors.



Repair and Maintenance of Post-Tensioned Concrete Bridges

NCHRP Synthesis 562

Presented in this synthesis report is information on the practices used by bridge owners to repair and maintain post-tensioned bridges and facilitates knowledge transfer across state departments of transportation, aiding bridge owners in the identification of effective repair practices that will extend the useful life of bridges.

2021; 78 pp.; TRB affiliates, $53.25; nonaffiliates, $71. Subscriber categories: bridges and other structures, construction, maintenance and preservation.

Evaluating and Implementing Airport Privatization and Public–Private Partnerships

ACRP Research Report 227

A public–private partnership can help infrastructure owners achieve a range of objectives on projects, such as incorporating life-cycle project costs into decision making, benefiting from innovation in design and construction techniques, or sharing certain performance risks.

2021; 190 pp.; TRB affiliates, $70.50; nonaffiliates, $94. Subscriber categories: aviation, finance, terminals and facilities.

Airport Microgrid Implementation Toolkit

ACRP Research Report 228

Awareness of the vulnerability of the country's electrical system has increased with the frequency of short-term blackouts and long-term utility outages. Power outages affect airport operations by causing flight delays, extended layovers, disruptions in cargo operations, loss of revenue, and limitations in airports' ability to provide emergency support. This report addresses site-specific criteria for airports of all types and sizes.

2021; 108 pp.; TRB affiliates, $62.25; nonaffiliates, $83. Subscriber categories: aviation, energy, environment.

To order the TRB titles described in Bookshelf, visit the TRB online bookstore, www.TRB.org/bookstore, or contact the Business Office at 202-334-3213.

Airport Collaborative Decision Making (ACDM) to Manage Adverse Conditions

ACRP Research Report 229

ACDM is a process in which the stakeholders—airport operators, air traffic control tower staff, flight operators, ground handlers, fixed-base operators, and others—share information to improve policies, planning, real-time coordination, and decisions regarding operations. This report offers a step-by-step approach to achieve ACDM implementation.

2021; 64 pp.; TRB affiliates, $48; nonaffiliates, $64. Subscriber categories: aviation, operations and traffic management, safety and human factors.

Enhancing Academic Programs to Prepare Future Airport Industry Professionals

ACRP Research Report 230

Offered in this report is guidance to assist academia in preparing graduates for careers as airport industry professionals.

2021; 122 pp.; TRB affiliates, $59.25; nonaffiliates, $79. Subscriber categories: education, training, aviation.

Guide to Joint Development for Public Transportation Agencies

TCRP Research Report 224

Joint development is real estate development that occurs on transit agency property or through some other type of development transaction to which the transit agency is a party. This report is designed to expand the successful use of joint development in North American transit systems, in the volume and variety of projects undertaken, the diversity of transit agencies participating, and the quality of outcomes achieved.

2021; 192 pp.; TRB affiliates, $70.50; nonaffiliates, $94. Subscriber category: economics.

EMERGENCY-RELATED RESOURCES

LaGrone, S. Coast Guard Led 9-11 Water Evacuation "Bigger Than Dunkirk." USNI News, July 23, 2014. https://news.usni.org/2014/07/23/coast-guard-led-9-11-water-evacuation-bigger-dunkirk.

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Skinner, R. E., Jr. TRB's Response to 9/11 Attacks (blog post). Moving History. TRB History Subcommittee, July 24, 2020. https://transporthistory.wordpress.com/2020/07/24/trbs-reponse-to-9-11-attacks/.

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Simplified Guide to the Incident Command System for Transportation Professionals. FHWA, U.S. Department of Transportation, 2006. https://ops.fhwa.dot.gov/publications/ics_guide/ics_guide.pdf.

Planned Special Events Traffic Management. FHWA Publications, U.S. Department of Transportation. https://ops.fhwa.dot.gov/publications/publications.htm#pse.

Road Weather Management. FHWA Publications, U.S. Department of Transportation. https://ops.fhwa.dot.gov/publications/publications.htm#rwm.

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Capability Maturity Frameworks Overview. FHWA Office of Operations Publications, U.S. Department of Transportation. https://ops.fhwa.dot.gov/tsmoframeworktool/cmf_overview.htm.

Transportation Systems Management and Operations. AASHTO. http://www.aashtotsmoguidance.org.

Security and Emergencies Research at TRB. Transportation Research Board, The National Academies of Sciences, Engineering, and Medicine. http://www.trb.org/SecurityEmergencies/SecurityandEmergencies1.aspx.

Coaffee, J. 2009. *Terrorism Risk and the City: The Making of a Contemporary Urban Landscape.* Ashgate Publishing, Burlington, Vt., 2003.

Baglin, C. *NCHRP Synthesis 454: Response to Extreme Weather Impacts on Transportation Systems.* Transportation Research Board of the National Academies, Washington, D.C., 2014. https://doi.org/10.17226/22376.

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National Response Framework: Fourth Edition. U.S. Department of Homeland Security, Washington, D.C., 2019.

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Incident Command System Training. Federal Emergency Management Agency, U.S. Department of Homeland Security. https://search.usa.gov/search?utf8=&affiliate=fema&query=ICS%20Training.

Sandia National Laboratories. *Identification and Analysis of Factors Affecting Emergency Evacuations: Main Report.* Office of Nuclear Security and Incident Response, U.S. Nuclear Regulatory Commission, 2005. https://www.nrc.gov/docs/ML0502/ML050250245.pdf.

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Plotch, P. M., and J. Nelles. Mitigating Gridlock: Lessons on Regional Governance from the Organization that Keeps New York Moving. Open Edition.org, 2017. https://journals.openedition.org/articulo/3290.

INFORMATION FOR CONTRIBUTORS TO **TR NEWS**

TR News welcomes the submission of articles for possible publication in the categories listed below. All articles submitted are subject to review by the Editorial Board and other reviewers to determine suitability for *TR News*; authors will be advised of acceptance of articles with or without revision. All articles accepted for publication are subject to editing for conciseness and appropriate language and style. Authors review and approve the edited version of the article before publication. All authors are asked to review our policy to prevent discrimination, harassment, and bullying behavior, available at https://www.nationalacademies.org/about/institutional-policies-and-procedures/policy-of-harrassment.

ARTICLES

FEATURES are timely articles of interest to transportation professionals, including administrators, planners, researchers, and practitioners in government, academia, and industry. Articles are encouraged on innovations and state-of-the-art practices pertaining to transportation research and development in all modes (highways and bridges, public transit, aviation, rail, marine, and others, such as pipelines, bicycles, pedestrians, etc.) and in all subject areas (planning and administration, design, materials and construction, facility maintenance, traffic control, safety, security, logistics, geology, law, environmental concerns, energy, technology, etc.). Manuscripts should be no longer than 3,000 words. Authors also should provide tables and graphics with corresponding captions (see Submission Requirements). Prospective authors are encouraged to submit a summary or outline of a proposed article for preliminary review.

MINIFEATURES are concise feature articles, typically 1,500 words in length. These can accompany feature articles as a supporting or related topic or can address a standalone topic.

SIDEBARS generally are embedded in a feature or minifeature article, going into additional detail on a topic addressed in the main article or highlighting important additional information related to that article. Sidebars are usually up to 750 words in length.

POINT OF VIEW is an occasional series of authored opinions on current transportation issues. Articles (1,000 to 2,000 words) may be submitted with appropriate, high-quality graphics, and are subject to review and editing.

RESEARCH PAYS OFF highlights research projects, studies, demonstrations, and improved methods or processes that provide innovative, cost-effective solutions to important transportation-related problems in all modes. Research Pays Off articles should describe cases in which the application of project findings has resulted in benefits to transportation agencies or to the public, or in which substantial benefits are expected. Articles (approximately 750 to 1,000 words) should delineate the problem, research, and benefits, and be accompanied by the logo of the agency or organization submitting the article, as well as one or two photos or graphics. Research Pays Off topics must be approved by the RPO Task Force; to submit a topic for consideration, contact Nancy Whiting at 202-334-2956 or nwhiting@nas.edu.

OTHER CONTENT

TRB HIGHLIGHTS are short (500- to 750-word) articles about TRB-specific news, initiatives, deliverables, or projects. Cooperative Research Programs project announcements and write-ups are welcomed, as are news from other divisions of the National Academies of Sciences, Engineering, and Medicine.

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

SUBMISSION REQUIREMENTS:

- **Articles** submitted for possible publication in *TR News* and any correspondence on editorial matters should be sent to the *TR News* Editor, Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001, 202-334-2986 or 202-334-2278, and lcamarda@nas.edu or cfranklin-barbajosa@nas.edu.
- Submit **graphic** elements—photos, illustrations, tables, and figures—to complement the text. Images must be submitted as TIFF or JPEG files and must be at least 3 in. by 5 in. with a resolution of 300 dpi. Large photos (8 in. by 11 in. at 300 dpi) are welcomed for possible use as magazine cover images. A detailed caption must be supplied for each graphic element.

Note: Authors are responsible for the authenticity of their articles and for obtaining written permissions from publishers or persons who own the copyright to any previously published or copyrighted material used in the articles **as well as any copyrighted images** submitted as graphics.

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